Please handle with
EXTREME CARE
This volume is ***brittle***
and CANNOT be repaired!
Photocopy only if necessary
Return to library staff, do not in bookdrop
GERSTEIN SCIENCE INFORMATION CENTRE
Library staff, please refile with black ribbon and reshelve

Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/electricalworld38newy

INDEX TO VOLUME XXXVIII

GENERAL ALPHABETICAL INDEX

NOTE.—*Entries from the Digest of Current Electrical Literature are indicated by D. (Digest) and D. R. (Digest Reference.) Illustrated Articles are indicated by*.*

A

Aaron Electric Co. Multipolar dynamo and motor, 752*.
Abbott, Arthur Vaughan. Biographical sketch and portrait, 1052.
Acetylene as anodic depolarizer. By Coehn, (D.) 147.
——black. Manufacture of. Frank patent, 473.
Accounting. Modern electric light, 726.
Acme Switch Co. Automatic time switch, 308.
Aeronautics and electricity. By Hospitalier, (D.) 475.
Air Insulation. Resistance of, 126.
——Natural and radioactive. By Elster and Geitel, (D.) 228.
Air-gap induction, 879. By F. W. Carter, 884*.
Albumens. Electrolytic production of substitutes. Blum patent, 106.
Alkali. Girouard cell for production of caustic, 344.
——Industry. By Seibert, (D.) 999.
——Salt vapors. Electrolysis of. By Wilson, (D.) 690.
Alkalis and chlorine, (D. R.) 861.
——Acker process for the production of. By J. B. C. Kershaw, (D. R.) 826, (D. R.) 790.
——Diaphragm cells for production of. By J. B. C. Kershaw, (D.) 949.
——Electrolytic production of. By Cohn and Geisenberger, (D.) 602.
Alkylammonium-amalgam. By Crotogino, (D. R.) 30.
Alloys. Aluminum-zinc. By J. W. Richards, (D.) 1035
——Commercial aluminum-zinc. By J. W. Richards, (D.) 73.
——Electro-deposition of. By Lehfeldt, (D.) 147.
——made in the electric furnace. By Sargent, (D.) 147. Hamilton and Smith, (D.) 147.
——Some dangers of, 580.
Awards. Pan-American, 627, 649, 667.
ALTERNATORS. (See also Dynamo, Generator).
——Compound. By Woodfield, (D. R.) 512.
——Compounding. Steinmetz patent, 106.
——Construction of. By Lasche, (D. R.) 386, 435, 474.
——Conversion of single-phase to polyphase. By E. K. Scott, (D.) 557.
——dampers, 1050. By J. Fischer-Hinnen, 1058*.
——Design of large. By A. Heyland, (D.) 347.
——Diagrams of the action of an. By Barbillion, (D. R.), 226.
——Ferranti iron-type, 36*.
——High-frequency. By Chadwick, (D. R.) 108.
——Induction and copper in armatures of. By Wilson and Marden, (D.) 386.
——Inductor. By E. Heitmann, 548, 594, 636*.
——Inductor, litigation, 555.
——Inductor. Periodic variation in the exciting current of. By Duddell and Marchant, (D.) 1032*.
——Natural period of oscillation of. By Soubrier, (D. R.) 947.
——Oerlikon, (D. R.) 70.
——in parallel. Operation of, (D.) 734. By Darrow, 1074.
——in parallel run by tandem-compound engines. By Garfield, (D.) 860.
——in parallel. Synchronous motors and. By Russell, (D.) 226.
——Regulating. Edwards patent, 300.
——Regulation of. By A. S. McAllister, (D. R.) 226.
——Self-exciting. By Bunet, (D.) 859.
——Self-exciting asychronous induction, 492.
——Short-circuit current of three-phase machines. By Bauch, (D. R.) 687.
——testing. By Goldschmidt, (D.) 435*.
——Theory of. By Woodfield, (D. R.) 512.
——Theory of the short-circuited. By Horschitz, (D. R.) 137*. (D. R.) 600.
——22,000-ampere, (D.) 474.
——Variations in speed of parallel-driven, 711.
ALTERNATING CURRENTS:
——And direct-current systems, (D.) 72.
——Circuits. Regulation of. Everest patent, 898.
ALTERNATING CURRENTS.
——Constant current from constant e. m. f. 3, 21*.
——Conversion into direct-current by electric valves. By Montpellier, (D.) 263.
——Conversion into direct-current from electro-chemical standpoint, (D.) 266.
——Measurements. By Treichlinger, (D.) 111.
——Measuring instruments. By Addenbrooke, (D. R.) 737.
——motor without brushes. Self-starting single phase. (D. R.) 386.
——plants. Efficiency of. By Weyde, (D.) 689.
——Rectifying by aluminum valves. By E. H., (D.) 226.
——Rectifying by Hall effect. By des Courdes, (D.) 229*.
——Single-phase system advocated. By Warrilow, (D.) 436.
——Terminology, (D.) 737, 825. By Boucherot, (D.) 902, (D.) 999. By W. H. Browne, Jr. Dr. Louis Bell, 1031.
——Theory of three-phase. By Russell (D.) 437.
——Top factor. By La Cour, (D.) 303. Benischke, (D.) 303.
——Wave-forms. Plotting. By Blondel, (D. R.) 230. By Hospitalier, (D.) 350*, (D.) 691.
Aluminum. By Wilson, 394, (D.) 689.
——vs. Copper, 757, (D.) 862.
——Galvanic coppering of. By Gianoli, (D.) 190.
——Improvement in metallurgy of. By C. P. Townsend, 14.
——manufacturers. Association of, 798.
——Production of. By Ohly, (D. R.) 190.
——rectifiers. By Pollak, (D.) 110. By Mitkiewiz, (D.) 887.
——valves. Rectifying alternating currents by means of. By E. H., (D.) 226.
——zinc alloys. Commercial. By J. W. Richards, (D.) 73, 189, 1035.
American Association for the Advancement of Science, 245, 260.
American District Steam Co. Pan-American exhibit, 308.
American Bell Telephone holdings, 66.
American Electro-Chemical Society, 768, 995, 1071.
American Engine Company. Pan-American Company, 353.
American Incandescent Lamp Co. Formation of, 353.
American Institute of Electrical Engineers, 164, 183, 209, 248, 284, 319, 336, 723, 918.
American Miniature and Decorative Lamp Co. Electric signs, 441.
American Society of Mechanical Engineers. Annual New York meeting, 937.
American Steel & Wire Co. Exhibit at Pan-American.
American Street Railway Association. Annual meeting, 256, 615*, 628, 645.
Ammeters. Atkinson, (D.) 73.
——Column type, (D. R.) 389.
——Hot-wire. By Soulier, (D.) 902*.
Amines. Electrolytic production of. By Chilesotti, (D. R.) 229.
Ammonium. Iron cathode in a solution of nitrate of. By Kaufmann, (D.) 229.
Arc. Direct-current. By Peukert, (D.) 29*. Janet, (D.) 687.
——Mechanism of electric. By Hertha Ayrton, (D.) 386.
——Photographs of. By Scott, (D. R.) 947.
——Pyrogenetic reactions by means of the. By Loeb, (D.) 190.
——Resistance and e. m. f. of, 581. By Duddell, (D.) 654.
——Speaking. By Ruhmer, (D. R.) 476. Janet, (D. R.) 690.
ARC LAMPS:
——By Chester, (D. R.) 512. By Bainville, (D. R.) 651. By Bochet, (D.) 687.
——Bardon. By Montpellier, (D. R.) 387.
——Bremer, 246, 259. By Laporte, (D.) 387, 651. By Schaft, 512, 685.
——Higham patent, 434.
——Illumination from, 432.
——Lane enclosed, 115*.
——Polyphase. Rice patent, 27.
——Rasch. By Rasch, (D.) 557.
ARC LAMPS.
——Regina, (D. R.) 28.
——Compensating winding. Elihu Thomson patent, 185.
——Light flux of, 162.
——Low frequency single-phase. Fish patent, 511.
——Lupus cure, 433.
——Open versus enclosed, 385.
——Patents. Thomson, Steinmetz, Higham, Symons, Way, Luhr, 100.
——Regulation. Alternating-current series Baker patent, 649.
——With three arcs, (D. R.) 600.
——Dynamo troubles. Some brush. By Hanlon, (D. R.) 1074.
——Photometry. Mathews apparatus, 528, 549*.
Arc lighting. Helios-Upton system, 999*.
——Rice patent, 68.
——Thomson constant-current transformer for alternating series, (D. R.) 948.
Armatures. Slotted. By E. Dick, (D.) 386. By Rothert, (D. R.) 435. Berry, (D. R.) 512. Ziehl, (D.) 1557. Meyer, (D.) 1557.
——Re-winding of a 5,000 H.-P. By A. B. Weeks, 719*.
——winding. Alternator. Lamme patent, 345.
——With commutators for alternating-currents. By Leblanc, (D.) 859.
Arnold, B. J. Biographical sketch, with portrait, 52.
Ash-handling. Telpherage. Elizabethport, N. J., 564*.
——Belt conveyors as, 568*.
Associations. (See titles, National Electric Light, etc.).
Association of Edison Illuminating Companies. Annual meeting, 366, 470.
Atmosphere. Ions in the. By Ebert, (D.) 789.
Atmospheric discharges. Electrograph for, (D.) 862.
Atoms and electrons. By Sutherland, (D.) 602.
——Masses smaller than. By Edser, (D. R.) 110. J. J. Thomson, (D.) 227.
——Reality of. By Ruecker, (D.) 602, 736.
Aultman Company. Coal handling plant, 907*
Aurora Borealis. "Mother of pearl" clouds, 431.
AUTOMOBILE:
——By Mueller, (D. R.) 601, 788. Pelot, 788
——Contal, (D.) 436.
——Eight horse-power gasoline, 306*.
——Fire chief's, 114*.
——Krieger, (D.) 997.
——Omnibus, (D.) 188.
——Sieges. New York city, 983*.
——Thompson, 398*.
——"Tonneau," 35.
——Contact device for feeding from overhead wires. By Reyval, (D. R.) 900.
——Drop forgings for, 400*.
——Long runs on one charge. By Joel, (D.) 997.
——Manufacturers. Meeting of, 830.
——Motors. By Gasnier, (D. R.) 435, 900.
——Race. Paris-Berlin, 10.
——Records on Coney Island Boulevard, 701, 841, 851*.
——Savings bank, 434.
——Show in Budapest, 345. New York, 511, 791*. Paris, 1031.
——Storage batteries, 527, 538*.
——Testing. By Rankin Kennedy, (D. R.) 264.
——Tests. Cleveland and Chicago, 308*. By F. C. Phillips, 391*.
——Tests. New York-Buffalo, 180, 385, 432, 650.
——Club of America, 141, 1068.
Automobilism in France, 1030.
——Sandwich Islands, 551*.
——Some Dangers of, 580.
——Pan-American awards, 627, 549, 667.

B

Balance. Electric. By Cremieu, (D.) 30*
Barstow, W. S. Biographical sketch, with portrait, 456.
Battery. (See Primary, Storage, etc.)
Baylis, R. N. Biographical sketch, with portrait, 712.
Bay State Traction Co. Maxham contract system, 862.

Bauxite. Electrolytic purification of. Roberts patent, 510.
Becquerel rays, burning by, 414.
——Velocity of. By Kaufmann, (D. R.) 388.
Becker-Brainard Milling Machine Co. Motor-driven miller, 750*.
Behrend, B. A. Biogrpahical sketch, with portrait, 4*.
Benjamin Elec. Mfg. Co. Cluster fixtures, 198.
Benzidine, electrolytic manufacture of, (D. R.) 515.
Berlin Exposition. By Ruhmer, (D. R.) 478. Wilking, (D.) 604.
Berg, E. J. Biographical sketch, with portrait, 284.
Bernard Co., E. G. Back-geared motor, 752*.
——Pan American exhibit, 402.
Besly & Co., Chas. H. Band polishing wheel, 605*, 751*.
Billings & Spencer Co. Drop forgings for automobiles, 400.
Birmingham, Ala., railway and lighting consolidation, 152.
Bismuth. By Lownds, (D. R.) 901.
——Hall effect and resistance of. By Van Everdingen, (D.) 228.
——Resistance of, to alternating currents. By Simpson, (D.) 476.
Bit stock. Angle-boring, 867*.
Black body, electrical. By Summer and Kurlbaum, (D.) 305.
Blast furnaces, electric burner for. By Grammer, (D.) 862.
Bleaching by electricity. By Walsh, (D. R.) 30. Tailfer, (D. R.) 515. Briggs patent, 647.
Blood. Magnetic properties of human. By Gasngee, (D.) 561.
Boat. Electric submarine, 283.
——Submerged propeller electric, (D. R.) 825.
Book Reviews:
—Annuaire pour l'an 1901, 192.
—Atoms and energies. By D. A. Murray, 112.
—Automobiles électriques. By Sencier and Delasalle, 739.
—Cours d'electricité. By H. Pellat, 951.
—Dental electricity. By L. E. Custer, 693.
—Directory electrical trades, 352.
—Dynamos and motors. Shop and road testing of dynamos and motors. By E. C. Parham and J. C. Shedd, 390.
—Electrical catechism. By Prof. G. D. Shepardson, 1036.
—Electrical engineering formulæ. Pocketbook of. By Geipel and Kilgour.
—Electromagnet. The. By T. Wolcott, A. E. Kennelly and R. Varley, 516.
—Electromagnets: Their design and construction. By A. N. Mansfield, 739.
—Electro-magnetic phenomena. Treatise on. By T. A. Lyons, 191.
—Electromotoren fur mechselstrom und drehstrom. By G. Roessler, 827.
—Elektrische Verbrauchsmesser der Neuzeit. By Zacharias, 32.
—Elementary questions in electricity and magnetism. By J. M. Maclean and E. W. Marchent, 112.
—Engineering education, 604.
—Engineering and electric traction pocketbook. By P. Dawson, 739.
—Etudes sur les paratonnerres. By A. Della Riccia, 951.
—Experimental physics. By E. Sommel, 192.
—Handbuch der Electrotechnik. By Nethammer and Schultz, 351.
—How to become a good mechanic. By J. Phin, 739.
—Indicator handbook. The, 1036.
—Induction coils; how to make, use and repair them. By H. S. Norrie, 230.
—Instructions for the use of telephones, 192.
—Inventor's manual, 148.
—Lessons in practical electricity. By C. W. Swooper, 1078.
—Handbook for machinists' apprentices. By O. J. Beale, 351.
—Manufacturers of the United States. Tugman's index to the, 478.
—High temperature measurements. By Le Chatelier and Boudouard, 604.
—Mechanical drawing. By F. W. Bartlett, 561.
—Recording and integrating meters. By R. Ferris, 738.
—Mill building construction. By H. G. Tyrrell, 903.
—Motor. The induction. By B. A. Behrend, 903.
—Moteurs synchrones a courant alternalifs. By A. Blondel, 516.
—Motor vehicle. Construction of a gasoline. By C. C. Bramwell, 738.
—Nature's miracles. By Elisha Gray, 305.
—Ohio Electric Light Convention, 74.
—Original papers by the late John Hopkinson. By B. Hopkinson, 561.
—Physical chemistry. Introduction to. By J. Walker, 692.
—Practical electro-chemistry. By Blount, 191.
—Practical electrical testing. By G. D. A. Parr, 305.
—Railway handbook. Practical electric. By A. B. Herrick, 561.
—Schaltungsarten und Betriebsvorschriften. By A. Kistner, 1078.
—Telephone lines and their properties. By W. J. Hopkins, 192.
—Telephone system of the British Post Office. By T. E. Herbert, 827.
—Theoretical elements of electrical engineering, 439.
—Transactions of the American Institute of Electrical Engineers, 951.
—X-Ray work. Practical. By F. T. Addyman, 951.
Boilers. Zinc in. By Douglass, (D. R.) 1075.
Booster systems. Storage battery. By Lamar Lyndon, 13*, 65*, 49.
Borides. Metallic. By Tucker and Moody, (D.) 73.
Bowsher Company, N. P. Ready-dressed mill cogs, 113.
Brake and car heater. Westinghouse electric railway, (D.) 144.
——Dynamometric. By Guillaume, (D. R.) 948.
——Eddy current. By Feussner, (D.) 438.
——Electric railway. Emergency, (D. R.) 948.
British Institution of Electrical Engineers. Visit to Germany, (D. R.) 112. By E. K. Scott, (D.) 560.
Brooklyn Rapid Transit, 39.
Brown, C. E. L. Debt of electrical engineering to. By B. A. Behrend, 805, 809, 845, 881, 932, 1015*.
Brushes carbon. Fish patent, 68.
Buffalo Forge Co. Pan-American exhibit, 269*.
Buffalo terminal transformer station. By Woodbury, (D.) 227.
Buck, Harold W. Biographical sketch and portrait, 674.
Bullock Elec. Mfg. Co. Motors, 746*.
——Pan-American exhibit, 234.
——Railway generators, 905.

C

C. & C. Electric Co. Electrical equipment of white goods factory, 741*.
Cables. High-tension. By Schaefer, (D.) 997.
——Networks. Potential of insulated. By Guyer, (D. R.) 736.
——Telephone. By Baechtold, (D.) 190*.
——Underground, (D. R.) 437.
Cables, Submarine:
——Alaska, 184, 261, 384, 385.
——Atlantic. New, 1030.
——Australian, 15,000-mile, 811.
——Azores, 858.
——Canadian, 298.
——Chinese. New, 183.
——Cuban controversy, 65.
——Greece, 570.
——Indo-China. French, 106.
——Pacific. Proposed, 104, 598, 841, 858, 945, 994.
——Pacific. American proposed, 384, 509, 556, 627, 648, 946.
——Pacific. British, 224, 432, 685.
——Philippines, 732. By Moore, (D. R.) 1035.
Cables. By Larose, (D. R.) 737.
——Artificial submarine. By Trowbridge, (D.) 190.
——Currents and potentials on submarine. By Crehore, (D. R.) 191.
——Factory. Measurements in a. By Krejsa, (D. R.) 31.
——Gutta percha supply, 592.
——Localization of breaks. By Rymer-Jones, (D. R.) 31. Jona, (D. R.) 73. Rymer-Jones, (D. R.) 190.
——Localizing faults in. By Betts, (D. R.) 389, 580. Raymond-Barker, (D.) 60. Murphy, (D.) 737.
——Making, (D. R.) 109.
——Manufacture in America, 1018.
——Mileage of ocean. By E. W. Stevenson, 996.
——Recorder. By Jaulin, (D.) 477.
——Speeds. Rates of. Table for conversion of. By Raymon-Baker, (D.) 999.
——And Telegraphy. President McKinley on, 472.
——Works of the Allgemeine Electricitas Gesellschaft. By E. K. Scott, 390.
Cadmium standard cell. By Kinsley, (D.) 790*.
——Reichanstalt report on, (D.) 31.
Calcutta Institution of Electrical Engineers. Local section of, 162.
Calorimetric measurements of electric oscillations. By Harms, (D.) 227.
Canal lift, (D. R.) 824.
——Lighting in Canada, 870.
——Towage. Miami & Erie, 568.
——Traction. By Fabre, (D.) 302.
Cancer. Electricity and, 897.
Capacities. Measurement of small capacities by Geissler tubes. By Borgmann, (D.) 515*.
Capillary phenomena, Electro-. By Palmaer, (D.) 303.
Car heater. Westinghouse electric brake and, (D.) 144.
——Lighting devices. Moskowitz patent, 510. Prasch, (D. R.) 512.
——Trolley. Sleeping, 224.
——Wheels, (D.) 187.
Calcium carbide and acetylene. Data on use of, 817.
——Frolich patent, 782.
——Furnace with series arcs. Koller patent, 27.
——Manufacture. By Pradon, (D.) 690.
Carbide. Barium. Limb patent, 261.
——Magnesium. Blackmore patent, 382.
Carbon. Anodes for electrolysis of chlorides of alkalies. By Sprocesser, (D.) 949.
——Bisulphide in the electric furnace. Taylor patent, 1028*.
——Electrodes. Best structure of. By Haerden, (D.) 304.
——Manufacture of. By Strauss, (D.) 1077.
——Visible radiation from. By E. L. Nichols, (D. R.) 388.
Carborundum Co. Pan-American exhibit, 605.
Carpenter Enclosed Resistance Co. Enclosed resistances, 197.
Catalysis. By Ostwald, (D.) 999.
Cathode. Iron, solution of nitrate of ammonium. By Kaufmann, (D.) 229.
——Plates. Electro-deposited. Elliott and Kishner patent, 556.
Cathode rays. By Seitz, (D.) 825. Von Geitler, (D.) 303.
——Space. Dark. By Wehnelt, (D.) 30.
Census. Electrical tabulation in the twelfth, 1065*.
Central Stations:
——Accounting, 726*.
——Communication in, (D. R.) 388.
——Distribution. A. I. E. E. discussion, 890.
——In cities, 919.
——Electricity supply. Monopoly for London, (D. R.) 1034.
——German practice. By E. K. Scott, 323*.
——High voltage vs. direct distribution, 806.
——Incomes and outputs per ton of. A. D. Adams, 814.
——Influence of the load factor on design and operation of, 97.
——Lighting and traction stations. Cost in combined. By Tittensor, (D. R.) 109.
——Load factors. By Booth, (D. R.) 788.
——110 vs. 220-volt. By Mueller, (D.) 303. Wikander, (D. R.) 475.
——Pilot wires. By Picou, (D.) 689.
——Refuse destructors in combination with. By Highfield, (D.) 108.
——Small, (D.) 28.
——Statistics. Australian, (D.) 340.
——German, (D.) 558.
——Steam engineering in. By Dawson, (D. R.) 1034.
——Storage batteries in. By R. F. Shuchardt, 254*, 306*.
——Tariff systems. By A. Wright, 60* Chamess, (D.) 71, 125. Kallman, (D.) 601. De Fodor, (D.) 788, 1051.
——And telephone plants. Depreciation of, 137.
Central Station: Alstrætten, Switzerland. By Bignami, (D.) 514.
——Bangor, Me. By Alton D. Adams, 291.
——Battersea, Eng., (D. R.) 689.
——Berlin, 1071.
——Birmingham, Ala. By Williams, (D.) 514.
——Boston consolidation, 309.
——Carlsruhe, Germany. By Winawer, (D. R.) 824.
——Cedarburg, Wis., (D.) 602.
——Croydon, England, 788.
——Dresden. By Meng, (D.) 109.
——East Ham, England, (D.) 514.
——Essen, Germany, (D. R.) 789.
——Hackney, Eng., (D.) 947.
——Helena, Mont., 755.
——Heywood, Eng., (D. R.) 948.
——Holyoke and West Kirby, Eng., (D.) 388.
——Keighley, Eng., (D.) 860.
——Kensington and Notting Hill, Eng., (D.) 514, 631*.
——Lausanne, Switzerland. By Tacuber, (D. R.) 789.
——Luton, Eng., (D. R.) 437.
——Niederbronn-Reichohofen. By Winawer, (D. R.) 900.
——Ottawa, Can., 392.
——Ottumwa, Ia., 225.
——Philadelphia consolidation, 518.
——Port Jervis, N. Y., 908.
——Seattle, Wash., 991.
——St. Anne, England, (D. R.) 825.
——Staten Island. By Ch. Loewenthal, 1053*.
——Toledo, O., municipal. History of, 430.
——Trafford Park, England, (D. R.) 900.
——Tyneside, England, power, 263.
——Walthamstard, (D. R.) 689.
——Wappinger Falls, N. Y. By Obert, (D.) 1034.
——Warren, O., (D. R.) 475.
Central Union Telephone Company, 39, 354, 755.
——Statement of, 354.
Charges, electric. Dissipation of. By Elster and Geitel, (D.) 146.
Charleston Exposition. Electricity at the. By C. T. Malcolmson, 977*.
Chesney, Cummings C. Biographical sketch and portrait, 880.
Chili. Water power development in, 484.
Chimneys for power stations. By Enn's, (D. R.) 1033.
Chlorides, Ferric. Susceptibility of. By Mosler, (D.) 901.
——Fused alkali. Electrolysis of. By Fischer, (D.) 789.
Chlorine, (D. R.) 861.
——Acker process for production. By J. B. C. Kershaw, (D. R.) 826.
——Diaphragm cells for the production of. By J. B. C. Kershaw, (D.) 949.
——Electrolytic production of. By Cohn and Geisenberger, (D.) 602.
——Girouard cell for production of, 344.
——Mercury cathode cell for electrolytic production of, 297*.
Chromium. Electrolytic production of metallic. By Neumann, (D.) 190.
Cincinnati Milling Machine Co. Pan-American exhibit, 696.
——Vertical spindle milling head, 956*.
Circuits. Calculating polyphase. (D. R.) 900.
Clark Automatic Telephone Company. Pan-American exhibit, 402.
Clift, A. S. Biographical sketch, with portrait, 366.
Climate and power transmission. By McAdie, (D. R.) 735.
Cling Surface Mfg. Co. Cling Surface at the Pan-American, 115.
Clutch vs. rheostat in electric traction, 528.
Coal handling. Boston Elevated. The, 396*.
——handling machinery for small plant, 907*.
——handling at Tacony, Pa., 399*.
——Mine. Electric power in. By Habermann, (D. R.) 688, (D. R.) 824.
——Pulverized culm. By Douglass, (D. R.) 513.
Cobalt and nickel, separating. By Balachowsky, (D.) 654.
Coherers. By Eccles, (D.) 437.

Coherer. Anti. By Neugschwender, (D.) 145.
——Development, construction, operation and function of. By A. F. Collins, 251*.
——Filings. By Eccles, (D.) 476.
Collector rings. Properties of. By Latour, (D.) 996. Heyland, (D.) 1032. St. Martin, 1073.
Commutation. Limits of. By Hobart, (D.) 600.
Colliery installation. British three-phase, (D. R.) 734.
——Theory of. By Pichelmayer, (D.) 1074.
Commutator. New type, 102*.
Condensers. Motor, 384, 829*, 1080*.
Condict, G. Herbert. Biographical sketch and portrait, 976.
Conductivity bridge. Direct reading. By Appleyard, (D.) 389*.
——Effects of magnetization on. By Barlow, (D.) 602.
——of metallic particles under cyclic electromotive variation. Change of. By Bose, (D.) 736.
Conductors. Flexible steel-armored, 396*.
——Most economical cross-section of. By Rossander and Forsberg, (D. R.) 1076.
Conduit. "Flexduct" flexible, 793.
——Steel snap cover, 695*.
——system. Data on New York Underground, 26.
Connecticut corporations, 235.
Connecticut Telephone & Electric Co. Telephone apparatus, 955*.
Consolidated Telephone & Telegraph Company. Incorporation of, 4.
Constant current from constant potential. Berg patent, 186.
Controller, railway. Care of. By Berry, (D. R.) 1034.
——Knight patent, 67.
——Recording device. Railway. Kitsee patent, 510.
——Reynolds current, 196.
——Three-phase. By Ephraim, (D. R.) 72.
——Three Rivers elevator, 233*.
Convection. Magnetic effects of electric. By Wilson, (D.) 145. Cremien, (D.) 388, (D.) 653.
Converters, Rotary:
——Synchronous. By De Marchena, (D. R.) 651. By Thornton, (D.) 734, (D. R.) 947, (D.) 1074.
——Heating of armature. By B. A. Behrend, 346.
——Hutin & Leblanc patent, 473.
——Leblanc. By Feldmann, (D.) 787.
——vs. motor generators, 454, 460*, (D.) 947, 1062.
——Phase swinging. By Thornton, (D.) 687.
——Six-phase. Rice patent, 225.
——S. K. C., 863*.
——Storage battery with sixty-cycle railway. By Reynolds, (D. R.) 861.
——Without field windings. Lamme patent, 511.
Copper. Aluminum as a substitute for, 757, (D.) 862.
——Deposition from various electrolytes. By Beadle. (D.) 266. Sayer and Spiers, (D.) 229. Froment, (D. R.) 229.
——Electro-chemical equivalent of. By Richards, Collins and Heimrod, (D.) 229.
——Electro-metallurgy of. By Codara, (D. R.) 111.
——Grading, 833.
——market, 491, 519, 571, 1003, 1041, 1068.
——Ore refining. Hoefner. Electrolytic process, 69.
——Ores. Electrolytic treatment of. Kessler patent, 27.
——Production. World's, 237.
——In pyrites. Estimation of. By Heidenreich, (D. R.) 477.
——Refining. Elliot and Kishner patent, 647. McCoy patent, 647.
——refining plant. Electric connections for. Walker patent, 990*.
——Rotating cathode for electro-deposition of. Cowper-Coles patent, 300.
——In 1900. Statistics of, (D.) 31.
——Rumor. Westinghouse, 755.
Corpuscles and cosmic phenomena, 246.
——and popular science, 210. By L. K. Noll, 262.
Cosmic phenomena. Corpuscles and, 246.
Couch & Seeley Co. Hand microphone, 395.
Coulomb indicator. Doane patent, 299.
Coupling for dynamo, (D. R.) 899.
Cranes. Electric. By Wellner, (D. R.) 348. Rung, (D.) 512.
——Brake magnets for. By Ehnert, (D. R.) 1075.
——Equipment of. By Rung, (D. R.) 735, (D. R.) 1033.
——Traveling. By Hahn, (D. R.) 651, (D. R.) 1033.
Crocker-Wheeler Electric Co. Engine-type generator, 951*.
Crystals. Magnetic induction in. By Wallcrant, (D.) 901.
Crystal Palace Exhibition. London, 630.
Cutler-Hammer Mfg. Co. Pan-American exhibit, 308.
——Self-starter for large motors, 268.
Cyanide solutions. E. M. F. of metals in. By Christy, (D. R.) 30.
——Solution. Treatment of exhausted. Orr patent, 1072.

D

D. & W. Fuse Co. D. & W. fuses at Buffalo, 569*.
Daft, Leo. Biographical sketch, with portrait, (D. R.) 119.
Dainz Electrical Company, G. A. R. Display in Cleveland, 478.
Damper. (See also alternator, alternating current.)
——Anti-hunting. Lunt patent, 897.
De Laval Steam Turbine Co. Turbine, 693*.
Demagnetizer, Watch, 694*.
Depolarizer. Acetylene as anodic. By Coehn, (D.) 147.
Destructors. Refuse, in combination with electric power stations. By Highfield, (D.) 108, 348; (D.) 947. Goodrich, (D.) 1075.
Diaphragms. Brush discharge through. By Toepler, (D. R.) 825.
——Electrolytic cell. By Le Blanc, (D.) 189.
——Porous. Wunsche patent, 647.
Diehl Mfg. Co. Sewing machine motors, 956*.
Dielectrics. By Fleming and Ashton, (D. R.) 388. Von Hoor, (D.), 653.
——Cohesion. By Boutz, (D.) 388.
——Constant of paraffins. By Hormell, (D.) 1034.
——Constants of pure liquids. By Turner, (D.) 109. Schlundt, (D.) 901.
——Electrification of, by mechanical means. By Ashton, (D.) 72.
——Model of. By Fleming and Ashton, (D. R.) 72. Buchanan, (D.) 998.
——Resistance of. By Ashton, (D.) 72, (D.) 861.
——Specific inductive capacity of. By Ladenburg, (D. R.) 476.
——Strain. By More, (D. R.) 901.
Discharges. Electric brush through diaphragms. By Toepler, (D. R.) 825.
——Curves traced by point. By Weber, (D.) 825.
——High-altitude. By Ebert. (D.) 146.
——Induced alternating-current. By Wright and Downs, (D.) 72.
——Negative electricity. Influence of light upon, (D.) 825.
——Point. By Von Wesendonck, (D.) 109. Lamm, (D. R.) 901.
——Surfaces of large curvature. By Almy, (D.) 438.
Dissociation. Law of. By Lehfeldt, (D.) 111.
Distribution. Composite electrical. Arnold patent, 856.
——Modified three-wire system. By L. J. B. Wall, 898.
——Networks. Localizing faults and testing insulation of. By Charpentier, (D.) 950*.
——Superposed current. Bedell patent, 822.
——Three-phase system and operation of single-phase circuits from. By W. L. R. Emmet, 985*.
Dynamo. (See also Alternators, Generators):
——Comparative weights of. By Seefeklner, (D.) 28.
——Construction. By Schulz, (D. R.) 687.
——Design of 5-kw., (D. R.) 947.
——Determining hysteresis and eddy-current losses in. By Strymeersch, (D.) 1033.
——Direct-current. By Eichberg, (D. R.) 263. Mavor, (D.) 600. Hill, (D.) 651. Kennedy, (D.) 1033.
——Eddy-current, loss in. By Picon, (D.) 996.
——Efficiency of maximum. By Finzi, (D.) 386.
——Fields. Combination. By A. Grieve, 27. G. T. Hanchett, 107.
——Series field shunt. Hobart patent, 67.
——In parallel. Engines for, (D.) 263.
——Shunt wound. Theory of. By Bernard, (D. R.) 860.
——Troubles. Brush arc-light. By Hanlon, (D. R.) 1074.
Dynamos. Windings of direct-current. By Fischer-Hinnen, (D.) 187. Rothert, (D.) 187.
Dynamo and motor. Aaron multipolar, 752*.
——Extensions of Swinburne's method of testing. By Brunhes, (D. R.) 1033.
——Mayer, 748*.
——Reliance, 907*.
Dynamometer. Electric transmission. By Deroude, (D. R.) 190.
Dreses, Mueller & Co. Motor-driven radial drill, 752*.
Drill, electric. Lincoln, 268*.
——Mershon patent, 345*.
——Motor-driven radial, 752*.
——Percussion rock, (D. R.) 436.
——Portable, (D.) 788.
——Rock. By G. H. Waltman, 267*.
Doors. Plating wood. Warren patent, 106.
D'Olier Engrg. Co. Pan-American exhibit, 795.
Dunn, Gano S. Biographical sketch, with portrait, 416.

E

Eck Dynamo & Motor Works. New Eck motor, 749*.
Edison Mfg. Co. Battery for motor outfit, 35.
Elasticity. Magnetization and modulus of. By Tangl, (D.) 901.
Electric Motor & Equipment Co. Universal sign receptacles, 794.
Electric Regulator Co. Sayles regulator, 906.
Electric Storage Battery Co. Pan-American exhibit, 270.
Electric Vehicle Co. Eight-H.-P. gasoline carriage, 306.
——Electric "Tonneau," 35.
——Fire-chief's automobile, 114.
Electrical engineering. Debt of, to C. E. L. Brown. By B. A. Behrend, 809, 845, 881, 932, 1015*.
——Trades' Society, 1038.
Electricity. Dualism in theory of. By Sire de Villar, (D. R.) 189, 736.
Electricity. Gas and acetylene in Germany, (D.) 109.
Electro-capillary relay, (D.) 1078.
Electro-chemical action. By Reed, (D.) 110.
——Industry, 247. By Swan, (D.) 265. Kershaw, (D.) 789, (D.) 826, (D.) 949.
——Microscopy. By R. Kohn, (D. R.) 691.
Electro-chemist. Training of an. By Hutton, (D. R.) 737.
Electro-chemistry. By Nernst, (D.) 949*.
——Historical, (D. R.) 438.
——Electric heating in organic. By Loeb, (D.) 826.
——Medical. By Leduc, (D.) 1036.
——Theory of. By Jones, (D. R.) 229, 691.
Electrodes. Carbon. Manufacture of. By Strauss, (D.) 1077.
——Platinum, (D.) 691.
——Sensitive to light. Formation energy of water. By Bose, (D.) 199.
Electrograph for atmospheric discharges, (D.) 862.
Electro-galvanizing, (D.) 265.
Electrolysis of alkaline solutions. Carbon electrodes. By Foerster, (D.) 476.
——Manufacture of water glass, 102*.
——Railway return currents, (D.) 109.
——Secondary reactions in. By J. W. Richards, (D.) 1077.
——Transport numbers and constitution in. By Rieger, (D. R.) 477.
——Velocity. Reaction in. By Siegrist, (D. R.) 477.
Electrolytes. Disruptive discharge in. By Johnson, (D. R.) 559.
——Dissociation of strong. By Sackur, (D. R.) 350.
——E. M. F between adjoining. By Sackur, (D.) R.) 350.
——Influence of oscillations on. By Morris, (D.) 227.
——Law of mass action for strong. By Steinwehr, (D.) 304.
——Measuring resistance of. By Duddell, (D.) 691.
——Solubility in non-. By Rothmund, (D.) 190.
Electrolytic action. Effect of gravity and pressure on. By Ramsey, (D.) 304.
——Cell. Girouard, 344*.
——Lamp. Kitsee patent, 27.
——Production of substituted albumens. Blum patent, 106.
——Rectifier. Theory of aluminum. By Dr. K. Norden, 673, 681.
——Reduction of organic compounds. By Hewitt, (D. R.) 304.
——"Valves." By Blondin, (D. R.) 651.
Electromagnets. Brake-releasing, (D.) 474.
——For lifting, (D. R.) 861.
Electromagnetic effects of moving charged spheres. The, 283.
——theory of mechanics. By Wien, (D.) 145.
——units and unit of time. By Rey-Pellhade, (D.) 950.
Electrometer, electrostatic. Braun's cathode ray tube. By Milham, (D.) 437.
——Lippmann. By Crane and Cottrell, (D. R.) 862.
——Quadrant. By Dolezalek, (D.) 351.
Electron idea. By Kaufmann, (D.) 900. Lodge, (D.) 1076.
——And atoms. By Sutherland, (D.) 602.
——Theory of. By Voigt, (D.) 998.
Electro-osmose. Schwerin patent, 942.
Electroplating. Rosell patents, 783.
——Straying of current in. By Pfauhausser, (D.) 949.
——Wood doors. Warren patent, 106.
Elevator controller. Three Rivers, 233*.
——Electrically driven freight. By Schindler, (D. R.) 71.
——Electric. By D. B. Clinton, 434.
——Washington Monument. By C. M. Lewis, 176*.
——Hydraulic. Electrically controlled. By Baxter, (D. R.) 513.
——Starter. Cutler-Hammer, 268*.
Elwell-Parker Electric Co. Round pattern motors, 750*.
E. M. F. contact and theory of ions, (D. R.) 654.
Emery wheels. Electrolytically made. By Rieder, (D.) 30.
Emmet, W. L. R. Biographical sketch, with portrait, 530.
Energy, electrical. Charging for. By Wallmann, (D.) 601. Wilkens, (D.) 653, 1051.
Engine Builders' Association. Meeting of, 943.
——Josse waste heat. By E. Josse, 733.
Engineering. By Crompton, (D.) 604.
——Electrical. English. By A. C. Shaw, 898.
——Human element as a factor in, 364.
English electrical industry. The. By H. W. Knott, 822.
——Methods. A note on. By E. K. Scott, 381.
Equalization mains. By Teichmueller and Edelstein, (D. R.) 145.
Ericsson Telephone Co. House telephones, 567*.
Erie Exploration Company. Electric current regulator, 113.
Ether. By Lord Kelvin, (D. R.) 389.
——Properties of the. By Graetz, (D.) 29.
Eureka Electric Co. Telephone apparatus, 568*
Export trade. Features of, 709.
——Some elementary requirements in. By J. Alexander, 733.
Exposition lighting. By Luther Stieringer, 686.
——Evolution of, 468*.

F

Factory distribution. Cotton. Columbia, S. C., (D. R.) 824.
——Electric power in billiard, (D.) 436.
——British Thomson-Houston, (D. R.) 351.

Factory Electromotors, Ltd. British, (D. R.) 992.
——Lahmeyer & Co., (D. R.) 902, (D. R.) 1078.
——Pittsfield, (D. R.) 902.
——Preston, England, (D. R.) 862.
——Shuckert, (D.) 604.
——Siemens & Halske (German), (D. R.) 351.
——Westinghouse, in Great Britain, (D. R.) 351, 700, 756.
Factories. Choice of an electric power distribution in. By Moses, (D.) 435.
——Design of electrically driven, (D.) 226.
Fan motor outfit. Battery, 35*.
Feed-water Heater, 696*.
——Hoppes Heater, 865*.
——Softeners, (D. R.) 1033.
Feeders, Duplicate. By Andrews, (D. R.) 825.
Ferguson, Louis A. Biographical sketch and portrait, 494.
Ferrates. Electro-chemical formation of alkaline. By Pick and Haber, (D.) 146.
Ferracute Machine Co. Pan-American exhibit, 754*.
Ferranti Company, S. Z. Oil-break fuse, 952*.
——Iron-type alternator, 36.
Ferro-silicium. By Morris, (D.) 476.
Fiber, Vulcanized combination, 796.
Filaments from refractory oxides, 472.
Fire alarm system, Hanau, Germany. By Ohl, (D. R.) 560.
Firedamp meter, electrical, (D.) 111.
Firemen, Danger to, from electrical wires, 382.
Fires, extinction of electrical, 517*.
——Hazard from electrical circuits, 894.
Fitting. Floor outlet, 864*.
——Interior marine, 831*.
Fixtures. Cluster, 198*.
Flame gases. Discharge by. By von Wesendonck, (D.) 30.
Flanges. Standardization of extra heavy, 785.
Fluoroscope. By Caldwell, (D. R.) 901.
Fly-wheels for electrically-driven shaper. By Hahn, (D. R.) 144.
Fountain development. Luminous. A brief history of. By L. Stieringer, 413, 417*.
Freezing points of dilute solutions. By Griffiths, (D.) 861.
French electrical engineers in America, 142.
Frequency changer. Lamme patent, 511.
——Indicator. Chesney & Lloyd patent, 493.
Fulton. Memorial to, 995.
Fuse block. Goodwin, 198.
——Carrier. Panel board with removable enclosed, 401*.
——Cut-outs. Downes patent, 345.
——D. & W., 569*.
——Oil-break, 962*.
——Plug. Cabinet panels, 1000*.
Furnace, Electric:
——By Richard, (D. R.) 439.
——Alloys made in. By Sargent, (D.) 147. Hamilton and Smith, (D.) 147.
——Barry pigment, 818*.
——Carbon bisulphide, 1028*.
——Coutardo, 66.
——Dental. Hammond patent, 995.
——By Dieffenbach, (D.R.) 73.
——Dumoulin patent, 555.
——Frolich patent, 782.
——Gibbs patent, 730*.
——Glass, 102*. By Bermbach, (D.) 477.
——Heat distribution in, 373*.
——Induction. Kjellin patent, 434.
——Iron smelting, (D.) 516.
——Irvine patent, 373.
——Keller patent, 1071.
——Koller carbide electric, 27.
——Laboratory. By Howe, (D. R.) 950.
——Maxim patent, for calcic carbide, 647.
——Morley patent, 858.
——Nernst and Glazer patent, 647*.
——Parker, (D.) 266.*
——Ruthenburg patent, 895*, 945.
——Stassano. By Fusnero, (D.) 737.

G

Galvanometers. By Mendelhall and Waidner, (D. R.) 737.
——D'Arsonval. By Kuemmell, (D.) 230.
——Inexpensive mirror. By Carman, (D. R.) 73.
——Perfectly astatic. By Lippmann, (D.) 30.
——Shunt. By Volkmann, (D.) 477*.
Garvin Machine Co. Small oil slotter, 400.
Gas versus electricity. By A. D. Adams, 676*, 672. Martin, (D.) 736.
——electricity and acetylene in Germany, (D.) 109.
——Furnace. Progress in the utilization of. By Luermann, (D.) 71.
——Mond, (D.) 264.
——Water. Use of electric power for making. By Schmidt, (D.) 651.
Gas Engines. By Simon, (D. R.) 824. Burstall, (D. R.) 947.
——Maywood, 829*.
——Mietz and Weiss, 865*.
——Nash. By J. M. Cremer, 740.
——Oechelhaeuser, (D. R.) 651.
Gauge. Small screw, (D. R.) 827.
Gases. Conduction in. By Rutherford, (D.) 388.
——Ionic velocities in. By Von Wesendonck, (D.) 998.
——Spark discharges in. By Guggenhelmer, (D.) 475.
General Electric Company. Condenser alternating current motors, 829*.
——Fuse plug cabinet system, 1000*.
——Remote control switches, 38.
——in England, 76.
——surplus, 699.
General Incandescent Arc Light Co. Panel board with removable enclosed fuse carrier, 401.
General Incandescent Arc Light Co. Push button switch, 600*.
——Water-tight floor outlet, 864*.
Generator (See also Alternator, Dynamo):
——Bullock railway, 905*.
——Crocker-Wheeler engine type, 751.
——Holtzer-Cabot electrolytic, 479*.
——Sturtevant, 568*.
——Direct-current, large. By Rothert, (D. R.) 600.
——Double-current, Regulation of. Woodbridge patent, 262.
——Large direct-current. By H. M. Hobart, (D.) 435.
——Polyphase. Calculation of. By Pichelmayer, (D.) 899.
——Railway. By Dettmar, (D.) 788.
——Small, (D. R.) 697.
——Speed and size of three-phase. By Siewert, (D. R.) 28.
——Telephone. Efficiency of. By Henry, (D. R.) 515.
——Theory of three-phase. By Blondel-Neithammer, (D. R.) 71.
——Three-phase. Grounding the neutral point of windings of. Potter patent, 68.
——Transmission plant. Protecting. Johnston patent, 105.
Generators and motors. Efficiency test of direct-current, 974, 981.
Generating set. Sturtevant, 307*, 831*.
Germany. Industrial and electrical situation in. By Dr. L. Fleischmann, 21, 973.
Godfrey, J. W. Obituary notice, with portrait, 838.
Gossler, Philip G. Biographical sketch and portrait, 920.
Gould Storage Battery Co. Large cell at Pan-American, 150.
Glasgow Exposition, 32*, (D.) 70, 104 (D.) 230, (D. R.) 351, 439, 478, 560, 561, 1036.
Glass. Arc furnace for making. By Bermbach, (D.) 477.
——Making, electrically. By Bermbach, (D.) 604.
Greece. Electrical development in, 383.
Grant Tool Co. Milling machine, 831*.
Gravity and pressure. Effect of on electrolytic action. By Ramsey, (D.) 304.
Ground detector. By T. W. Varley, 50, 54*.
——Locating. Hewlett patent, 185.
——On lighting circuits. Protection obtained by. By Uppenborn, (D.) 29.
Gutta percha. Submarine cables and, 592.

H

Haines & Noyes Co. Apartment house telephony, 954*.
——Desk telephone, 36.
Hamilton Metal Pattern Works. Baber telephone receiver, 233.
Hanchett, George T. Biographical sketch and portrait, 322.
Hart Mfg. Co. Automatic door switch, 695.
Haskins, Caryl D. Biographical sketch and portrait, 768.
Heat and light. Dynamical theory of. By Lord Kelvin, (D.) 145.
Heating. Electric. By Bainville, (D.) 230.
——Apparatus. By Haerden, (D. R.) 692.
Helios-Upton Co. Series alternating current arc lighting system, 999*.
Hoists. Electric. By Hall, (D. R.) 601.
——Mine electric, on Comstock lode, 232*.
Holophane Glass Co. Exhibit at Pan-American, 196.
Holtzer-Cabot Electric Co. Dynamometers for telephonic signalling, 1000*.
——Electrolytic generator, 479.
——Universal enclosed motors, 747*.
——Watch demagnetizer, 695*.
Hoppes Mfg. Co. Feed-water heater, 696*.
——Induction chamber for feed-water heaters, 865*.
Human body. Capacity of the. By De Metz, (D.) 561.
——Resistance of. By Hooper, (D.) 191.
Hunt Co., C. W. Coal handling installation of the Boston elevated, 306.
Hydraulics. Some problems in, 628.
Hydrogen. Spectrum of. By Parsons, (D.) 349. Trowbridge (D.) 999.
——And oxygen. Electrolytic production of, (D.) 999.
Hypochlorites. Haas system of producing, 782.
Hysteresis and eddy current losses in dynamos. Determining. By Steymeersch, (D.) 1033.
——measurements. By Finzi. (D.) 1078.
——Advance of phase. Graphical determination of the angle of. By Jacobson, (D.) 188*.

I

Igniters. Electric. By Meyer, (D. R.) 827.
Illinois State Electric Association. Meeting of, 596.
Illumination. Electrical in Australia, 830*.
——Effects by means of electric sparks. By Soulier, (D.) 788.
——Elements of. By Dr. Louis Bell, 98, 221, 295, 463, 641, 721, 850*.
——Richmond, Va., Carnival, 852*.
Imperial Electric Light, Heat and Power Co., St. Louis, 39.
Imperial Electrical Supplies Co. Pile block battery, 1080.
Incandescent Lamp:
——Bases. German standard, (D. R.) 558.
——Buffalo exhibition, 320.
Incandescent Lamp.
——Crawford-Voelker. By Maguire, (D.) 1074.
——Distribution of. By Fish, (D.) 512.
——Economy. By Guy C. Williams, 19*.
——Efficiencies and lamp renewals, (D.) 387.
——Filaments from refractory oxides, 472.
——Filaments. Vibrations of. By Kempff Hartman, (D.) 736.
——Hand e for, 234*.
——Osmium, (D.) 824.
——Phosphorus in exhausting. By R. A. Fessenden, 473.
——Portable and desk, 746*.
——Reflecting. Gibbins patent, 432.
——Regulator for light of, 906*.
——Socket. Marshall-Sanders, 268*.
——Sterling, 565*.
India rubber. Preparation and treatment of, (D. R.) 303.
Indiana Mutual Telephone Association. Meeting of, 230.
Indicator. Magnetic speed. Storer patent, 434.
——Maximum-current. Haskins patent, 106.
——Maximum demand. By Armagnat, (D. R.) 737, (D.) 1035.
——Power factor. By Browne, 378*, 710.
——Speed. Prize offered for a, (D.) 305.
Induction coil. By Ebnert, (D. R.) 476.
Insects put out lights of St. Paul, Minn. By C. L. Fitch, 222*.
Insurance. Central station, 785.
Instruments. Electrical test, 440*.
——Lord Kelvin's electric measuring. By Maclean, (D. R.) 515.
——And meters. By Armagnat, (D. R.) 515.
Insulation. India rubber strip for. By Terry, (D.) 437.
——And insulating material. By Kessler, (D.) 948.
——Of net-works. Localizing faults and testing. By Charpentier, (D.) 950*.
——Strains, localization of on high potential circuits upon breaking. Rice patent, 225.
——Wire. Woods patent, 67.
Insulating materials. Disruptive strength of. By O'Gorman, (D.) 602. Baur, (D.) 514, 825.
——Material. New German, (D.) 386.
——Resistance. Measuring the. By Strecker, (D. R.) 1078.
International Engineering Congress, 414.
International Power Company. Charter of, 354.
Interocean Telephone and Telegraph Company. Incorporation of, 4, 116.
Interrupter. By Soulier, (D.) 691.
——Caldwell electrolytic. Caldwell patent, 67.
——Disk. For alternating-currents. By Ruhmer, (D.) 737.
——Induction coils. By Turpain, (D) 999.
——Mercury jet, 580. By R. H. Cunningham, 588*.
——Simplified liquid. By Goldhammer and Ariston, (D.) 147.
——Turbine, (D.) 790.
——Wehnelt. By Codd, (D.) 999.
Interstate Telephone Company. Incorporation of, 152.
Ions and atoms. By J. J. Thomson, (D.) 227.
——In atmosphere. By Ebert, (D.) 789.
——Color of. By Vaillant, (D.) 790.
——Conduction through metals. By Riecke, (D.) 303.
——Contact E. M. F. and theory of, (D. R.) 654.
——Nomenclature of. By Walker, (D.) 826.
——Theory of. By Paul and His, (D. R.) 999.
——Velocity of. By Child, (D.) 29, Steele, (D. R.) 190, Jahn, (D. R.) 861.
Iron. Change in. Caused by magnetization. By Rhoads, (D. R.) 861.
——Magnetic properties of. By Mauermann, (D.) 789.
——Magnetic tests of. By Gumlich and Schmidt, (D.) 690.
——And nickel sulphates. Electrolysis of mixed solutions of. By Kuester, (D. R.) 350.
——Ore separation. Edison, 571, 1064.
——Smelting. Electric furnace for, (D.) 516. By Simpson, (D.) 477.
——Tests of sheet, (D.) 111.
——Works. Electricity in. By Hanscom, (D.) 263.

J

Jeffrey Mfg. Co. Icing refrigerator cars, 400.
——Mining locomotive, 565*.
Jenney Electrical Mfg. Co. Electrical drive for stereotype plate-shaving machine, 753*.
——Linotype motor, 479.

K

Kellogg Switchboard and Supply Co. Pan-American exhibit, 697.
——Switchboard apparatus, 1080*.
Kelly, John F. Biographical sketch, with portrait, 630.
Kendrick & Davis. Chromatic top, 865*.
Keystone Telephone Co. Stock, 699.
Knight, C. S. Signs for street corners, 864.

L

Laboratory. British National physical. By Glazebrook, (D. R.) 827.
——Electric installation of a, (D.) 1076.
Lambert-Schmidt Telephone Mfg. Co. Manhattan telephone system, 605.

Lamme, B. G. Biographical sketch, with portrait, 88*.
Lamp. (See Arc, Electrolytic, Incandescent, Nernst, Vapor.)
Lamps, Burglars', 105.
Lancaster, Pa., consolidation, 77.
Lea Elec. Mfg. Co. Exhibit at Pan-American, 195.
Lead, electrolytic refining of, 260.
——Speculation in, 519.
——White, electrolytic manufacture of. By Cowper-Coles, (D.) 190.
Light, electron theory of. By Voigt, (D.) 998.
——And heat. Dynamical theory of. By Lord Kelvin, (D.) 145.
——Mechanical equivalent of. By C. J. Reed, 170, 247.
——Polarized. New York Electrical Society paper, 1069.
——Pressure of. By Lebedew, (D.) 998, (D. R.) 1035.
——Standards of, 766.
Lighthouses in France. By De Rochemont, (D.) 688.
Lighting. Advertisement, (D. R.) 651.
——Arc. Development of. By A. D. Adams, 888.
——Church, 352, 423.
——Electric. Statistics, 807.
——At expositions. By Luther Steiringer, 687.
——Humming in church. By G. W. Cook, 346.
——Newark department store, 979*.
——And power statistics. Buenos Ayres, 992.
——San Francisco Bay, 1030.
——Street, (D. R.) 71, 688. By Loewy, (D.) 823, 878.
——Train. By Prasch, (D. R.) 788, 870.
Lightning arresters. By Mueller, (D. R.) 437.
——Arresters. Coherence phenomena in carbon. By Gansange, (D.) 862*.
——Church struck six times, 224.
——Destroys tall poles, 224.
——Flash. Pickering on a, 857.
——Globe. By Violle, (D. R.) 189.
——Kills elephant, 106.
——Magnetizing action of. By Pockels, (D.) 861.
——Nature of. By Koch, (D.) 789.
——Protection, 86.
——Protection of high-tension circuits from. By Benischke, (D. R.) 303. Kelly patent, 511.
——Rods. By Hedges, (D.) 692.
——Tesla's artificial. By H. J. Ryan, (D.) 901.
Lincoln Electric Company. Electrically-driven drill, 268.
Lincoln, Neb., Gas and Electric, reorganization, 116.
Line construction. Poles for, (D. R.) 390.
Link-Belt Engrg. Co. Coal handling at Tacony, Pa., 309.
——Conveyor in storage battery factory, 150.
Liquids. Dielectric constants of pure. By Turner, (D.) 109.
Lithium. Production of, (D. R.) 30.
Load factor. Influence of on the design and operation of a lighting and power system, 97.
Locomotives. Current supply to large, 766.
——Jeffrey mining, 565*.
Lumen-meter. Houston & Kennelly, 395.
Lunkenheimer Co. Pan-American exhibit, 402.
Luminous effects on wires. By Borgmann, (D.) 825.
Lupus. Arc light treatment of, (D. R.) 191, 390, 433.

M

McKenzie Furnace Co. Traveling grate stoker, 753*.
McLeod & Ward. Portable deck lamps, 746*.
McPherson Switch and Frog Co. Niagara plant, 752*.
McRoy Clay Works. Pan-American exhibit, 308.
Magnet Brake. For electric cranes. By Ehnert (D.R.) 1075.
——Coils. Heating of. By S. S. Neu, A. J. Levine and O. A. Havill, 50, 56*.
——Winding, (D. R.) 28.
——Influence of the form of pole pieces upon tractive force. By Beneke, (D.) 304*.
——Preservation of. By Klemencic, (D.) 789.
Magnetic action of cathode rays. By Von Geitler, (D.) 303.
——Balance. By Guglelmo, (D.) 111.
——Effect due to electric connection. By Wilson, (D.) 145, 475, Cremieu, (D.) 388, 653, Eichenwald, (D.) 654.
——Effects due to moving charges. By E. P. Adams, (D.) 264, Pender, (D.) 264.
——Field. Unsymmetric alteration of spectrum lines in a. By Zeeman, (D.) 109.
——Effect of, on resistance of thin metallic films. By Paterson, (D.) 514.
——Induction in crystals. By Wallcrant, (D.) 901. Buchanan, (D. R.) 901, Mellendorf, (D.) 948.
——Measurements. By Montpellier & Aliamet, (D. R.) 31, 230, 389.
——Observatory in Alaska, 432.
——Pole expedition, 945.
——Power of a coil, (D.R.) 1035.
——Properties of human blood. By Gamgee, (D.) 561.
——Qualities of materials in bulk. Testing the. By Drysdale, (D.) 1077*.
——Separator. Waring, (D.) 561.
Magnetism. Earth's secular variation of the. By Raulin, (D.) 998.
——Solar activity and terrestrial, 843.
——Terrestrial, (D. R.) 901.
——And viscosity. By Gray, (D.) 736.
Magnetization. Effects of upon electrical conductivity. By Barlow, (D.) 602.
——In iron. Change in [illegible]. By Rhoads, (D. R.) 861.
——And modulus of elasticity. By [illegible], (D.) 901.
——Terrestrial, (D. R.) 304.
——Of wires by intermittent current. By Honda and Shimizu, (D.) 388.
Malcomson, Chas. T. Biographical sketch and portrait, 582.
Manganese. Metallic. Simon patent, 858.
Marks, L. B. Biographical sketch, with portrait, 808.
Marshall Sanders Co. Improvement in incandescent lamp construction, 268.
——Slate base for baby knife switches, 198.
Matrix machine. Motor driven, 745*.
Mayer Electric Co. Dynamos and motors, 748*.
Maywood Foundry and Machine Co. Maywood gas engine, 829*.
Measurements. Alternating-current. By Treichlinger, (D.) 111.
——Energy. Three-wire circuits. By Stern, (D.) 351.
——Direct reading bridge conductivity. By Appleyard, (D.) 389*.
——High resistance. By Rood, (D. R.) 266.
——Instruments. By Heyck, (D.) 826*.
——Pocket, 396*.
——Log angle with one wattmeter. By A. S. McAllister, 849*.
——Localizing high-resistance breaks in cables. By Rymer-Jones, (D.R.) 190.
——Magnetic. By Montpellier and Aliamet, (D. R.) 230.
——Polyphase circuit power. By J. A. Fleming, (D. R.) 148.
Mechanical applications of electricity. By Richard, (D. R.) 900.
Mechanics. Electromagnetic theory of. By Wien, (D.) 145.
Medical electrochemistry. By Leduc, (D.) 1036.
Mercury lamp. By Lummer, (D.) 387*.
——Vapor. Conduction of electricity through. By Schuster, (D.) 789.
Mershon, Ralph D. Biographical sketch and portrait, 248.
Metals. Electro-coppering, 856.
——Films. Effect of magnetic field on resistance of thin. By Patterson, (D.) 514.
——Locating. By electricity, (D.) 950.
——From ores. Extracting, (D.) 229.
——Precious. Extraction of. By Tatro and Delius patent, 434.
——Theory of ions in conduction of electricity through. By Riecke, (D.) 303.
Meter. (See also Ammeter, Voltmeter, Watt meter.)
——Frequency, 85.
——Electrolytic type. By Dick, (D.) 603.
——And instruments. By Armagnat, (D.) 515.
Metermen's Association, The, 104.
Metric system. By Greenwood, (D.) 604.
Metropolitan Telephone and Electric Co. Leich telephone system.
Mexico. Traction and light in, 77.
Microphone, Hand, 395*.
Mietz. August Mietz and Weiss gas engine, 865*.
Mill cogs. Ready-dressed, 114*.
Milling machine. Cincinnati, 1038*.
——Grant, 831*.
——Motor-driven, 750*.
——Head. Vertical spindle, 956*.
Mines. Alternating currents in. By Walker, (D. R.) 558.
——Electricity in. By Goetze, (D.) 860.
——Locomotive. Jeffrey, 565*.
——Plant. Electric. Silver City, Idaho, 751*.
——Pumping plant. Essen, (D.) 788.
——Transmission plant for, (D.) 263.
Monarch Fire Appliance Co. Extinction of electrical fires, 517.
Monarch Mfg. Co. Pan-American exhibit, 353.
Moonlight tables for 1902, 973.
Montreal. Electrical activity in, 103, 256.
Morgan Smith Co. Silver City water power plant, 751.
Morse Twist Drill Co. Pan-American exhibit, 353.
Mosquitoes shut down power plant, 222.
MOTORS:
——Alternating-current. Small single-phase, 828*.
——Wilson patent, 1029.
——Circuit devices for alternating current, 512.
——Comparative weights of. By Seefehlner, (D.) 28.
——Condenser. Single-phase. Steinmetz patent, 898.
——Control. Multi-voltage. Andrews patent, 945.
——Railway. Case and Rice patents, 946.
——Controller. Series. Reed patents, 821.
——Electrostatic induction, 260.
——Drives. Novel of, 744*.
——Stray power methods of testing direct-current. By W. L. Smith, 981.
——Heyland induction. With unity power factor. By E. H., (D.) 651, 843.
——Measuring the energy of three-phase. By Stern, (D.) 305.
——Oerlikon, (D. R.) 108.
——Performance. Railway. By Hanchett, (D.) 1074.
——Railway. By Collischonn, (D. R.) 735.
——Capacity of. By Mueller, (D.) 947.
——Rating and testing. By G. Kapp, (D.) 512.
——Rise of the, 710.
——Self-exciting asquchoronous induction, 492. By Bunet (D.) 1859.
——Self-starting single-phase, without brushes. By Michel, (D.) 557, L. Gutman, 107*, J. Fischer-Hinnen, 225, (D.) 687.
——Speed control of. By Hoit, (D. R.) 823.
Motor. Direct-Current. [illegible]
——[illegible]
——[illegible]
——[illegible]
——[illegible]
——[illegible]
——[illegible]
——[illegible]
——Shunt. Relation of [illegible] to operating characteristics and cost of operation. By [illegible], 1[illegible].
——In steel works. By Minshall, (D.) 108.
——Sterling shielded type, [illegible]
——Wall suspension. Rochester, 747*.
——Zieh, direct current. Variable speed, [illegible]
Motor. Induction. [illegible]
——Calculation of stray coefficient of. By Heubach, (D.) 144.
——Lamme patent, 346.
——Measuring slip. By Schweitzer, (D.) [illegible]
——Measurement and calculation of no load losses. By Benischke, (D.) 474*.
——Phase compensation for high-speed railways. By Heyland, (D.) [illegible]
——Polyphase railways, 184, 415, 427, 842.
——Power factor equal to unity. By A. Heyland, (D.) 347*, (D. R.) 386.
——Short-circuit current of three-phase. By Siemert, (D. R.) 348.
——Squirrel-cage rotor. Eickemeer patent, 68.
——Starting three-phase, (D.) 734*.
——Stray field in armature. By LaCour, (D. R.) 301.
——Tandem railway induction. Armstrong patents, 184.
——Theory of. By Meller, (D. R.) 1074.
——Three-phase. By Trvlski, (D.) 301, (D. R.) 734, Weisshaar (D. R.) 1074.
——Variable speed for. De Lignieres patent, 511.
Motor. Synchronous, (D. R.) 263.
——And alternators in parallel. By Russell, (D.) 226.
——Graphical theory of. By Verhoeckx and Blondel, (D. R.) 226, 734.
——And induction, 365.
Motor generators versus rotary converters. By Braun, 454, 460*, (D.) 947, 1062.
Municipal Electricians. International Association of. Convention of, 431, 441.
Municipal Signal Co. Pan-American exhibit, 867.
Murdock Company. Wm. J. Molded telephone receiver, 955.

N

National Academy of Sciences, Philadelphia meeting, 880.
National Meter Co. Nash gas engine, 740.
National Standardizing Bureau, 27.
Navigation. Electric buoys for. St. Lawrence River, 786.
Navy yard polyphase plant. New York, 249*, 713*.
Nernst lamp. By A. H., 319, 328, (D.) 348, 364, 455.
——Commercial. By Wedding, (D.) 301*.
——German. Ochs patent, 946.
——Germany. By E. Kilburn Scott, 294.
——Filament. Drake patent, 67.
——Filaments and gases. Analogy between the By Kaufmann, (D.) 303.
——Heater. Swinburne patent, 384.
——Nernst patents, 783.
——Potter. Hanks and Goddard patents, 649.
Networks. Insulated cable. Potential of. By Guyer, (D. R.) 736.
——Relative advantages of three, two and single phase systems. By Field, (D.) 601.
Newspapers. Telephonic, (D. R.) 390.
New Orleans consolidation, 77.
New York Street Railway Association. Annual meeting, 346, 469, 480.
News office. The city, 2.
Niagara Falls Power Company. New high tension work of, 94*.
Niagara power. Retrospect of, 320.
Nickel-ammonium sulphate. Electro-chemical behavior of. By Pfanhauser, (D. R.) 190.
——And cobalt. Separating. By Balachowsky, (D.) 654.
——At high temperatures. By Campbell, (D.) 30.
——And iron sulphate. Electrolysis of mixed solutions. By Kuester, (D. R.) 350.
——Metallurgy of. By J. B. C. Kershaw, (D.) 266.
——Plating, (D.) 691.
——Steels. Permeability of. By Paillot, (D.) 30.
Nitrites. Reduction of. By Suler, (D. R.) 447.
Nobel prizes, 778, 976.
North American Company. Report to, 76.
Northern Elec. Mfg. Co. Novel methods of electric drive, 744*.
North American electrical plant. By J. H. Vail, 129*.
Northwestern Electrical Association, 1, 16, 37.
Noyes Brothers. Electrical illumination in Australia, 830.

O

Ohio Brass Co. Flexible pole brackets, 604*.
——Trolley wire hangers, 567*.
Ohio Electric Light Association. Convention of, 334.
Ohmmeter, Evershed, 37*.

Omaha Transportation and Power Company. Formation of, 199.
Optical electric phenomenon. By Bose, (D.) 948.
Ores. Extracting metals from, (D.) 229.
Orlyte. By Duschan de Vulitch, (D.) 790.
Osburn Flexible Conduit Co. Flexible conduit, 793*.
Oscillator. Shaft. By A. B. Weeks, 517*.
Oscillations. Calorimetric measurements of electric. By Harms, (D.) 227.
——And electric waves. By J. A. Fleming, (D. R.) 388.
——Discharges through divided inductive circuits. By Miguno, (D.) 476.
——Experiment. Electric. By Pellat, (D.) 29.
——Influence of, on electrolytes. By Morris, (D.) 227.
Oscillographs. By Blondel, (D. R.) 389.
——Osmium incandescent lamp, (D.) 824.
Oxygen and hydrogen. Electrolytic production of, (D.) 999.
Ozone, (D. R.) 350.
——Purification of water by. By Erlwein, (D.) 998.

P

Pan-American exposition, 161.
——Fire hazard. By H. Rustin, 385.
——Flambeaus, 295*.
——Ground lighting at. By L. Stieringer, 89*.
——Lighting, 85.
——Wire tapping at, 104.
Paris exposition, 738.
——Alternators, dynamos, etc. By Reyval, (D. R.) 305.
——Dynamos, converters, etc. By Reyval, (D. R.) 191.
——Dynamos. By Reyval, (D. R.) 31.
——Oerlikon Company, etc. By Reyval, (D. R.) 439.
——Generator. By Dronin, (D.) 230.
——Machines. By Siemens & Halske, etc., (D. R.) 516.
Paraffins. Dieelectric constant of. By Hormell, (D.) 1034.
Patents in Great Britain, 67.
——U. S. Classification, 1030.
Patterson Engine Controller Co. Compound engine controller, 562*.
Payne. Postmaster-General, with portrait, 1049-68.
Permeability. Measuring. By Baily, (D.) 603.
Permeameter. By Baily, (D. R.) 999.
Persulphates. By Perkin, (D. R.) 438.
Phase meter. By Letheule, (D. R.) 737.
Phosphorus ionized. By Barnes, (D.) 146.
Photo-electric effect. By Zeleny, (D.) 188, Kreuster, (D.) 825.
Photographone. By Ruhmer, (D.) 31.
Photometer. Houston & Kennelly, 395*.
——Physiological. By Stanoievitch, (D.) 560.
Photometry. Oil lamp as applied to commercial. By E. J. McAllister, (D. R.) 266.
——Arc light. Mathews apparatus for, 528, 549*.
Pignolet, L. M. Pocket measuring instruments, 396.
Pilot wires. Central station. By Picon, (D.) 689.
Piperidin. Electrolytic, 300, (D.) 790.
Pipes. Steam. Transverse stresses in. By Mann, (D. R.) 1033.
Pittsburg Transformer Co. Three-wire secondary distribution, 394.
Platinum electrode, (D.) 691, (D. R.) 737.
Pliers. Smith & Hemenway, 1039*.
Polarization balance. Electric. By Maccarone, (D.) 1035.
——Of electric waves. Interference and. By Quincke, (D.) 789.
Pole brackets. Flexible, 604*.
——Lines. Construction of. By K. B. Thornton, 61, Poole, (D. R.) 602.
Polyphase lines. Calculation of voltage drop in. By Stock, (D. R.) 948.
Polyphase systems. Regulation of. Feldmann system, (D.) 145*.
Polishing wheel. Band, 605*. 751*.
Population. Figures of Urban, 105.
Porter Battery Co. Record automobile run, 308.
Potassium cyanide solutions. Cold precipitation from. By Jory, (D.) 73.
Potter, W. B. Biographical sketch and portrait, 1014.
Power Distribution, Electric:
——By Hahn, (D. R.) 651.
——Chicago Into Ocean plant, (D.) 71.
——Fries Mfg. Co., 393.
——Power. German plant, (D.) 688.
——And industrial prosperity. By Dunlop, (D.) 824.
——Lorrain Steel works, 346.
——New Jersey brewery, 1037*.
——New York navy yard, 713*.
——Paper mill. By Bentom, (D. R.) 900.
——Railroad shop, (D.) 512.
——Rise of electric. By A. D. Adams, 716.
——Shipbuilding works, (D.) 860.
——By Robertson, (D.) 558.
——Silvertown, England, (D.) 997.
——Tweedale, (D. R.) 824.
——Tyneside, England, 5*.
——White goods factory, 711*.
Power factor indicators. By Browne, 378*, 710.
Power Transmission. (See also Transmission.)
——Bear mountain, Cal. By Calloway, (D. R.) 735.
——Dutcher, (D. R.) 735.
——Bulgarian Iskar-Sophia. By Perkins, (D.) 387.
——Chats Falls, 821.
——Climate and. By McAdie, (D. R.) 735.
Power Transmission. Columbus, Ga. Power, 832.
——Increased voltage on lines. By Boernecke, (D. R.) 824.
——Russian project. By Dobrotvorsky, (D.) 824.
——St. Joseph, Ind., 781.
Poynting's theorem. By Franklin, (D. R.) 789.
Press. Armature. Thirty-ton motor driven, 754*.
Primary Battery:
——By Rosset, (D.) 72.
——Cadmium standard. By Tinsley, (D.) 790*.
——Chemical regeneration of peroxide plates, 100.
——Diaphragm. Dobell patent, 384.
——Fused electrolytes. By Sulhy, (D. R.) 476.
——Hydra dry cell, (D. R.) 266.
——Persulphate. By Peters, (D.) 999.
——Pile-block, 1080*.
——Polarization and internal resistance of. By Atkins, (D. R.) 389, (D.) 737.
——Possibilities of, 87.
——Regenerative. Zone patent, 68.
Printing. Electrolytic. By Darling, (D.) 389.
——Office. Motors in, 696*, 744*, 793 (D.) 996.
Projectile speed. Electrical measurements of, 1050.
Pumps. Electric. By Hicks, (D. R.) 735.
——Electrically driven. By Pattison, (D.) 108, Perkins, (D. R.) 513.
——Motor, 568*.
——Three-phase motor and, (D.) 144.
Pupin wave transmission, 96.
Pyrometers. Electric. By Rosenhain, (D. R.) 190 (D.) 229.

Q

Queen & Co. Lumen-meter, 395.
——Testing set, 37.

R

Radiation. Pressure of, 975, (D.) 998. By J. W. Darley, Jr., 1073, Lebedew, (D. R.) 1035.
Radio-activity. By Pegram, 126, (D.) 146. Lennan, (D. R.) 789.
Radium rays. Chemical action or. By Berthelot, (D.) 948, Becquerel, (D.) 998.
——Magnetic analysis of. By Becquerel, (D.) 72.
——Physiological effect of. By Becquerel and Curie, (D.) 72.
Rail bonds. Copper, 820.
——Bonds on the B. & O. R. R. By Young, (D.) 1034.
——Bond. New type, (D.) 1034.
——Chair for electric lines. By Koetensy, (D. R.) 948.
Railroad block systems. By Rank, (D. R.) 653.
——Signals. By Timmis, (D. R.) 560, Peggs, (D. R.) 738.
Railroads. Electricity as a motive power for steam. By Carus-Wilson, (D.) 513.
Railways, Electric:
——Adirondack, 1072.
——Albany & Hudson third-rail, 227.
——In Alstraetten, Switzerland. Combined lighting and traction. By Bignami, (D.) 514.
——Atlanta Rapid Transit, (D.) 302.
——Baltimore consolidation, 77, (D. R.) 388.
——Barmen-Elberfeld. By Leudorf, (D. R.) 188.
——Belgian, (D.) 735.
——Bergen County Company stock, 39.
——Berkshire, Mass. By A. D. Adams, 326*.
——Berlin and Hamburg high speed, 436.
——Birmingham, Ala., 442.
——Black Hills and Fort Pier transformed, 224.
——British schemes, (D.) 735, (D.) 1076.
——Bronx. By Maher, (D.) 653.
——Brooklyn Rapid Transit Company's power stations. By Roehl, (D.) 688.
——Budapest. By Spaengler, (D. R.) 860.
——Buffalo, (D. R.) 145.
——Canton-Massillon. Purchase of, 959.
——Cascade division of the Great Northern to use electricity, 433.
——China concession, 897.
——Clark cross-continent, 210.
——Chicago, 898.
——Chicago-Farnham. Test of, 782*.
——Chicago & Great Western. Suburban, 299*.
——Chicago-Joliet, (D. R.) 689.
——Chicago long distance, 366.
——Chicago Union. Elevated sale, 235.
——Colorado Southern to use electricity, 433.
——Croydon, Eng., (D. R.) 788.
——Detroit United, new organization, 443.
——Diatto surface contract system at Paris. By Laffargue, (D. R.) 71.
——Dublin, (D.) 345*.
——Dundee, (D. R.) 145.
——East Ham, England, traction and lighting station. British, (D.) 514.
——Englewood & Chicago, (D.) 651.
——Everett-Moore syndicate, 143, 335, 434.
——Great Northern. Proposed electrification, 582.
——Hartford to Boston, 224.
——Hartford-Springfield, 152.
——Havana, (D.) 824.
——Hudson Valley Company, 235, 310.
——Indiana Union Traction, (D.) 1075.
——Indiana interurban, 26.
——Italian. By Reyval, (D.) 947.
——Jungfrau three-phase, (D. R.) 689.
——Kansas City. Power station, 772.
——Kentucky interurban, 186.
——Lisbon. Portugal, 153.
Railways, Electric:
——London, (D. R.) 227, (D. R.) 825, 858.
——Alternating vs. direct-current, 974, (D.) 997, 1018.
——London Metropolitan, 261.
——London underground, 141, 183, 311, 897.
——London United Tramways, 105.
——Long Island Network, 423.
——Lucerne, Switzerland, (D. R.) 71.
——Mt. Holly and Burlington, 994.
——Madrid concession, 41, 154.
——Manchester, Eng., (D.) 144.
——Mexican, 153, 273, 403, 571, 660, 909.
——Michigan networks. By E. J. Hart, 812*.
——Michigan single-phase. Single-phase, 556.
——Milan and the Italian lakes, (D.) 302.
——Milan-Monza. By Semenza, (D.) 1033.
——Milford, Holliston and Framingham, (D.) 1095.
——Mont Blanc, 143.
——Munich surface-contact system. By Bainville, (D. R.) 689.
——Naples-Aversa-Calvano system. By Pio, (D.) 302.
——Nashville, Tenn., 868.
——New England consolidations, 868.
——New Jersey third-rail, 1029.
——New York, 519.
——New York. Manhattan, 857, 944, 974, 1014.
——New York Metropolitan. By Pearson, (D.) 652.
——New York Metropolitan organization. By Vreeland, (D.) 688, Starrett, (D.) 688.
——New York Metropolitan statistics, 482.
——New York power houses. By Kent, (D.) 652.
——New York Rapid Transit subway, (D.) 735.
——New York storage battery line (D.) 475.
——New York and Portchester third rail, 52.
——New York and Stamford, 658.
——New Orleans & Carrollton, (D.) 860.
——Niagara Falls, St. Catharines & Toronto. By Seixas, (D.) 513.
——Norfolk & Atlantic terminal, (D.) 475.
——Ohio. By Davis, (D.) 302.
——Paris. By Kohlfuerst, (D. R.) 349, 855, 856.
——Paris-Antwerp. Proposed, 260.
——Philadelphia franchises, 235.
——Pike's Peak, 433.
——Pittsburg, 443, 570, 1002.
——Reading (Pa.), 271.
——Rochester-Niagara, 152.
——Rosenfeld and Zelenay system., By Gernard, (D.) 348.
——Sacramento, (D. R.) 1075.
——Saxon, 856.
——Schenectady, 354, 442.
——Shanghai proposed lines, 897.
——Sicily. By Bignami, (D.) 652.
——Staten Island. By M. Loewenthal, 1053*.
——St. Louis, (D.) 144, (D.) 145, (D. R.) 900.
——St. Petersburg, Russia, 730, 856.
——Sweden steam roads to electric, 732.
——Syracuse. By Tonnette, (D. R.) 145.
——Tokyo system, 223, 404.
——Toledo, Ohio-Monroe, Mich., interurban, 165, (D. R.) 825.
——Trinidad. B. W. I., 660.
——Troy freight line, 856.
——Vienna trials, (D.) 652.
——Worcester, Mass., 116, 235.
——Yucatan projected, 517.
Railways electric. By Cardew, (D. R.) 824, More, (D. R.) 824.
——Automatic train recorder, (D.) 862.
——Barbillion and Griffisch system. By Reyval, (D.) 735.
——Bidwell patent, 685.
——Boston elevated block signal system. By Knowlton, (D.) 475.
——Boston elevated. Operating features of the. By F. H. Shepard, 213*, 1210.
——Brakes for cars. By Fell, (D.) 108.
——Brake tests in electric interurban service, (D.) 1034.
——Brooklyn problems. By Greatsinger, (D.) 735.
——Calculation of current distribution. By Pforr, (D. R.) 303.
——Cantor lecture. By Cardew, (D. R.) 513.
——Car maintenance. By Millin, (D. R.) 736.
——Comparison with steam railroads. By Cserhati, (D.) 475, Carus-Wilson, (D.) 513.
——Conduit, (D.) 735.
——Connecticut. Supervision in, 184.
——Convention at Aachen, (D.) 144.
——Cost of constructing and operating the Port Chester road, 854.
——Electrolysis by return currents. By Wheeler, (D. R.) 948.
——Emergency repair service in Brooklyn, (D.) 558.
——Energy consumption on. By Volkers, (D.) 108, (D. R.) 303.
——Express service in New York, 27, 74*.
——Freight systems in Ohio, 259*.
——General electric system of train equipment, (D.) 653.
——Generating units for the Boston elevated, 257*.
——Heavy traction tests, 732.
——High-speed. By Reymond-Schiller, (D.) 349, Schiemann, (D.), 436, Meyer, (D.) 652, Reynolds-Schiller, (D. R.) 689, Dolezalek, (D.) 1788, A. B. Brown, 996.
——Induction motor for, 427, 464.
——Induction motors with phase compensation for high-speed. By Heyland, (D.) 899.
——Influence of polyphase apparatus on design of power houses. By J. E. Woodbridge, 532, 592, 638*.
——Johnson on fares, 606.
——Lighting and traction stations. Cost in combined. Tettensor, (D. R.) 109.
——London rapid transit. By Sprague, (D.) 652.

RAILWAYS, ELECTRIC:
____Long-distance. By Hospitalier, (D.) 997.
____Loop terminals for elevated, (D. R.) 1076.
____Maxham surface contact system of, 862*.
____Metropolitan. New York power house and distribution system, 531*.
____Mono-rail in England, 184.
____Motor performance. By Hanchett, (D.) 1074.
____Multiple-unit system. German. By Kubierschky, (D. R.) 302, (D. R.) 513.
____Non-paying roads. How to make them pay. By Cooper, (D. R.) 303, 475, (D.) 145.
____Overhead safety construction. By Manville, (D. R.) 475.
____Permanent way for. By Howard Smith, (D. R.) 349.
____Polyphase. By H. S. Meyer, (D.) 188, (D. R.) 227, Eborall, (D.) 28, 188, 684.
____Power calculations. By Hansard, (D. R.) 788.
____Power house engineering. By Woodbridge, 632, 692, 638.
____Power house proposed by Westinghouse for London railways, (D.) 436.
____Power stations. Influence of polyphase apparatus on the design of. By J. E. Woodbridge, 532, 592, 638*.
____Recent practice in construction and operation, (D. R.) 436.
____Return circuit, (D. R.) 71, 650, (D.) 558.
____Rolling stock. By Chamberlin, (D. R.) 736.
____Shallow underground, (D.) 1075.
____Sprague multiple unit system, (D. R.) 227.
____Standardization, (D.) 189.
____Storage battery in power station service. By Lyndon, (D.) 144.
____Swiss construction and operation. By Edstrom, (D. R.) 28.
____Surface contact. Felice, Tosi and Parboni. By Reyval, (D. R.) 735.
____Tangential traction system, 546*, 598.
____"Third-rail" eye, 104.
____Third-rail system. By Hoopes, (D.) 688, (D.) 1034.
____Three-phase. Brown-Boveri, (D.) 860.
____Three-phase traction abroad, 86.
____Traction service without track. By Schiemann, (D.) 1075.
____Transfers. By Root, (D. R.) 736.
____Trolley repair stations, 183.
____Urban and suburban, 672.
____Zossen high-speed. By Walter Reichel, 367, 589, 644, 678, 719, 777*, O. Lasche, 424*, 457*, Carus-Wilson, (D. R.) 900, 253, (D.) 513, 529, 558, 628, 786, 842, 857, (D.) 997, 1012, 1029.
Rays. (See Becquerel, Radium, Röntgen, etc.)
Rectifiers. By Warrilow, (D. R.) 108.
____Aluminum. By Pollak, (D.) 110, Milkiewiez, (D.) 787.
Reed, C. J. Biographical sketch, with portrait, 212.
Refuse destruction. By Priestley, (D.) 860.
Regulations for installations. German, (D. R.) 1076.
Regulator. Electric current (Rheocrat), 113*.
Reichsanstalt, (D.) 31, (D.) 111.
Relay. Electro-capillary, (D.) 1078.
Reliance Electric Co. Dynamo and motor, 907.
Resistance. Contact. By A. H., (D. R.) 653.
____Effect of high frequency oscillations on electric. By White, (D.) 146.
____Of human body. By Hooper, (D.) 191.
____Insulating. Measuring the. By Streecker, (D. R.) 1078.
____Measuring high. By Rood, (D. R.) 266.
____Starting. By Kubierschky, (D. R.) 653, Bunet, (D. R.) 653.
Resonance. By Turpain, (D. R.) 948.
____Certain phases of, 365.
____Currents. Protection against. By Bemischke, (D. R.) 303.
____Phenomena in direct-current circuits. By Armagnat, (D.) 227.
Reynolds Electric Co. The Reynolds "Flasher," 196, 307.
Rheocrat or electric current regulator, 113*.
Rheostats. Carpenter enclosed, 197*.
Rice, E. W., Jr. Biographical sketch, with portrait, 128.
Risdon Iron Works. Mine hoists, 232.
Rochester Electric Motor Co. Wall suspension motor, 747*.
Röntgen ray apparatus. Caldwell patent, 1030.
____Harmless. By Demerliac, (D.) 189.
____In pension examinations, 821.
____Tubes, (D.) 228.
____In warfare, 821.
Rotary field. By Bergmann, (D. R.) 386.
____Theorem in. By Campbell, (D.) 388.
Roth Brothers & Co. Motor-driven matrix machine, 745*.
Rowland memorial meeting, (D. R.) 1078.
Rubber in French Africa, 433.
____Venezuela, 898.
Russell-Tomlinson Elec. Co. Telephone receiver, 957*.

S

Salts. Determining constitution of complex from electrolytic transport numbers. By Rieger, (D.) 603.
____Fused. Electrolysis of. By Lorenz, (D.) 228*, Garrard, (D. R.) 790.
____Sault Ste. Marie. Clergue syndicate, 69.
San Francisco consolidation, 77.
Schieren Co., Chas. A. Pan-American exhibit, 754.
Searchlights. Parabolic reflectors for, (D. R.) 512.
____Signals to Toronto from Buffalo, 300.
Selenium cells. Photoelectric. By Marian, (D. R.) 37.
____Resistance of. By Giltay, (D. R.) 476.
Self inductance. Absolute measurement of. By Duane, (D.) 901.
Separators. Magnetic and electric, (D. R.) 478.
____Waring magnetic, (D.) 561.
Shaft oscillation. By A. A. Adler, 557.
Ship's compass affected by electric circuits, 224.
____Lighting an antarctic, 255*.
Shipyards. Electric power in. By Robertson, (D.) 558.
Shock. A 10,000 volt. By H. Pieper, 1073.
Shop work. Modern systems for. By Booth, (D.) 516.
Shunt regulating resistances. By Hahn, (D. R.) 28.
Signs. Electric, 441*.
____Flashers. Electric, 397*.
____Receptacles. Universal, 794.
____Street corners, 864*.
Signal corps. Work of the U. S., 779.
Signals. Block. By Prasch, (D. R.) 31, (D. R.) 791, 500*.
____Railway. By Timmis, (D. R.) 560, Ellis (D. R.) 1035.
____Railway. Cohen, 307.
Signaling. Railway. By Timmis, (D. R.) 791.
____Submarine. Boston, 185.
Silver. Allotropic. Potential differences of. By Craw, (D. R.) 826.
____Electro-chemical equivalent of. By Richards, Collins and Heimrod, (D.) 229.
Skin diseases. Electrical treatment of, (D.) 515.
Slate quarries. Electric power in. By Brunswick, (D.) 388.
Slotter. Die, 400*.
Sluice. Electric operation. Seine river of a, (D.) 788.
Smith & Hemenway Co. Angle boring bit stock, 867.
Smoke detector. Electrical. Freymann and Tolman patent, 1030.
Soda. Caustic from fused electrolytes. Acker patent, 993.
Sodium. Electrolysis of metallic. Scholl patent, 260.
____Mercury cathode cell for electrolytic production of, 297*.
Soldering. Aluminothermic process of. By Goldschmidt, (D.) 950.
Spark. Electric. By Niculcea, (D. R.) 737.
____Discharges in gases. By Guggenheimer, (D.) 475.
____Illumination effects of. By Soulier, (D.) 788.
____Spectrum of. By Schenck, (D. R.) 34.
Spectra. Electrical theory of, 629.
Sprague Electric Co. Electrically-driven pump, 568*.
____Flexible steel-armored conductors, 396.
____Interior marine cable box, 831*.
____Lundell motors, 748*.
____Modern printing press equipment, 696*.
St. Louis exposition, 925.
____Electricity building, 729*.
____Lighting, 819.
Stages. Electric. New York, 897.
Standard Paint Co. Exhibit at Pan-American, 195.
Standardization of electrical apparatus. By Broderick, (D. R.) 687, 767, (D.) 823.
____In Germany, (D.) 70.
Standardization bureau. National, 820.
Stanley Electrical Mfg. Co. Motor condensers, 1080*.
____Pan-American exhibit, 794.
____S. K. C. converter, 863.
____Southern water power plant, 393.
Stanley & Patterson. DeVeau telephone apparatus, 953*.
Static discharge from Leyden jars. By Brooks, (D. R.) 146.
____Induction currents, 893*.
____Influence machine discharge. Vibration due to. By Negreano, (D.) 109.
STEAM ENGINES:
____(D. R.) 71.
____American. For Glasgow railways, (D. R.) 264.
____Controller. Compound. By R. J. Patterson, 562*.
Hopkinson, (D.) 1035.
____Determining the degree of uniformity of revolution. By Frankes, (D.) 861*.
____Driving large dynamos. By Day, (D. R.) 824.
____And dynamos. Standardization of, 938*.
____For dynamos running in parallel, (D.) 263.
____Delivery guarantees. By T. Reid, 69.
____Josse waste heat, 210, 219*.
____Superheated steam in. By Lenke, (D. R.) 788.
Steam pipe coverings. Tests of, 945.
____Superheated. Practical application of. By Hutchinson, (D. R.) 301, Lenke, (D.) 788.
____Superheating apparatus. Commercial types of. By Hutchinson, (D. R.) 513.
____Tables. By Hubbard, (D. R.) 513.
____Trap. High pressure non-return, 958*.
Steel works. Power distribution in. By C. H. Hines, 346.
Sterling Electrical Mfg. Co. Incandescent lamp, 565.
Sterling Electric Motor Co. Shielded type motors, 957*.
____Stereotype plate-shaving machine. Electrical drive for, 753*.
Stoker. McKenzie traveling grate, 753*.
____Mechanical tests of. By W. R. Roney, 1079.
Stott, H. G. Biographical sketch, with portrait, 164.
STORAGE BATTERY:
____Alkaline nickel oxide. By Prof. A. L. Marsh, 136.
____Automobile, 527, 538*, (D. R.) 603.
STORAGE BATTERY:
____Descriptions of various, (D. R.) 190, (D. R.) 737.
____Edison, 24*, Hubbard, (D.) 72, Peters, (D.) 110, U. S. patent 134*, [illegible] (D.) 147, 170, De Contades (D.) 189, Lucas (D.) 261, [illegible] (D.) 265, Wade (D.) 438, Lucas, (D.) 511, [illegible] (D.) 559, Roeber, 598, 647*, Lucas, (D.) 661, Johnson, 733, Newburger, (D.) 780, 896, Roeber, 931.
____Gould. At Pan-American, 150*.
____Hagen plant. By Marmor, (D. R.) 903.
____Kaufman patent, 684.
____Lloyd patent, 684.
____Max. By Casmier, (D.) 438, (D. R.) 826.
____Niblett traction, (D.) 228.
____Nickel. By Michalowski, (D.) 654.
____Non-lead. By Von Laszczynski, (D.) 349.
____Paget patent, 858.
____Pascal marine lead. By Hibbert, (D.) 265.
____Pergne, (D. R.) 950.
____Telegraph, 569.
____Telephone, 780.
____Union. By A. Z., (D. R.) 691.
____Zinc-lead, (D.) 691.
____booster systems. By Lamar Lyndon, 13*, 65*, 49.
____Booster system. Storer patent, 786.
____In central stations. By R. F. Schuchardt, 254*.
____Charging from alternating current mains. By F. J. Koch, (D.) 787*.
____In Chicago Edison station, 306*.
____Connections for lighting circuits. By C. Brandeis, 11*.
____Curves showing remanent charge, (D. R.) 514.
____Discharge of. By Montel, (D. R.) 603.
____Factories in Prussia. By Heffter, (D. R.) 999.
____Handling. By Lees, (D. R.) 389.
____Increase of capacity by heating. By Helm, Schoop, (D.) 350, (D.) 825, (D. R.) 901. Liagre, (D.) 949.
____Local action and other losses in. By Fay, (D. R.) 266.
____Losses of energy in lead. By (D.) 1077.
____Measuring resistance of. By Bruger, (D. R.) 351.
____For power houses, 635.
____In power stations controlled by reversible boosters. By Highfield, (D. R.) 29.
____Railway power station service. By Lyndon, (D.) 144.
____With sixty-cycle railway synchronous converters. By Reynolds, (D. R.) 861.
____Solutions. Concentration changes in, 3.
____Sulphuric acid in the lead. By Pfaff, (D.) 73.
____Theory of the lead. By Abel, (D.) 110.
____Traction tests. By R. Kennedy, (D. R.) 601.
____Storer, Norman W. Biographical sketch and portrait, 844.
Street car travel. Direction of. By. J. S. Badger, 1072.
____Lighting, (D. R.) 688.
____At Montreal, 225.
Stromberg-Carlson Telephone Mfg. Co. Wheeling exchange, 955*.
Sturtevant Company, B. F. Compact generating set, 568*.
____Direct-connected generating set, 831*.
____New generating set, 307.
Suction. Electric. By Lemtstroem, (D.) 303.
Sulphide ore treatment. By Ashcroft, (D.) 189.
Surgings in electrical circuits, 321.
____Transmission circuits. By A. E. Kennelly, 847.
Switch. Automatic door, 695*.
____Automatic time, 398*.
____Electric. By Kennelly, (D.) 900.
____Electro-mechanical railway, 566*.
____Fuse, 695*.
____G. E. push button, 1001*.
____High-potential, (D. R.) 264, (D. R.) 388, (D. R.) 689.
____For lighting installations. By Herzog, (D.)*.
____Remote control, 38*.
____Slate base for baby knife, 198*.
____Zimdars & Hunt quick break, 439*.
Switchboard. Combined lighting and traction, (D. R.) 900, (D. R.) 1076.
____Engineering, 493.
____High-tension. By Warrilow, (D.) 514.
____High voltage. Kansas City, 765, 772.
____Instrument. Calibration of. By J. F. Stevens, 107.
____Manufacture in England, 154.
____Simplicity, 772. By L. B. Stillwell, 858.
Switching. Control of high-potential systems of large power. By. E. W. Rice, Jr., 374*.
____And fusing devices. High tension. By Masson, (D.) 264.
____High tension, 415.
Synchronizer. Lincoln, 562*.

T

Tachometry. By J. A. Fleming, (D.) 827.
Tariff for Germany. New higher, 104, 182.
Telegraphy in Arabia, 1072.
____Belle Isle straits, 433.
____Chinese, 104.
____Klondike, 555, 556.
____Korea, 1030.
____Paraguay, 185.
____Rowland. By Robichon, (D. R.) 31.
____Trans-African, (D. R.) 477.
____American. Clark on the conditions of, 292*.

Telegraphy. Automatic or machine. By E. A. Calahan, 133.
——Automatic or machine. By E. A. Calahan, 133.
——And cables. President McKinley on, 472.
——High speed, (D.) 31.
——Mercadier multiplex, (D. R.) 266, (D. R.) 390.
——Multiplex, (D. R.) 111.
——Rapid, 100, 163. By Delany, 291.
——Simultaneous multiplex and ordinary. By Mercadier, (D.) 737.
——Submarine. By Janlin, (D. R.) 148.
——And telephony. Progress in Germany, (D. R.) 560, in England, 846.
Telegraph. (See also Wireless Telegraphy.)
——Bill to buy U. S., 1030.
——Lines. By Medina, (D.) 691.
——Plant. Cleveland, (D. R.) 351.
——Poles. High, 105.
——Protection of telegraph lines against strong currents, (D. R.) 31.
——Offices. Cleveland and Denver, (D. R.) 477.
Telegraph repeater, (D. R.) 862.
——System. Delany rapid, 218*.
——Systems. Operating speeds and economies. R. Hitchcock, 816.
——And telephone service. Combined. By R. Hitchcock, 1073.
——And telephone wires. Sag of. By Lawrence, (D.) 737.
Telegraph, Telephone and Cable Company, 699.
Telephone, Telegraph & Cable Co. Reorganization of, 199, 403, 442, 518, 639, 658.
Telautograph. Ritchie. By Letheule, (D. R.) 191.
TELEPHONE:
Telephone apparatus.
——"American,' 958*.
——Apartment house, 954*.
——"American" central energy, 115*.
——Cable carriers. By Henry, (D. R.) 266.
——Connecticut Tel. & Elec. Co., 955*.
——Desk set, 36*.
——DeVeau, 953*.
——Egan pay telephone, 75*.
——Eureka, 566*.
——House station, 398*.
——Leich selective system, 149*, 1039.
——Lockout party-line system. Selective, 952*.
——Molded receiver, 955*.
——Receiver. Baber, 233.
————Russell-Tomlinson, 957*.
——Relay-Nessel & Gouin patent, 143.
——Repeater. Bela Gati patent, 684.
——Signaling dynamotors for, 1000*.
——Switchboard apparatus. Kellogg, 1080*.
Telephone companies. Bell. In Central States, 1067.
——Central Union, 117, 755, 908.
——Erie, 755.
——Farmers lines, 335.
——In Indiana. By R. D. Fisher, 1022.
——North Indiana consolidations, 77.
——Indiana independent meeting, 104.
——Indiana rural, 103.
——Inter-Ocean consolidated.
——Michigan. The, 936.
——New Jersey. Combination of, 88.
——Ohio Farmers' Association meeting, 932.
——Ohio Independent, 430.
——Pacific coast, 991.
——Pennsylvania combinations, 88.
——Philadelphia, 786.
——Pittsburg and Western Pennsylvania, 1022.
——Rocky Mountain States, 992.
——San Francisco independent, 261.
——Texas, 936.
——South. The, 991.
——Strowger. New Company. Automatic, 1040.
——Western independent, 655, 1071. 1071.
——Wisconsin independent meeting, 26.
Telephone exchanges
——Automatic, (D. R.) 902.
——Merlin, (D. R.) 266. Kroesing, (D. R.) 1078.
——Boston automatic, 928.
——British, (D. R.) 351.
——Brussels, (D.) 603.
——Faller automatic, 940*.
Telephone systems.
——Glasgow, (D. R.) 515, (D. R.) 791.
——Hotel. Chicago, (D. R.) 1078.
——Jackson, Mich. New, 830-1.
——London-Brussels line, 556.
——Manhattan railway, 605.
——Maryland Telephone and Telegraph Company. By K. B. Miller, 921*.
——Minneapolis. New, 294*.
——Munich, (D. R.) 477.
——New York. Cortlandt St., N. Y. City, 769*. By H. L. Webb, 925*.
——New York. 18th St., (D. R.) 390.
——Pan-American. By H. W. Pope, 112*.
——Private houses, 567*.
——Rochester, (D. R.) 266.
——Wheeling, W. Va., 955.
Telephone. Bell output, 483.
——Central battery system. By Tobler, (D. R.) 999.
——Cable. By Baechtold, (D.) 190*, (D.) 790, 821.
——Changing a battery system. Magneto drop to a central. By C. L. Goodrum, 547*.
——Coal mines, 163.
——Diplomacy by, 107, 453.
——Exchange notes. By Henry, (D. R.) 1078.
——Exchanges. The economic design and management of. By A. V. Abbott, 929, 982, 1020, 1062.
——In French drama. The, 984.
——Generators. Efficiency of. By Henry, (D. R.) 515.
——[illegible] By Gill, (D.) 390.
——Information bureau, 682.
——Line. Submarine, (D.) 389.
Telephone. Lines on power transmission poles, (D.) 603.
——Lines. Right to erect in New York State, 920.
——Loud speaking. By Krejsa, (D. R.) 351.
——Money orders, 834, 973, 1073.
——Nickel. In Chicago, 994.
——Oath. Legality of, 464.
——Operators. Elocutionary training for, 992.
——Patents, 597, 645, 683, 729, 784, 819, 882, 895, 944, 987, 1026, 1070.
——Plants. Depreciation of lighting and, 137.
——In railroad service. By F. P. Valentine, 22, 217.
——Rates. Long-distance, 64, 282.
——Rates. French, 938, 992.
——Receiver for wireless telegraphy. By Ruhmer, (D.) 515.
——Running trains by, 52, 88, 945.
——Seeing by, 1071.
——Service. Co-operation in perfecting public. By J. B. Baker, 372.
——System for railways. By Barbillion, (D. R.) 738.
——And telegraph service. Combined. By R. Hitchcock, 1073.
——And telegraph wires. Sag of. By Lawrence, (D. R.) 737.
——And telegraph. Possibilities of, 917.
——Test at Reading, Pa., 35.
——Trial by, 142.
——U. S. Signal Corps, 946. By T. J. Stewart, 1032.
——Voltaic arc as a, 673.
Telephony. By Wiettishbach, (D. R.) 862.
——In America, 918.
——Cost of, 363.
——In Egypt, 1083.
——In Europe. By U. N. Bethell, 171.
——Improvements in. By Pulnj, (D. R.) 230.
——Magnetoes for delivering pulsating current for selective signalling. By N. H. Holland, 327*.
——And mail service, 462.
——Meter. Chicago, 833.
——Military. New York state, 182*
——Newspaper, (D. R.) 390.
For power transmission plants. By Theberath, (D. R.) 390.
——Pupin system, 579. By M. I. Pupin, 587*.
——Regulations in France, (D. R.) 862.
——Selenium. Poliakoff patent, 299.
——In Siam. The, 592.
——Situation in independent, 325.
——Some aspects of. By H. L. Manton, 650.
——Statistical, (D. R.) 692.
——Swiss underground circuits, (D. R.) 1036.
——And telegraphy in England, 846.
——And telegraphy. Progress in Germany and, (D. R.) 560.
——Unprofitableness of cheap, 256.
——In Venezuela, 994.
Tellurium. Thermomagnetic and galvanomagnetic effects in. By Lloyd, (D. R.) 72.
Telpherage ash-handling at Elizabethport, N. J., 564*.
——In Cuba, 201.
Terminology. Alternating current, 805. By Boucherot, (D.) 902, 999. By W. H. Browne, Jr. Dr. Louis Bell, 1031.
Terrestrial magnetism. Solar activity and, 843.
Tesla patents. Sustained, 383.
——At Wardenclyffe, L. I., 509.
Test set. "All-switch" portable, 743*.
Testing dynamos and motors. Extensions of Swinburne's method. By Brunhes, (D. R.) 1033.
——Generators and motors. Direct currents. 974.
——Magnetic qualities of materials in bulk. By Drysdale, (D.) 1077*.
Thermo-couple. Cutaneous. By Lefevre, (D. R.) 110.
——Couple. Hermite and Cooper patents, 786.
——Force and electric resistance. By Harrison, (D.) 901.
Thermopiles. By Campbell, (D.) 146.
Thermostat. By Young, (D. R.) 230.
Thompson Electric Works. Motor-driven job presses, 745*.
Three Rivers Elec. Co. Elevator controller, 233.
Three-wire system. A modified. Heath patent, 185.
Thunderstorm. Hertzian waves in. By Larroque, (D.) 227.
——Indicator and recorder. By Odenbach, (D.) 998.
Time signal apparatus. By Kintner, (D. R.) 230.
Toerring o., C. J. Arc lighting at the Pan-American, 401.
Tools. Electrically heated. Ward-Leonard patent, 142.
——Motor-driven, 903*.
Top. Electric chromatropic, 865*.
Torpedoes. Dirigible, 994.
——Discharging by electricity, (D. R.) 478.
Towers. History of electrically illuminated. By Luther Stierenger, 285*.
Traction. Clutch vs. rheostat in electric, 528.
Trains. Telephone connection with, 945.
TRANSFORMER:
——For Castner works at Niagara Falls, 148*.
——Comparative weights of. By Sufehlner, (D.) 28.
——For measuring instruments. By Gallus, (D. R.) 230.
——Multiple circuit rotary. Steinmetz patent, 185.
——Reactance drop and reactance factor of. By A. E. Kennelly, 92*.
——Station. New Buffalo terminal. By Woodbury, (D.) 227.
——Three-wire, 394.
——Voltage drop in. By Bragstadr, (D.) 823*.
TRANSMISSION PLANTS:
——Bays Counties, 583*. By Dutcher, (D. R.) 602. Heitmann and Currie, (D. R.) 947.
——Big Fork, Montana. By A. E. Ransom, 467*.
——In Canada. Long-distance, 433. By J. A. Cammerer, 1031.
——Chambly. Montreal, (D. R.) 512.
——Chaudiere Falls, 833.
——Dahlonega, Georgia, 498*.
——Joliet, Ill., 1027.
——Kankakee River, 346.
——Missouri River Power Co., 53*.
——Ottawa, 833.
——Redding, Cal., 1029.
——Sao Paulo, Brazil, (D.) 513.
——Shawinigan Falls, (D. R.) 860.
——Snoqualmie Falls, 385, 429, (D. R.) 900.
——Southern California, 385.
——Springfield, Mass. United Electric Light Co. By A. D. Adams, 495*.
——Standard, Cal., 898.
——Susquehanna River. By O. P. Waters, 890*.
——Ticino, Italy. By Bignami, (D. R.) 860.
——Walla Walla, Wash., 675.
——Urft, Germany, (D.) 734.
——Western practice in long-distance, 59, 95, 138.
Transmission circuits. Surges in, 842. By A. E. Kennelly, 847.
——Discharge from high-tension, 414.
——Elements of long-distance. By Perrine, 502.
——High voltage. Study of, 50.
——Line construction, (D.) 263.
——Reducing the charging current of, 857.
——Superposed alternating and direct-current. By W. S. Horry, 995.
——Western practice in, 59, 95, 138.
Triumph Electric Co. Motors in printing office, 793.
Trolley bow. Plea for the. By E. K. Scott, (D.) 1034.
——Contacts. Overhead. Westinghouse patent, 345.
——Wire hangers. Twin type of, 567*.
——Wire protection, (D.) 653.
Tunnel. New York Central, 142, 184, 212, 245, 299. By Louis Bell, (D.) 302, 649.
——New York. Electricity for a Pennsylvania Railroad, 1025.
——Legality of the New York Rapid Transit, 103.
——Plans in New York, 2.
——Under the Narrows, New York, 26.
Turbine. De Laval steam, 693*.
——Installations in Switzerland. Modern, (D.) 824.
——For Niagara. Swiss, 272.
——Steam. For driving dynamos. By Parsons and Stoney, (D. R.) 512.
Turntables. Power for, (D.) 824.

U

Underwriters' National Electrical convention, 990.
Union Hardware Co. Handle for incandescent lamps, 234.
United Telpherage Co. Telpherage ash-handling plant at Elizabethport, N. J., 564.
U. S. Signal Corps work. Recent, 234.
United Water Elec. Mfg. Co. Selective lock-out party-line system, 952*.
Uranium. Radiation at very low temperatures. By Becquerel, (D.) 388.

V

Vacuum discharges. Energy absorbed by. By Cardani, (D.) 188.
Valves. Electrolytic. By Blondin, (D. R.) 651.
Vapor lamp. Cooper-Hewitt, 491, 503*, 993*.
——Mercury. By Lummer, (D.) 387*.
Vaults. Electrical protection of, 779.
Vector analysis. By Punga, (D. R.) 825, 948.
Vectors. Graphical combination of. By Emde, (D.) 602.
Velocity Ratio. By Abraham, (D.) 654.
Viscosity. Magnetism and. By Gray, (D.) 736.
Voltage calibration. By B. C. Washington, Jr., 143.
——Regulation. High-tension mains, (D.) 514.
Voltmeter. Atkinson, (D.) 73.
——Column type, (D. R.) 389.
——Hot-wire. By Soulier, (D.) 902*.
——Means of measurement of the angle of lag and the power factor with a. By G. T. Hanchett, 718*.
——Simple method of calibrating a. By Brown, (D. R.) 1035.
Voltameter balance. By Pfanhauser, (D. R.) 862.
——For small currents. By Lehfeldt, (D.) 950.
——Copper. By Shepard, (D.) 73.
——Silver. By Skinner, (D.) 691.
——Silver, and electro-chemical equivalent of silver and copper. By Richards, Collins and Heimrod, (D.) 229.
Voting machine. Electric, 352.
Vulcanized fiber consolidation, 1002
Wagner Elec. & Mfg. Co. Pan-American exhibit, 234.
——Transformers for Niagara Falls, 148.

W

Warships. Electricity on British, 104.
Water heater. Follett electric, 563*.
Water power development in Bosnia. By J. B. C. Kershaw, (D. R.) 600.

Water Power Development. Long Sault, Can. [illegible] 104.
——Minnesota, 856.
——Italian, Paderno. By Bignami, (D. R.) 264.
——Orwell, N. Y., 856.
——St. Joseph River, Ind., 1072.
——Sault Ste. Marie, New, 261.
——Sweden. By Arrhenius, (D.) 71.
——Wisconsin, 296.
Water. Purification of by ozone. By Erlwein, (D.) 998.
——Purifier. Electrolytic. Lemp and Koedding patent, 67.
Waterwheels. Governing under abnormal conditions. By G. U. G. Holman, 643*.
——Governing mechanism. Lincoln & Stillwell patent, 732.
WATTMETER:
——Alternating-current. Peloux patent, 345.
——Alternating-current. Schrottke patent, 1072.
——Barker and Ewing, Bell, Fish, Pratt, Cox and Holmes patents, 223.
——Brake. Saldana patent, 432.
——Davis patent, 106.
——Halsey direct-current, 231*, 563*.
——Hootham, (D.) 992.
——Hot wire. By E. H., (D.) 654*.
——Induction. By Schrottke, (D.) 559*.
——Kennedy-Kennedy patent, 1029.
——Losses. Distribution and, 1013.
——Prepayment. By Bainville, (D. R.), 691.
——Raschke, (D. R.) 691.
——Reading, 433.
——Repairs, 433.
——Testing. By Smith, (D. R.) 73.
——Variable tariff. By Goisot, (D. R.) 389.
Wave motors. By Walsh, (D. R.) 474.
Waves. Electric. By Abraham, (D. R.) 901.
——Absorption of, by resonators. By Aschkinass and Schaefer, (D. R.) 146.
——Influence of, on chemical action. By Lengfeld and Ransom, (D. R.) 901.
——Interference and polarization of. By Quincke, (D.) 789.
——Oscillations and. By J. A. Fleming, (D. R.) 388.
——In thunderstorms. By Larrogne, (D.) 227.
[illegible] Transmission [illegible] By [illegible] man, (D.) 559.
Welding rail. Alumino thermic process of. By Archdeacon, (D.) 653.
West Elec. Co. telephone station, 398.
Western Union finances, 483.
Westinghouse Elec. & Mfg. Co. Apparatus for Japan, 396.
——Exhibit at Pan-American, 193.
——Motor-driven tools, 903*.
——Thirty-ton motor-driven armature press, 754*.
Westinghouse Traction Company, English, 1082.
Wheatstone bridge resistance cut-out. Varley patent, 67.
Willyoung, Elmer G. "All switch" portable test set, 743*.
——Electrical test instruments, 440.
Wind turbines. For generating electrical energy. By Corz, (D. R.) 735.
Windmill lighting plant on the "Discovery," 255*.
Wire cleaner. Automatic. Used in Brooklyn, (D.) 1034.
WIRELESS TELEGRAPHY:
By Kimbrough, (D.) 230. Slaby, (D.) 428*. Ruhmer, (D. R.) 477. Blondlin, (D.) 515. Johnson, (D. R.) 738. Dell, 786. Turpain, (D. R.) 738, 902.
——Balloon, 878.
——Braun system, (D.) 74.
——De Forest, Smythe & Freeman system, (D.) 266.
——Experiments between Brussels, Malines and Antwerp. By Emile Guarini, 168*.
——Popp-Pilowski system, 68.
——Telephone receiver for. By Ruhmer, (D.) 515.
——Tesla patents, 822.
——Station, 262.
——Slably multiplier. By Blondel, (D.) 439. Seibt, (D. R.) 305.
——Syntonic. By A. F. Collins, 773*.
——Africa, 141.
——Atlantic liners, 183, 598.
——British navy, (D. R.) 1035.
——Canada, 385.
[illegible]
——Colonies, 66.
——Italy, (D.) 1035.
——Lake[illegible], 299.
——Lakes, 69, 299.
——For lightships, 820.
——Lloyd's marine, 785.
——Marine, 598, 806, (D.) 827.
——Marconi trans-Atlantic, 1023*, 1069.
——Wires, luminous effects on. By [illegible]
——Mechanical vibration of. By A. G. Dell, (D.) 825.
——Standard rubber insulation, (D. R.), 188.
——Trolley. Dangerous [illegible], and their prevention, (D.) 513.
Wiring accessories. By Boenninghofen, (D. R.) 437.
——Interior, (D. R.) 1034.
——Rules. By Wordingham, (D.) 900.
Wood. Drying by electricity in Austria, 556.
——Fibre. Disintegration of, by alternating currents, 591.
——Fittings. By Johnson, (D. R.) 388.

Y

Yale. Recognition by [illegible], 729*.

Z

Zimdars & Hunt. Quick-break switch, 439.
Zinc-Aluminum. Commercial alloys. By J. W. Richards, (D.) 73, (D.) 189.
——In bodies. Use of. By Douglass, (D. R.) 1075.
Zeeman effect. By Kent, (D. R.) 349.

AUTHOR INDEX

Abbott, Arthur V. The economic design and management of telephone exchanges, 929, 982, 1020, 1063.
Abrahams, Louis J. Money order telephoning, 1073.
Adams, Alton D. Changes in arc lighting, 888.
——Electrical incomes and outputs per ton of coal, 814.
——Electrical supply in Bangor, Me., 291.
——Gas versus electricity, 676*.
——Massachusetts. Long electric railway in, 326*.
——Rise of electric power distribution, 916.
——Water powers of the Springfield, Mass., United Electric Light Company, 495*.
Adler, Alphonse A. Shaft oscillation, 557.
Alexander, J. Some elementary requirements in trade export, 734.

Badger, J. S. Direction of street car travel, 1072.
Baker, Joseph B. Public co-operation in perfecting telephone service, 382.
Behrend, B. A. Debt of electrical engineering to C. E. L. Brown, with portrait), 809*, 845, 932.
——Heating of rotary converter armatures, 346.
Bell, Louis. Alternating current terminology, 1031.
——Dr. Louis. Elements of illumination, 98, 221, 295, 463, 641, 721, 850.
Brandeis, Charles. Direct-current engineering practice in Germany, 11*.
Brown, A. B. High speeds, 996.
Browne, Wm. Hand, Jr. Alternating current terminology, 1031.

Calahan, Edward A. Slight use of automatic or machine telegraphy, 133.
Carter, F. W. Air-gap induction, 884*.
Clinton, D. B. Elevating presidents and kings, 434.
Collins, A Frederic-Coherers. The development, construction, operation and function of electric wave detectors, 251*.
——Wireless telegraphy. Syntonic, 773*.
Cook, G. W. Humming in church, 346.
Cremer, James M. Nash gas engine, The, 740*.
Cunningham, R. H. Interrupter for Röntgen ray induction coils. Simple and efficient mercury jet, 688*.

Darbie, Myron A. Moblodge, 301.
Darley, J. W., Jr. Pressure of radiation, 1073.
Delany, Patrick B. Rapid telegraphy, 291.
Dell, Alfred G. Mechanical vibration of wires, 186.
——Wireless telegraphy, 786.

Emmet, W. L. R. Distribution of the three-phase system and the operation of single-phase circuits by it, 985*.

Fessenden, R. A. Phosphorus in incandescent lamps, 473.
Fischer-Hinnen, J. Alternators with dampers, 1058*.
——Self-starting single-phase motors without brushes, 225.
Fisher, R. D. Development of the Indiana telephone field, 1022.
Fitch, Chas. L. How insects put out the lights of St. Paul, 222*.
Fleischmann, Dr. Lionel. Industrial and electrical situation in Germany, 21.

Gehring, G. P. Wireless telegraph reports of yacht races, 686.
Goodrum, Chas. L. Changing a magneto drop to a central battery system, 547*.
Grieve, A. Combination dynamo fields, 27.
Guarini, Emile. Wireless telegraph experiments between Brussels, Malines and Antwerp, 168*.
Gutmann, L. Self-starting single-phase motors without brushes, 107*.

Hanchett, George T. Combination dynamo fields, 107.
——Means of measurement of the angle of lag and the power factor with a voltmeter. A, 718*.
Hart, Edward J. Development of trolley networks in Michigan, 812*.
Havill, O. A., S. S., Neu and O. A. Havill. Heating of magnet coils, 56.
Heitmann, Edward. Inductor alternator, The, 548, 594, 636*.
Hines, C. H. Power distribution in steel works, 346.
Hitchcock, Romyn. Combined telegraph and telephone service, 1073.
——Telegraph systems, operating speeds and economies, 816.
Holland, Norman H. Telephone magnetoes for delivering pulsating current for selective signaling, 327*.
Horry, Wm. Smith. Superposed alternating and direct-current transmission, 995.

Johnson, Woolsey, McA. Edison nickel-iron cell. Theory of the, 733.
Josse, Emil, Josse waste heat engine, 733.

Kammerer, J. A. Long-distance transmission in Canada, 1031.
Kennelly, A. E. Reactance drop and reactance factor of transformers, The, 92*.
——Transmission circuits, surges in, 847.
Knott, Henderson W. Electrical industry, the English, 822.

Lannan, W. M. Signal corps telephone apparatus, 946.

Lasche, O. High-speed electric railway car of the Allgemeine Elektricitats Gesellschaft, 424*, 457.
Lewis, C. M. Washington monument. Electric elevator in the, 176*.
Levine, A. J., S. S. Neu and O. A. Havill. Heating of magnet coils, 56.
Loewenthal, Max. Lighting and railway development on Staten Island, 1053*.
Lyndon, Lamar. Storage battery auxiliaries, 13, 64*.

Malcolmson, Chas. T. Electricity at the Charleston Exposition, 977*.
Manton, H. L. Aspects of telephony, some, 650.
Marsh, Albert L. Alkaline nickel-oxide cell, 136.
——J. W. American manufacture of Pacific cable, 946.
McAllister, A. S. Measurement of the angle of lag of three-phase circuits with one wattmeter, 849*.
Miller, Kempster B. Maryland Telephone and Telegraph Company. The telephone exchange system of the, 921*.

Neu, S. S.-Levine, A. J. and Havill, O. A. Heating of magnet coils, 56*.
Noll, Lucius K. Popular science and corpuscles, 262.
Norden, Dr. K. Theory of the electrolytic rectifier, 681.

Patterson, Ralph J. Compound engine controller, 562*.
Phillips, Frederick Carrington. Electric automobile tests in Cleveland and Chicago, 391*.
Pieper, Henri. A 10,000 volt shock, 1073.
Pope, H. W. Pan-American telephone exchange, The, 112*.
Probasco, W. M. Westinghouse industries in the Pan-American Exposition, 193*.
Pupin, M. I. A note on loaded conductors, 587*.

Ransom, A. E. Plant of Big Fork, Montana, Electric Power and Light Company, 467*.
Reed, C. J. Mechanical equivalent of light, The, 170.
Reichel, Walter. Yossen polyphase railway installation for experimental trials with speed up to 125 miles an hour, 367, 556*, 589, 644, 678, 719.
Reid, Thorburn. Steam engine delivery guarantees, 69.
Rice, E. W., Jr. Control of high-potential systems of large power, 374*.
Roeber, E. F. Theory of the nickel-iron cell, 931.
——Edison nickel-iron cell, 598.
Roney, Wm. R. Tests of mechanical stokers at the General Electric Company's works at Schenectady, 1079.
Rustin, Henry. Pan-American electrical hazard, 385.

Schaft, L. F. Bremer arc lamp, 512.
Scott, E. Kilburn. Cable works of the Allgemeine Electricitats Gesellschaft, 390.
——Nernst lamp in Germany, The, 294.
——Note on English methods, A, 381.
——Some details of German electrical generating station practice, 323*.
Shaw, A. C. Electrical engineering in England, 898.
Shepard, Francis H. Operating features of the Boston elevated, 213*.
Shuchardt, R. F. Storage batteries in central stations, 254*.
Smith, J. A. Edison convention at Buffalo, The, 69.
Smith, Wm. Lincoln. Stray power method of testing direct-current motors and generators, The, 981.
St. Martin, H. Properties of collector rings, 1073.
Stevens, J. Franklin. Calibration of switchboard instruments, 107.
Stevenson, E. W. Mileage of ocean cables, 996.
Stewart, Thomas J. U. S. Signal Corps telephones, 1032.
Stieringer, Luther. A brief history of luminous fountain development, 417*.
——Christmas tree to Pan-American, From, 285*.
——Ground lighting at the Pan-American and prior expositions, 89*.
——Lighting at Omaha and the Pan-American, 686.
Stillwell, L. B. Switchboard simplicity, 858.

Thornton, K. B. Notes on the construction and production of aerial transmission and distribution systems, 61*.
Townsend, Clinton Paul. Improvement in the metallurgy of aluminum, 14.

Varley, T. W. A true ground detector, 54*.
Vail, J. H. Electrical plant of a Philadelphia newspaper, 129*.

Wall, L. J. B. Modified three-wire system, 898.
Waltman, George H. Electric rock drills, 267*.
Washington, B. C., Jr. "Wanted, a volt," 145.
Waters, O. P. Power transmission on the Susquehanna, 890*.
Webb, Herbert Laws. Recent common battery telephone exchange works in New York City, 925*.
Weeks, Arthur B. Re-winding of a 5,000 H. P. armature, The, 719*.
——Shaft oscillator, 517*.
Woodbridge, J. E. Polyphase apparatus. Influence of, on the design of railway power stations, 532*, 692, 638.
Wright, Arthur. Central station tariff system, 60*.
Wurts, Alexander Jay. Nernst lamp in America. Development of the, 328*.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, JULY 6, 1901. No. 1.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - 6.00
Single Copies, - .10
In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JULY 6, 1901.

CONTENTS.

	PAGE
Editorial	1
Moves in the Independent Telephone Field	4
Electrical Engineers of the Day—I: B. A. Behrend	4
Tyneside Electrical Distribution Power Plant	5
Direct Current Engineering Practice in Germany, by Charles Brandeis	11
Storage Battery Auxiliaries—V, by Lamar Lyndon	13
Improvement in the Metallurgy of Aluminum, by Clinton Paul Townsend	14
The Nernst Glower Applied to Electric Furnaces	15
Convention of the Northwestern Electrical Association	16
The Efficiency Curves of a Shunt Motor and its Relations to Operating Characteristics and the Cost of Operation	17
Incandescent Lamp Economy	19
The Industrial and Electrical Situation in Germany, by Dr. Lionel Fleischmann	21
Conversion from Alternating Constant Potential to Constant Alternating Current	21
The Telephone in Railroad Service	22
The Edison Storage Battery	24
Interurban Trolley Roads in Indiana	26
Data on New York Conduit System	26
Wisconsin Independent Telephone Meeting	26
Current News and Notes	27
LETTER TO THE EDITORS:	
Combination Dynamo Fields, by A. Grieve	27
Digest of Current Electrical Literature	28
New Book	32
Some Electrical Features at the Glasgow Exhibition	32
Battery Fan Motor Outfit	35
A New Electric "Tonneau"	35
A Telephone Test at Reading, Pa	35
Desk Telephone	36
Ferranti Iron-Type Alternator	36
A New Testing Set	37
Northwestern Convention Notes	37
Remote Control Switches	38
NEWS OF THE WEEK	39
INDEX TO VOLUME 37.	

BIOGRAPHICAL SKETCHES OF ELECTRICAL ENGINEERS.

In the earlier days of electrical engineering it was the custom of the journals consolidated as the ELECTRICAL WORLD AND ENGINEER to print from time to time biographical sketches of the leading electrical engineers of the day. When this practice was discontinued some years ago the ground had been fairly well covered, but since then an entirely new generation of engineers has come to the front. With this issue we commence the publication of a similar series of sketches, having as subjects the engineers now occupying leading positions in the profession, and which, besides the younger men, will naturally include many whose names were prominent when the sketches above referred to were discontinued. One of the criteria that will be applied in the selection of names is that the subject shall be a full member of the American Institute of Electrical Engineers, or qualified for full membership under the provisons of the new constitution of the Institute.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The Northwestern Electrical Association summer convention held last week at Sheboygan, Wis., while not a failure as to the quality of the papers presented, was generally admitted by those present far from a success as to attendance. When an association of the size and importance of the Northwestern can hold a convention at the sessions of which less than a half dozen central station men are in attendance, surrounded by a score of supply men, it is certainly time for some one to diagnose the case. The trouble is not one that need seriously alarm those who have the interests of the Northwestern Association at heart, for it has demonstrated its usefulness and importance to its members too thoroughly to receive a permanent setback by the Sheboygan fiasco.

There are lessons to be learned from the latter, however. The winter conventions of the association have always been fairly well attended by central station men and fill a place taken by no other convention. The long and short of the matter seems to be that the association's conventions and the summer junket in particular have been bolstered up by the supply men's contingent to a point where it is practically a case of the tail wagging the dog. Any association of this kind must depend for its real success on the attendance and active interest of the central station operators. A party of supply men alone at a convention may have a very jolly time among themselves, but it is the central station element that attracts them to conventions, and if this element is lacking nothing remains to hold the convention together. The supply element has always been very active in the Northwestern Association; in fact, it has been too active. The result has been an unnatural and forced growth, the holding of conventions not justified by the interest and attendance of the central station element, and as a culmination the affair of last week. The Northwestern Association will probably confine itself to one meeting a year hereafter.

The history of Northwestern conventions has demonstrated two points. One is that the real success of the organization deepnds on the activity of the central station men, and that it is better for all concerned for the supply men to keep hands off as far as possible, attending the conventions only as visitors and omitting the elaborate

organized attempts at entertainment that have marked some of the past meetings. The central station men are more likely to take interest if they are running their own affairs than if the supply men are running things for them. The other point clearly demonstrated is that when the central station men of the Northwestern Electrical Association travel miles to a convention they mean business, and want to talk business, and that this is naturally a greater attraction than various forms of entertainment and diversion which may or may not be to their tastes and the equivalent of which they do not need to travel miles to a convention to secure. A convention once a year at some central point with an opportunity for the exhibition of some of the newer apparatus and a programme full of practical subjects will attract the central station men in the Northwestern's territory as nothing else can do, and will result in the building up of an organization from which no Western central station man can afford to absent himself.

TUNNEL PLANS AND OPERATION.

The steady advance of work on the New York Subway is investing with new interest and enthusiasm a number of plans of connecting New York City, or Manhattan Island, with the outside world by means of tunnels. There are definite plans afoot for tunnels under the Hudson, under the East River and under the Narrows, and some of them will certainly be carried out in the next few years. In each case the motive power is electricity, it being recognized now that no other power should or could be considered in connection with such work.

This universal admission of the feasibility of electric traction in tunnels has led during the recent painfully hot weather to many public expressions of wonder at the dilatoriness of the New York Central Railroad in adopting electricity as the motive power in the long, stifling tunnel by which it reaches the heart of New York City. The passage of the tunnel at this season of the year is not a pleasant experience, and consequently there are many complaints, although, rather curiously, nothing is heard about the equally unpleasant tunnels in Jersey, the inference being that people who put up with the average ferryboat and its perils will put up with anything. It is encouraging to note that the Central is said to have plans for electric traction seriously under study for adoption. The company has of late been spending huge sums on its system, from the new marble depot to the solid sunken tracks, so that questions of expenditure will evidently not be allowed to stand in the way of making travel more comfortable and secure. The only doubt can be that of a technical nature, but assuredly the accumulating evidence is now sufficient to prove to the Central management that they can drop their steam locomotives at Motthaven and come over the bridge, through the city tunnels, employing electric locomotives, with ease, success and economy. The change should, indeed, be be made at once, and the plea abandoned that it is awaiting the development of a satisfactory motor—a "reason" besides worn bare by "Uncle" Russell Sage in the service of the Manhattan.

THE CITY NEWS OFFICE.

The present age is certainly distinguished by the novelty of many of its agencies for giving public service, and those which relate to the dissemination of news have seen some very successful experimentation, nearly all depending upon the use of electricity; in fact, the wonder is that the sensational newspaper has grown up alongside the means which are most destructive of sensation and lying. With the prompt availability of the submarine cable, the telegraph land lines, the telephone, the wireless telegraph, the signaling by electric light, etc., it would seem that no wild rumor or bald inaccuracy could live many minutes or go far uncontradicted; and the fact that the rumor trade is still a fairly brisk one shows that these electrical resources are not yet utilized to their full. Of course, there will always be the rumors due to the refusal of some men to talk at all, or to the readiness of some unscrupulous folk to set stories going for the sake of the effect; but even here again electricity, with its swift transmission of intelligence, should be able to do its work of making known the real truth with instantaneity.

A curious recognition of the value of the telephone in news service has just come under our notice in some letters to the press of Mr. Franklin Ford, who seems to be preaching the doctrine that there should be a clearing house for news, and who proposes to organize some such service, in which the data of municipal work, or of various public services; the data compiled by the daily newspapers, the special items of the technical and trade press, the general information secured by exchanges, societies, etc., should all be correlated, exchanged, sifted and finally verified, so that a real fact once stamped could circulate like a certified check or a dollar bill. Here is an ingenious scheme, difficult possibly, but with underlying elements of practicability and value. But what strikes us specially is Mr. Ford's insistence on the point that with the telephone "or instantaneous communication," there should no longer be life for lies or a lingering chance for rumor in regard to any moot point in business, commercial or social life. It is of a verity one of the most extraordinary things to see men daily repeat and marvel over some rumor affecting them seriously, when by stepping to the nearest telephone they could prove or disprove it forever in four and two-tenths seconds. With many men in discussing rumors, settling the truth promptly thus, as enabled to do by telephone or telegraph is about the last thing they desire or venture.

RECIPROCITY.

The late James G. Blaine was a whole-souled protectionist, yet he was a warm advocate of reciprocity, and it has been interesting to observe how our trade ideas have slowly been approximating a logical reciprocal basis. In the case of the recent dispute with Russia, there has been absolutely no "high protection" talk in any quarter, but an evident desire to meet our old friend and ally on some reasonable footing, if it be possible. We are told from Europe that the Russian episode is but symptomatic and indicates a resolve that is quite general to crowd out the American goods that have of late been in so great demand, and that a movement has already in some vague form been started. When one considers how varied are the necessities of Europe, it is hard to believe that a common platform of active opposition to American goods could be found or has been attempted.

A Dr. Von Peez, in Germany, has been attributing to the United States a sort of cool, calculating malice in its laudable efforts to extend trade and one of his articles, freely reprinted, says: "A people so young, acute and rich in future possibilities as the citizens of the Union will find boundaries to their aspiration only when they see that attempts at further conquest will be met by vigorous resistance." So far as we can see, this utterly misrepresents the country in its policy, and our manufacturers in their sentiments, besides being all wrong on theories of trade. It is true everybody uses the phrase of "conquering new markets," but no one is compelled to buy from the conqueror. There is no need for resistance. It is purely a matter of the exercise of free will on the part of the purchaser, who buys only because he wants the article and only because the price suits him. In respect to protective policy, the United States has not stood alone, and England is the only country in Europe that can pertinently criticise her on that score. At any rate, it is only asserting

the truth to say that this country believes in the development of reciprocal trade, and is trying all the time for more of it; the expansion of our industries and agriculture being distinctly, moreover, for the welfare of the world. The fact that we have sold fifteen hundred million dollars of product the last year shows that people are eager for our goods, and do not require to have them choked down their throats with a mailed hand, as the Herr Doctor would intimate.

Conversion from Constant Alternating e. m. f. to Constant Alternating Current.

The paper read by Professor Owens at the recent Canadian Electrical Convention, an abstract of which appears elsewhere in this issue, contains an instructive illustration of a very pretty principle, which previously had been quite fully developed by Boucherot. If we have a constant alternating e. m. f. and desire to obtain a constant-alternating current from it through a circuit of varying resistance, we choose a condenser of sufficient capacity to take that current strength steadily under the alternating e. m. f., and two equal reactances each equal to the condensance of this adjusted condenser. These two reactances are then placed in series with the varying resistance and the condenser is applied as a shunt to the varying resistance and one reactance. Under these circumstances the current through the resistance will theoretically be maintained constant no matter how the resistance may vary. The limitations are set, of course, by the resistances in the reactances which disturb the regulation.

For series arc-light circuits requiring constant-alternating currents the plan is unsuitable when the constant pressure is adapted to low-pressure supply, as in incandescent lighting, since the condenser and reactances have to be unduly large. When the constant available source of pressure is, however, fairly high, this objection dwindles and the plan would seem suitable for practical trial. The storage system by which the energy is transformed from one pressure to another has an efficiency practically the same as that of the alternating-current transformer.

It would seem that arc lamps are devices specially adapted to constant current service, while incandescent lamps are devices specially adapted to constant pressures. It is true that incandescent lamps can be operated at constant current, and arc lamps at constant pressure, but the latter arrangements always suggest misfits. On the other hand, it is sometimes very awkward to supply a constant-current system from a large station arranged for constant pressure delivery, and the small constant-current service often exacts an unduly large share of floor-space, power and attention. Consequently all methods for securing constant-current transformation are well worthy of examination and development.

Concentration Changes in Storage Battery Solutions.

We published on page 1105 of last week's issue, an interesting paper by Dr. Roeber on the application of Hittorf's theory of ionic velocities to the phenomena appearing in the new Edison storage cell. It is there shown that although the density of the solution as a whole remains unchanged during charge and discharge, yet that differences in concentration tend to form in the electrolyte at the electrode surfaces and that such differences are at least partly due to differences in ionic velocity. While the deductions from Hittorf's theory are correctly stated, yet the corroboration of that theory by observations of the phenomena in the new Edison cell is rendered very difficult, partly by reason of the fact that the thickness of solution layer is reduced to a mere film in which diffusion and convection rapidly undo the work of ionic concentration, and partly because superficial concentration differences would necessarily occur by the electro-chemical combinations formed, even if the ions did not move past one another. In other words, concentration differences at the surfaces of the electrodes would occur even if no ionic migration took place, since the liberation of potassium at the nickel surface tends to form more potash at that surface, while the liberation of hydroxyl at the iron surface tends to decompose potash at that surface, the combined action being a tendency to increase the concentration at the nickel and diminish it at the iron.

The reliability of Hittorf's theory is, however, already established upon general electrolytic experience, and is readily rendered apparent in thick layers of electrolyte not subjected to the formation of secondary electro-chemical compounds at the electrodes. It would seem, for example, that the concentration differences that manifest themselves round copper electrodes in copper sulphate solution; or those which occur around zinc electrodes in zinc sulphate solution, can only be accounted for on Hittorf's hypothesis of a difference between the speed at which the anions and cations run past one another, and the deductions from that theory have not only led to fresh discoveries, but are also supplemented by a number of chemical supporting theories. In the case of the lead storage cell difference of concentration at the electrodes due to differences in speed of ionic migration are completely masked by the changes in concentration due to the absorption of hydric sulphate from the solution owing to electro-chemical decomposition. The change in density of the electrolyte, as a whole, makes it difficult to determine variations of density in different parts. Moreover, the variations of density due to electro-chemical decomposition and combination are large by comparison with the changes due to migration.

The great point of simplicty in the operation of the new Edison cell is, therefore, that while variations of concentration tend to occur at the electrode surfaces during charge and discharge, yet owing to the thinness of the solution layer these variations can readily cancel and annul each other by diffusion, leaving the solution, as a whole, in a constant condition with respect to mass, volume, density and chemical composition. The only ultimate changes in fact which transpire during the cyclic operation of the cell are changes in the oxygen contents of the active substances on the electrodes. This simplicity is not attained in other storage batteries and is not approached in any voltaic cell, since in all cases the solution is chemically altered by the action and discharge of the cell.

It is this simplicity of ultimate action which makes the Edison storage cell a special type of voltaic apparatus, and which also supports the hope of our reaching a chemically regenerative cell of this type, the transfer of oxygen in charging being then effected by some purely thermo-chemical process. The efficiency of this imaginary process of furnace charging would not be subject to the thermodynamic temperature limitations of heat engines, could probably be brought to a relatively high value, and might enable electrical energy to be obtained from coal. As regards the changes in the e. m. f. which make their appearance in the Edison cell at a certain stage of discharge, it seems likely that such change is associated with a change in the chemical conditions of the active materials, rather than with changes in concentration density of the electrolyte.

Moves in the Independent Telephone Field.

Several moves of great importance to the independent telephone movement were made last week by Cleveland people, thus greatly strengthening the position which the Forest City has long held as the center of the independent interests of America. Not the least of these changes was the announcement made by Judge Thomas, president of the Independent Association of the United States and general manager of the United States Telephone Company, that he had decided to accept the offer of the presidency of the Telephone, Telegraph & Cable Company of America, which is building independent exchanges in New York and Boston, with numerous through toll lines in New York and New England. It is said that when the Eastern position was offered him he demanded the assurance that the opposition would be fought from beginning to end, and that under no consideration should there be a sale to or a consolidation with the Bell interests. The directors of the New York company were somewhat slow in making answer to Judge Thomas' ultimatum, evidently fearing possible contingencies, but they finally agreed to the terms and last Friday Judge Thomas announced that he would accept the position. During the present week he will spend two days in Kansas City looking after the interests of the new independent company there, and about the middle of the month will take up his duties in New York. It is probable that Judge Thomas will be succeeded by Mr. Maxime Reber, at present consulting engineer for the properties of the Federal Telephone Company.

Almost coincident with Judge Thomas' announcement, and it is thought, in a measure, dependent upon it, came the announcement that Cleveland people had incorporated two companies for the purpose of systematically building up the independent movement in New York State. During the past two years the Century Telephone Construction Company, of Cleveland, has been securing franchises and building up exchanges in central New York State along the lines of the New York Central and Pennsylvania Railways. These exchanges now cover eighteen of the more important towns in the Empire State, and the new movement is for the purpose of connecting these and other towns with long-distance wires, as well as building exchanges in points not now reached. The campaign is to be conducted on the same plan as has been successfully carried on in Ohio under the leadership of the Everett-Moore syndicate with the assistance of Judge Thomas. The New York long-distance company has been incorporated as the Inter-Ocean Telephone & Telegraph Company, articles having been filed in Albany, N. Y., June 28. The capital stock is $2,000,000, divided into shares of $100 each. The controlling company, which will have for its aims the promotion of new exchanges, occupying the same position in New York that the Federal Telephone Company does in Ohio, will be known as the Consolidated Telephone & Telegraph Company. Its capitalization will be $10,000,000, and the incorporation papers have been taken out in Dover, Del.

The personnel of the new companies and character of the enterprises indicate that New York State and perhaps the whole of New England is to be systematically covered with exchanges, farmers' lines and long-distance toll lines as has been done during the past two years in Ohio and Indiana. In fact, it seems quite probable that the movement will be built up more thoroughly and that better service will be given than is now in vogue in these States. In Ohio and Indiana, many of the more important exchanges and nearly all of the smaller ones have been built up by local people with limited capital. The advantages of their position has not necessitated, until very recently, the best of service and equipment, while the numerous interests, in some cases antagonistic, has made a uniformity of rates and service almost an impossibility. It is the intention as soon as possible to connect the New York long-distance wires with those in Ohio and Indiana as well as with lines being built through the New England States.

Electrical Engineers of the Day—I.

B. A. BEHREND.

Bernhard Arthur Behrend was born in Pomerania, Germany, May 8, 1872. He received his early education from a tutor, at Varzin, Pomerania, where his parents lived remote from the nearest city with a good school, the railroad facilities at that time being very poor. The son of a man whose rare engineering and organizing abilities had won him the confidence of Prince Bismarck, with whom he had been associated for over thirty years in developing the industry of that part of Germany, his father's influence did more than the teaching of his tutors to stimulate the boy's intellect.

Mr. Behrend attended at Berlin the Polytechnical Institute and the University, studying natural philosophy and engineering under Helmholtz, Kundt, Slaby, Riedler, and a short time under Mr. Kapp, to whose influence it was mainly due that he devoted himself to electrical engineering. In spite of a strong bent of mind toward pure science, determined, perhaps, by a keen taste for the artistic side of engineering as so well illustrated by the graceful forms and lines characteristic of the constructions and designs of very able engineers, he joined, after having been for some time Mr. Kapp's assistant, the Oerlikon Company, and soon became assistant chief-electrician.

Very few men in the early nineties had clearly grasped the principles underlying the design of electrical machinery, especially for alternating currents. Assisted by the great amount of experimental material that had been and was being gained by the Oerlikon Works, and stimulated to no small degree by what he saw of the constructions of the ingenious designers, C. E. L. and Sidney Brown, Mr. Behrend was led to work out the theoretical basis of alternating current designs. He contributed to the theory of the induction motor, being the first to give a simple proof and to explain

the application of the circle diagram, now so generally used in Europe for the calculation and testing of these motors. Mr. Heyland had developed this diagram before, but in a rather abstruse and unattractive graphical manner. Prof. André Blondel took up the diagram in France after Mr. Behrend's publication, and his high authority in its advocacy was a potent factor in extending its employment.

Seeing the paramount importance of a simple determination of the drop in alternators working on an inductive load, Mr. Behrend began an elaborate experimental investigation to put to test Dr. Behn-Eschenburg's method of determining the drop in alternators. The results of this work are laid down in articles published in the German *Elektrotechnische Zeitschrift*, in *L'Eclairage Electrique*, and more recently in the ELECTRICAL WORLD AND ENGINEER.

In 1898 Mr. Behrend left the Oerlikon Works, having suffered for some time from poor health, and went to America to live with his parents, his father having become engaged in industrial undertakings in Pennsylvania. Here Mr. Behrend devoted himself to consulting engineering, to working out experimental work of former years, and to lecturing on scientific and engineering problems, having been in 1899 non-resident lecturer at the University of Wisconsin. In 1900 he was engaged by the Bullock Electric Manufacturing Company as chief engineer of its new alternating current department.

Mr. Behrend is a member of the Institute of Civil Engineers and of the Institution of Electrical Engineers, Germany; of the Institution of Electrical Engineers, Switzerland, of the American Institute of Electrical Engineers, and of the American Association for the Advancement of Science. He is the author of a treatise on the "Induction Motor."

Tyneside Electrical Power Distribution Plant.

LORD KELVIN on June 18 inaugurated the first extensive British plant for the distribution of power for manufacturing purposes, situated at Wallsend-on-Tyne, Scotland. At present the station is equipped with three 1400-hp generating units, but in his address Lord Kelvin said that this is to be regarded as only a small part of what is going to be done. What is contemplated by the Newcastle Electric Supply Company, he said, is to supply large consumers with three-phase currents for operating induction motors, and small consumers with direct current for motors and lighting. When the present plant becomes loaded another will be built on the riverside near by.

The generation is three-phase at 5500 volts, with a periodicity of 40 cycles, transmitting at this pressure and either stepping down by static transformers to 440 volts or feeding a direct-current three-wire network by means of synchronous motor generators, the motors of which work at the full pressure of 5500. The periodicity of 40 periods and the secondary voltage of 440 were settled by the fact that these worked in with both Continental and American standards, so that all classes were of apparatus obtainable at reasonable cost. The synchronous motor-generators are located in sub-stations where the direct-current feeders radiate to the three-wire distribution networks.

The ultimate equipment of plant in the present power station will consist of eight Babcock & Wilcox boilers; two 300-hp Bellis engines, each driving two 100-kw, 240-volt, direct-current generators; one 75-hp Bellis engine, driving a 50-kw, 240-volt, direct-current generator; four 1400-hp, triple expansion engines, each driving one 700-kw, 5500-volt, three-phase alternator; one 1500-kw, Parsons turbo-alternator, 5500 volts, three-phase; one 150-kw, 5500 to 240 volts, three-phase, direct-current synchronous motor generator.

ENGINES.

To drive the direct-current exciting and local power circuit generators, of which there is about 450 kw installed, three Bellis sets are [illegible] compound two-crank, two-cylinder type, the largest sets running at 380 r. p. m., while the 75 hp set runs at 500 r. p. m. They exhaust through two grease separators into a Wheeler surface condenser placed in the engine room basement, an automatic atmosphere valve allowing them to exhaust into the atmosphere should occasion require.

The engines driving the 700-kw sets are all of Tyneside manufacture, of the triple-expansion vertical inverted type, i. e., practically marine engines fitted with governor and modified valve gear. The first of these was constructed by the Wallsend Slipway & Engineering Company, and the other three by Wigham Richardson & Company. The former are steam-jacketted throughout, and fitted with Corliss valves, all positively driven, except the steam valves on the high-pressure cylinder, which are trip valves closed by dash pots and controlled by a chain-driven governor of the Proell type. The normal speed of the engine is 100 r. p. m. and an Aspinall's governor mounted in the rocking air pump lever shuts off steam when the speed rises above 115.

The air pump is driven by a rocking lever off the high-pressure crosshead while the centrifugal circulating pump is placed in the basement underneath and driven by a continuous current motor.

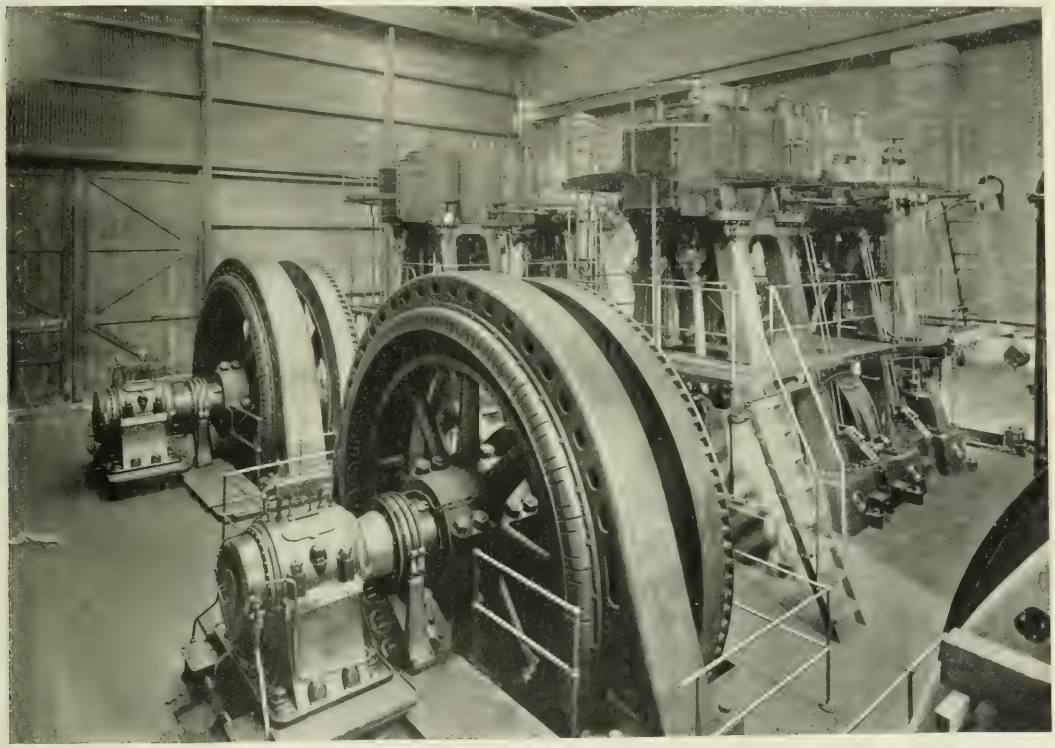


Fig. 1.—Two 1400-hp Generating Sets.

The surface condenser is supported on the back framing of the engine columns, an automatic valve being provided so that in the event of the circulating water failing the low pressure cylinder may exhaust into the atmosphere. The engine will, when on the atmosphere, drive the generator at full load (700 kw) and will also in these conditions fill the specifications as to governing and angular velocity.

The three Wigham Richardson's engines are to a similar specification as the Slipway set, so far as output, speed, atmospheric exhaust, angular velocity, governing, etc., are concerned. They are also self-contained with surface condenser direct driven Edward's air pump. Aspinall's emergency governor, and motor driven centrifugal pumps, but in other respects they present certain novel features. They have four cylinders, two low pressure, and the four cranks are not set exactly at 90 degrees, but are balanced on the Yarrow, Schlich & Tweedy system, the object being to do away with all vibration, and

to secure even turning moment without the use of a heavy fly-wheel. The engine is controlled by a governor of the flywheel type (Stump's patent) mounted direct on the crank shaft.

ALTERNATORS.

The large alternators are of the three-phase type with revolving fields and stationary armatures and were supplied by the British Thomson-Houston Company, Limited. Each machine is placed tandem to its engine, the field being mounted on an extension of the engine shaft 24 inches in diameter. The armatures are arranged to slide parallel to the shaft on base plates secured to the foundations by bolts.

The normal output of each generator is 700 kw at 5500 volts, the speed being 100 revolutions per minute. The fields have 48 poles, thus giving a frequency of 40 cycles per second. The armature winding has one slot per pole per phase, and the shape of the pole pieces is such that the wave shape approximates closely to that of a sine curve.

The normal exciting voltage is 240. Carbon brushes are used for the collector rings. The commercial efficiency of the generators is not less than 95 per cent at full load and 91½ per cent at half load, excluding the excitation, and the generators will carry an overload of 25 per cent for half an hour without injury. The rise of voltage upon throwing off full non-inductive load does not exceed 7½ per cent, and the temperature rise after a ten hour's run at full load does not exceed 40 deg. C. as measured by thermometer.

DIRECT-CURRENT GENERATORS.

Each set consists of two 100 kw generators supplied by the British Thomson-Houston Company, connected up tandemwise to a Bellis engine, the arrangement being such that the armatures are interchangeable. Each has an output as a shunt machine of 100 kw at all voltages from 260 to 270 at a speed of 380 revolutions per minute, and as compound machines they give 250 volts at no loads and 262 at full load. After 24 hour's run at full load the surface temperature of any part of the armature or field windings does not exceed 45 deg. C. above that of the surrounding air.

MOTOR-GENERATOR IN GENERATING STATION.

The motor-generator in the power house was supplied by Messrs. Richardsons, Westgarth & Company, and is designed for use in both directions, that is to say, either for receiving alternating, three-phase currents and delivering direct current, or vice versa. The set consists of one three-phase synchronous motor wound for the full pressure of 5500 volts, direct-coupled to two direct-current machines, each machine having an output as a shunt machine of 75 kw when running as a generator at 400 revolutions per minute. Each machine is shunt and compound-wound, and gives at full load 240 to 270 volts. The combined commercial efficiency of this set at full load and normal voltage and running either way is not less than 85 per cent. The temperature rise after ten hours' run at full load does not exceed 72 deg. F. above that of the surrounding air as measured by thermometer.

SWITCHBOARDS.

The high tension switchboard was supplied by Messrs. Ferranti, and consists of 17 panels, namely: six generator panels, one motor generator panel, two wattmeter panels, and eight feeder panels, and is suitable for working at 6000 volts three-phase. Each panel contains three fuses, three switches and three ammeters, and provision is made for disconnecting any panel from the bus bar when alive by means of insulated tools. Bus-bar voltmeter and synchronizing gear in duplicate is provided at the top of the board. The two wattmeters are required for measuring the respective output of the two companies operating the power station.

The low tension switch equipment consists of three boards, two being on the floor level and one being in the switchboard gallery. These panels deal with the two 200-kw Bellis sets, a small exciter set, and the 150-kw motor generator. One of the boards on the floor level holds the main dynamo fuses, the compounding switches, and the field switches. The main low tension board is on the gallery and contains three sets of bus bars, namely, station power and lighting bus bars, exciting bus bars, and feeder bus bars. The station bus bars and exciting bus bars are arranged one on each side of the

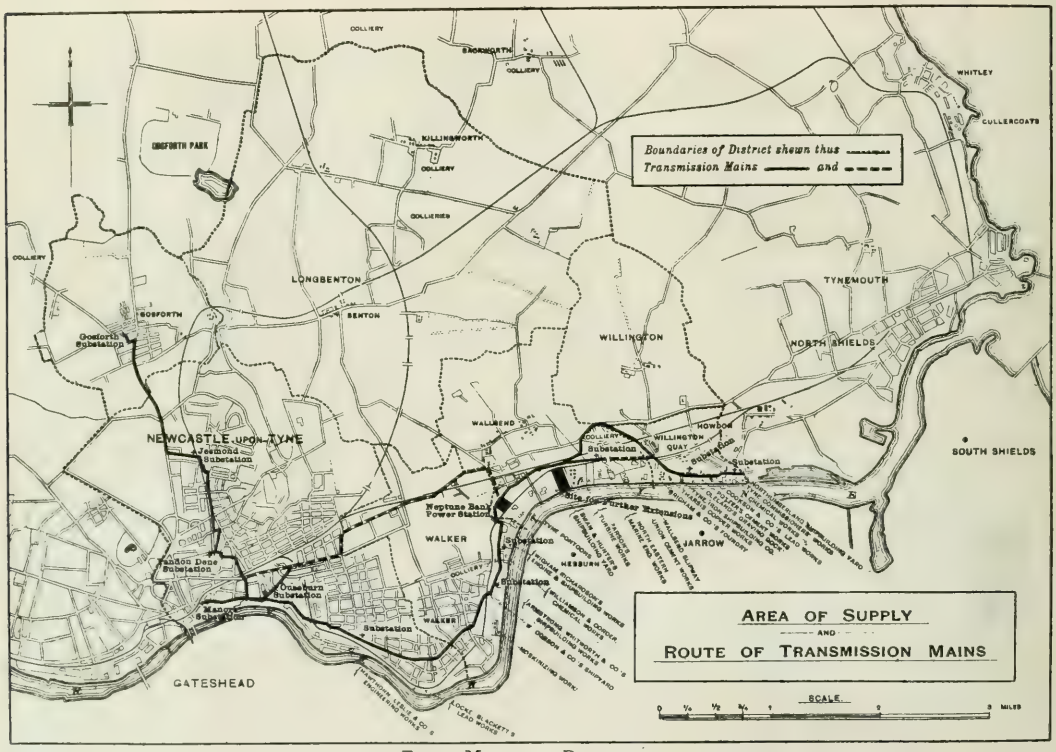


FIG. 2.—MAP OF THE DISTRICT.

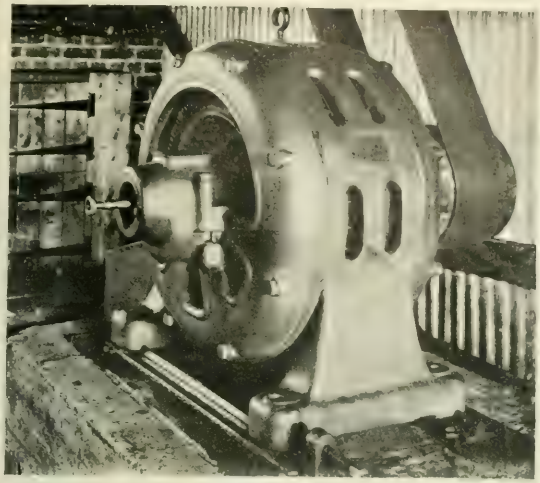


FIG. 3.—TYPICAL 30-HP THREE-PHASE MOTOR.

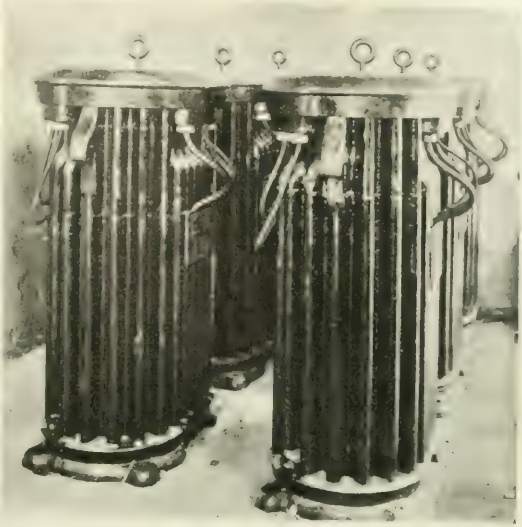


FIG. 6.—50-KW TRANSFORMERS.

FIG. 4.—HIGH-TENSION AND LOW-TENSION SWITCHBOARD IN NO. I STATION.

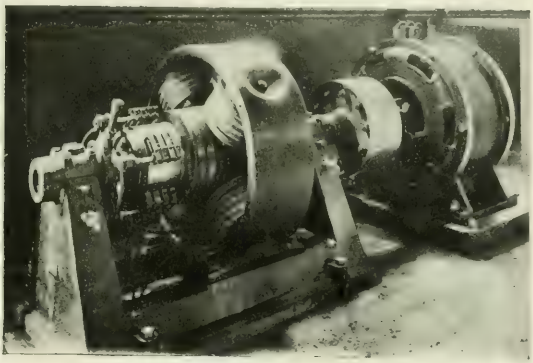


FIG. 7.—75-KW MOTOR GENERATOR.

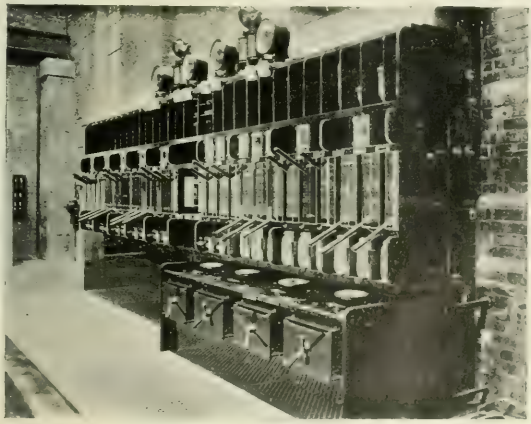


FIG. 5.—HIGH-TENSION THREE-PHASE FERRANTI SWITCHBOARD.

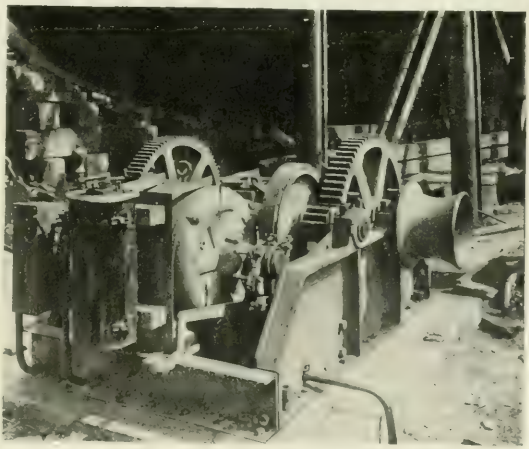


FIG. 8.—THREE-PHASE THREE-TON WINCH, WITH COVER OFF.

THE TYNESIDE ELECTRICAL POWER DISTRIBUTION PLANT.

system, so that the station power and lighting circuits and the alternator exciting circuits are each operated quite independently at 250 volts. In this way the exciting circuits are kept entirely distinct from anything else, thus greatly reducing the liability of any mishap to the excitation. Double throw switches are provided by which any generating set can be thrown on to these bus bars or on to the feeder bus bars. The feeder bus bars are connected through a wattmeter panel to the feeder board which is arranged for four sets of three-wire feeders, and also includes a traction panel for the supply of power to the shunting locomotive in the yard outside.

TEST POND.

A test pond has been constructed outside the station for the testing of the various generators. The arrangement consists of three plates of lead immersed in a brick pit filled with water. Each plate is separately suspended from a rope passing over a pole carried on a wooden staging above the pit. Three windlasses are provided at a safe distance from the pit by means of which each plate can be raised and lowered independently, and thus the load can be readily balanced and adjusted. Overhead wires connect these plates with terminals fixed on the wall of the switchboard gallery from which temporary connections are made for testing any of the three-phase or continuous current generators, the pond being of sufficient capacity to absorb 1500 kilowatts at 5500 volts.

AUXILIARY MOTORS.

The following auxiliary motors of Bruce Peebles make are provided in the station: Five centrifugal pump motors, each 20 hp at

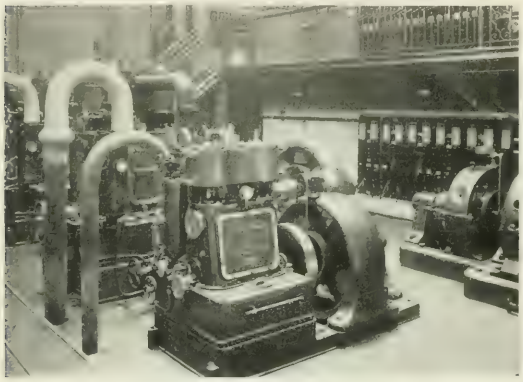


FIG. 9.—DIRECT-CURRENT GENERATING SETS AND PANELS.

800 revolutions; four barring gear motors, each 6 hp at 1000 revolutions; one air compressor motor 2 hp at 200 revolutions; one vacuum pump motor, ½ hp at 600 revolutions; one stoker motor, 15 hp at 900 revolutions; one economizer motor, 2 hp at 700 revolutions; one ash hoist motor, 6 hp at 600 revolutions; one river pump motor, 15 hp at 350 to 700 revolutions; one air pump motor, 40 hp at 100 revolutions.

CABLES.

The high-tension cables are all of the three-core paper-insulated lead-covered type laid solid in iron troughs, the various troughs being bolted together. The low-tension, direct-current cables are single core insulated with vulcanized bitumen and laid solid in separate earthenware troughs covered with hard tiles.

The main transmission cables to Newcastle are also of the three-core type, each core having a sectional area of .25 square inch; they are paper insulated, lead covered, and are, further, in the case of Callender's make, surrounded with an armor of galvanized steel wire. The function of this covering is not, however, that of protecting the cable from mechanical injury, but it is put on in order to meet the Board of Trade requirements as to conductivity of earth sheathing. The other maker, the British Insulated Wire Company, fills these requirements by providing just under the lead a continuous layer of copper tape.

The drawing system has been adopted for the transmission mains, the ducts consisting of four-inch earthenware pipes. There are nine of these pipes in each transmission route, laid in layers of three deep and embedded in concrete.

A separate cable will be carried up from Wallsend to the three main sub-stations, these sub-stations being inter-connected, both on their high and low tension side, but while the interconnector is in the latter case only meant to be used on very light loads the high-tension connecting cables are, on the other hand, of the same section as are the main Houston-Thomson cables from the generating station.

SUB-STATIONS.

The three main sub-stations are practically identical in design, the only difference being in their overall length, which was affected by the available site area. They have all a length of about 80 feet and a width of 35 feet, being designed for an eventual capacity of 2000 kilowatts in synchronous motor generators. The equipment of each at present consists of two 500-kw synchronous motor-generators, one 75-kw asynchronous balancing set, and one 25-kw direct-current balancer.

The large motor generators for the sub-stations in Newcastle were supplied by Messrs. Richardsons, Westgarth & Company, Limited, and manufactured by Brown Boveri, of Baden, and two—the first installment for one of the sub-stations—by the British Thomson-Houston Company, Limited.

Each set will consist of one three-phase synchronous motor, wound for the full pressure of 5500 volts, coupled to a single direct-current generator. The two machines of each set are mounted on one bedplate. The motor has a fixed armature and revolving field and the armature winding is star connected. The full load output of each direct-current set is 980 amperes at 510 volts, and the three-phase motor is so designed that by means of a field rheostat the power factor at full load can be varied from 1 to .8, the wattless current being a leading current. No part of the apparatus except the commutators in continuous running at the full load will rise in temperature more than 40 deg. C. as measured by thermometer, and no part of the commutators will rise in temperature more than 45 deg. C. The motor generators will be capable of running for one hour at an overload of 25 per cent without excessive rise of temperature in any part or injurious sparking, the position of the brushes being fixed for all loads.

The efficiency is guaranteed not to be less than 89 per cent at full load, 87 per cent at two-thirds load, and 78 per cent at one-third load.

The high-tension sub-station switchboards consist of a feeder board and a motor generator board which are placed at right angles, and which are connected through a panel which will contain wattmeters and power factor indicators dealing with the total power being taken by the motor generators.

Each board consists of two parts, a lower frame and an upper frame. The lower frame is located beneath the floor of the switchboard gallery and contains the high-tension bus bars, switches, fuses and instrument transformers. The upper frame contains the rheostats, indicating instruments, and handles for operating the main switches. The main switches are of the oil type and are geared to the operating handles by means of a chain and sprocket wheels. All the instruments, both voltmeters and ammeters, are operated through transformers. The whole of the high-tension parts are thus kept below the floor, and thus safety in ordinary working is secured since all high tension parts are inaccessible to the operator on the gallery.

NEWCASTLE SUBSTATIONS.

The low-tension sub-station switchboards are divided into three portions, namely, positive, negative, and neutral positions, which are separated by two voltmeter panels. There are three sets of horizontal bus bars and any generator, balancer, or feeder can be connected to any of the three sets of bus bars by means of the usual arrangement of vertical bars and screw plugs. The board is designed for ultimately dealing with four 500 kilowatt motor-generators, two balancers, and nine feeders, some of which will be interconnectors between sub-stations. For starting the synchronous motor generators an arrangement of switches is provided by which any motor generator can be connected with a special starting panel which is fitted with starting resistances and an automatic cut out, and is located at one end of the low-tension switchboard. The backs of the voltmeter switches are covered in with neat brass cases and all voltmeter wires are run in metal tubing, thereby securing a neat and safe arrangement of the back of the board. The dynamo fuses and field switches are located on panels fixed on the wall supporting the switchboard gallery.

All the low-tension cables in Newcastle are of Callender's make, single core, vulcanized bitumen, each cable laid in a separate chase of an earthenware trough, which is then filled in solid with the bitumen and covered with a hard tile 2 inches thick. Single pole disconnect-

ing boxes only are used throughout, the [illegible] design of the "Cork" type fitted with diving bell cover.

DISTRIBUTION.

In addition to supplying manufacturers with power the companies have undertaken to install all apparatus which may be required for power or lighting purposes free of first cost to the consumer, charging a rental per annum based on the capital cost to the company of providing and installing the plant. In this way manufacturers are relieved from having to go to any great expenditure and at the same time are freed from all trouble and responsibility in connection with the various branches of the work.

For an additional sum per annum the companies are prepared to do all the maintenance in connection with the installation renewing of bearings, adjusting of brushes, trimming arc lamps, etc., etc., and keeping the installation generally in good working order.

Owing to the great variety of the manufacturers' requirements which the plant is called upon to supply, difficulties have been met with which have made it impossible to adopt one system of supply throughout, and also have rendered it difficult to standardize the apparatus used. Where the matter was left to the company's engineers, as is the case in most of the yards, they recommend the three-phase system, especially for all constant speed work; but as some of the manufacturers prefer direct-current, arrangements have been made for supplying current on one or other, or both, of these systems as may be required.

On account of the quantity of direct-current required, and the fact that it is more suitable for arc lamps, direct-current distributing mains had to be laid throughout most of the district along the river side. This being so, it was convenient to do all lighting on this system, and thus avoid the necessity of keeping the three-phase voltage to within one or two per cent., the direct current being supplied through motor generators.

As has been previously stated the power is supplied at a pressure of 5500 volts, and for the purpose of reducing this to the working pressure of 440 volts a separate sub-station has been provided in those works which are too far distant to allow of their being supplied with low-tension currents from one of the main sub-stations. Each sub-station is in direct telephonic communication with the power house.

The plant is now supplying power to a number of the largest shipyards and engineering works on the north side of the Tyne, in the majority of which the power is supplied on the three-phase system. As practically the same arrangements have been carried out in the various yards in which the installation has been designed by the company's engineer it will suffice, for the present purpose, to detail the arrangements in one yard which may be taken as a typical example.

A large section of Messrs. Sir W. G. Armstrong Whitworth & Company's shipyard is now driven electrically, the total motors being installed at present aggregating some 400 horse-power.

Owing to every inch of ground being valuable a site for the sub-station was with difficulty selected. On this a brick building measuring 28 feet by 13 feet 6 inches has now been erected. In this building are installed the necessary transformers and switchboard panels.

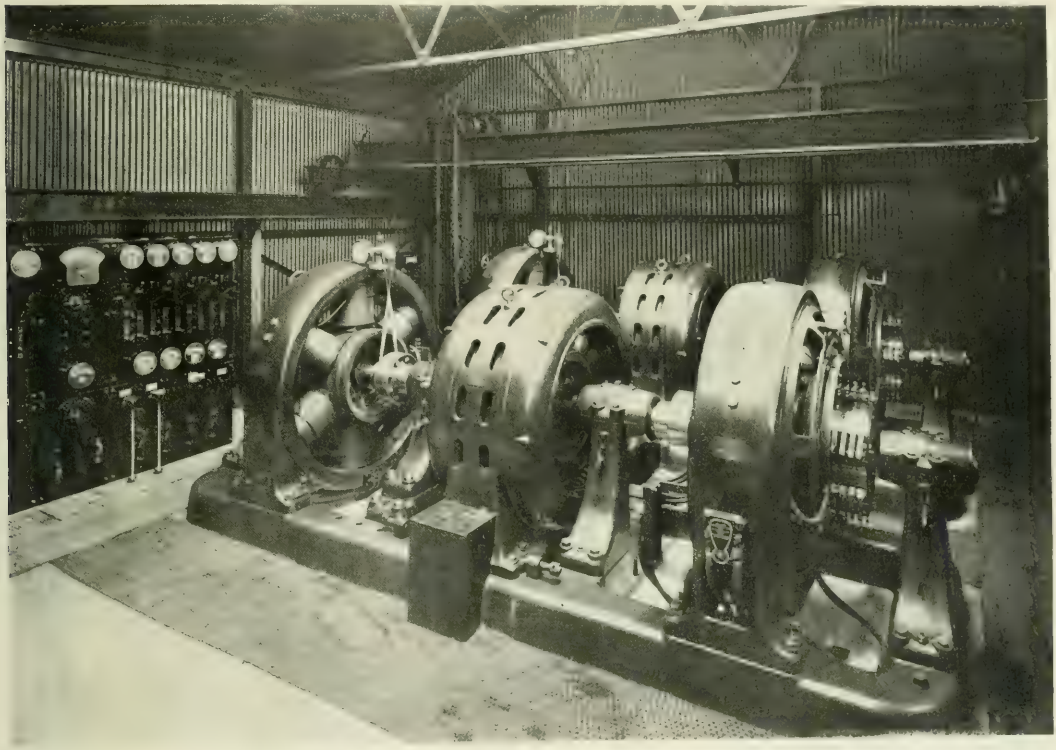


Fig. 10.—300-kw Motor-Generator in Sub-Station.

The high-tension switchboard, which is of Messrs. Ferranti's make, consists of two feeder and two three-phase transformer panels. Each feeder panel has been arranged for carrying 150 amperes in each phase, an ammeter being provided in one phase only.

The transformer panels are erected to the right of the feeder panels, and the board is capable of extension in either direction without any alteration being made to the existing panels.

Seven 50-kw British Thomson-Houston single-phase transformers have been installed, six of which are in use, the seventh being kept as a spare. All the transformers are connected-up delta, and in this way a failure of one does not affect the supply.

The low-tension transformer and circuit panels have been erected on the opposite side of the building. These are mounted with three fuses, one ammeter and one triple-pole switch.

The yard is divided into various sections, each of which is controlled by a separate circuit panel in the sub-station. The main cables leading from the sub-station have been run overhead, each circuit terminating at a distributing board. All overhead lines are efficiently protected from lightning discharges by means of reactance

coils and spark gaps. The standard distributing boards consist of cast iron boxes of special design, equipped with the requisite number of panels. They are made in different sizes suitable for taking from three to nine panels each, and are equipped with either power or lighting circuit panels according to the requirements of the case, the overall dimensions of the various classes of panels being identical.

In order to guard against the risk of a short circuit in a power distributing box, i. e., boxes equipped with fuses of over 5 amperes capacity, single pole boxes are used throughout. Wherever the cables strike down to a distributing box or motor they are run in iron pipe so as to protect them from mechanical injury.

The motors throughout this yard are of the induction type. Of the 29 motors which are being installed 10 drive line shafting, the remainder driving individual machines. Three types of motors are used—one having a squirrel cage rotor, while the others are form wound.

For the purpose of starting the former type of motor a compensator is employed in order to reduce the voltage at the station terminals. Combined with these compensators is an oil break switch so that in starting up a motor it is only necessary to actuate one handle. Owing to the possibility of placing this compensator at any distance from the motor this type has been used when the motors have had to be erected in out of the way positions.

Of the other types one carries a starting resistance mounted within the rotor itself. On starting up, this resistance is cut out by means of sliding contacts actuated by a handle through the hollow spindle

FIG. 11.—TWENTY-TON THREE-MOTOR CRANE.

of the motor, while the others are provided with collector rings and are used where variable speeds are required.

Perhaps the most interesting feature in the Northumberland Shipbuilding Company's installation is the electric winches. At present eight of these have been installed, each of which is driven by a 10-hp variable speed induction motor, which is capable of being run in either direction, all directions and speeds being controlled by one handle. Each winch will lift a load of 3 tons at a speed of 50 feet per minute from either of the two warping drums. As will be seen from the photographs reproduced, the winches are provided with covers and are generally designed so as to be thoroughly protected both from mechanical injury and from the weather.

As these winches are erected in the neighborhood of ship's berths the cables which supply them with power have been laid underground in wooden troughs and run in with bitumen. In this way they are protected from injury from falling spars, etc. The Northeastern Marine Engineering Company is one of the largest consumers within the company's area and is supplied on the direct current system at a pressure of 480 volts between the outers, the motors themselves, all being run 240 volts circuits. Up to the present time about 1600 horse-power in motors is being installed. The power for this yard is supplied from one of the sub-stations which is situated in close proximity to the works.

The sub-station, which is the largest on the Gas Company's system, measures 30 feet by 25 feet inside, and is equipped with a 7½-ton travelling crane.

INDUCTION MOTORS.

The following particulars refer to three-phase induction motors, working at a frequency of 40 cycles per second. There are three classes of motors. The motors of Class 1 have rotors with short circuited squirrel cage windings. To cut down the starting current when the maximum starting effort is not required, a starting compensator is used.

The motors of Class 2 have wound rotors with resistances in series with the windings. This resistance is cut out as the motor speeds up by means of a handle projecting from one end of the shaft.

The motors of Class 3 have wound armatures, the windings being taken to 3 collector rings on the shaft, and variable speed is obtained by means of resistances external to the motor inserted in the rotor windings.

The motors are partially enclosed and are designed to run on 440-volt circuits. The temperature rise is guaranteed not to exceed 40 deg. C. as measured by resistance after a 24 hours' run at full load as semi-enclosed motors. Small motors will reach their limiting temperature in 3 hours, and larger ones will take considerably longer.

The maximum torque of type 1 comes at a point varying for different motors, and about 20 per cent below full speed. If the overload continues, the torque remaining the same, after the motor falls below the maximum torque point it cannot be started without adjusting the resistance of the armature circuit in the case of a type 2 motor; and a type 1 motor cannot be started at all until the torque is reduced below the maximum starting torque for that motor. If, however, after the load has caused the motor to break down the torque be reduced sufficiently rapidly as the speed falls, a certain point will be reached where the torque becomes less than the maximum torque the motor is capable of yielding at that speed, the motor will then pick up and come up to speed again. The torque curves vary for different sizes of motors and different windings. The drop at speed from full load is from 6 per cent for smaller sizes to 3 per cent for larger sizes. The maximum output is about two times full load for 1, 2 and 3-hp motors and from 2½ to 3 times full load for larger sizes.

The maximum starting torque is 1½ times full load torque for 1, 2 and 3-hp motors and from 1½ to 2 times full load torque for larger sizes. The minimum starting torque and current is from about full load to 1¼ times full load torque and current.

The motors of type 3 are very flexible and can be wound if required for heavy starting torque up to twice full load torque.

Mr. Charles H. Merz, to whom we are indebted for the above details of the plant, is consulting engineer for the Tyneside enterprise. Mr. H. L. Riseley is resident engineer for construction of the station.

Paris-Berlin Automobile Race.

A great continental automobile race was witnessed last week, from Paris to Berlin, over a course 724 miles long. No fewer than 162 automobiles were entered for the race, and some 60 more went along in advance as tourist spectators. The course was divided into three stages running through France and Belgium and Luxembourg to Aix-la-Chapelle and thence through Dusseldorf and Hanover, to Berlin. The start was made from Champigny, 12 miles outside Paris. There were some notable instances of careful preparation for the contest. One firm of motor car builders had a staff of seventy-seven mechanics on the ground to inspect its cars before they started. A firm of oil men distributed 1300 gallons of gasolene at various points along the route.

So far as known, only one American, Foxhall Keene, was in the race, and his Mors machine was early disabled by a broken tire, landing him in a potato patch. The winner was Mr. Henri Fournier, in another Mors, whose speed is said to have averaged 40 to 45 miles an hour, although the exact time occupied is not stated in any of the dispatches. All of the first five arrivals were Frenchmen, and their reception at the West End course just outside Berlin, by a crowd of several thousands, was very enthusiastic. Mr. Fournier was the winner of the last Paris-Bordeaux race, when he made the 348 miles in 6 hours 11 minutes. Although the roads traveled have been in existence for hundreds of years, they are spoken of as being bad outside France, and as being often "execrable" and "awful." About a score of automobiles appear to have finished within a few hours of Fournier's arrival.

Direct-Current Engineering Practice in Germany.

BY CHARLES BRANDEIS.

WHILE in this country compound-wound dynamos are universal in use, this is very rarely the case in Germany, especially for lighting purposes. This is explained by the fact that the engineers in that country favor the use of storage batteries working in parallel with the generators, because of the advantages they have in assisting the latter during the peak of the load and enabling the entire steam plant to be shut down during light loads without interruption of the service. Thus the steam engines can always be worked at full load, and consequently with high average efficiency. Moreover, the storage battery ensures constancy of bus-bar pressure and makes the latter more independent of the generator voltage fluctuations.

According to published statistics there were in Germany up to March 1, 1900, 652 central stations in operation, of which 568 had direct-current systems, and of these only 43 are operated without storage batteries. Since compound-wound dynamos are not siutable for storage batteries, the result is that shunt-wound machines are most widely in use, the former rarely even for street railway work.

Thus the German engineering practice is entirely different from that of this country, and hence a description of their methods will porbably be of interest.

In the accompanying diagrams the following notation will be employed:

D_1, D_2, etc., shunt-wound generators.
BD_1, BD_2, etc., booster dynamos (shunt wound).
BM_1, BM_2, etc., booster motors (shunt wound).
B, storage battery.
F_1, F_2, F_3, etc., fuses.
A_1, A_2, A_3, etc., ammeters.
V_1, V_2, etc., voltmeters.
VS_1, VS_2, etc., voltmeter switches.
I_1, I_2, etc., indicators.
S_1, S_2, etc., S. T. switches.
O_1, O_2, etc., D. T. switches.
Sh_1, Sh_2, etc., field magnet windings.
R_1, R_2, etc., rheostats.
CR_1, CR_2, etc., cell regulators.
CB_1, CB_2, etc., circuit breakers.

Fig. 1 to 6 show diagrams for two-wire, Figs. 7 to 13, inclusive, for three-wire systems.

Fig. 1 shows the simplest method of operating a battery in multiple with generators. It has the disadvantage that lights cannot be operated simultaneously with the charging of the accumulators unless a rheostat R_3 is inserted, as shown for the reason that as the charging proceeds, the generator e. m. f. has to be continuously raised. This rheostat is, however, expensive, and, moreover, wastes considerable energy. The indicator I_1 indicates the direction of the current—that is, whether the battery is discharging or being charged. This instrument is frequently combined into one with the battery ammeter, the latter then having its zero in the middle of the scale, the needle moving either to the left or to the right, according to the direction of the current.

The arrangement of Fig. 2 has the advantage over that of Fig. 1, in that it employs two end-cell regulators, one for charging, the other for discharging; and it is obvious that the lights can be fed at constant voltage from the storage battery at the same time the latter is being charged.

Fig. 3 shows a case where the generator supplies current at constant voltage at the bus-bars, and at the same time may be charging the accumulators, the higher voltage necessary being obtained from a booster dynamo working in series with the generator. By means of the double-throw switch, O_1, the storage battery may be charged or made to discharge in multiple with the generators.

Fig. 4 shows the application of Fig. 2 with the addition of the booster dynamo with the same advantages over Fig. 3 as Fig. 2 has over Fig. 1.

In Fig. 5 the booster dynamo is driven by an electric motor, and it is of interest to note the shunts and rheostat connections of the same. Only one rheostat is employed for both machines. If it is desired to raise the voltage of the booster dynamo, the rheostat lever is moved in the direction which inserts more resistance in the motor shunt, and less in the dynamo shunt. Thus, the voltage is raised both by the increase of speed of the motor and by the greater exciting current of the dynamo. This method is, however, not always employed, preference being frequently given to the connections, as shown in Fig. 11. Here the booster voltage is automatically raised as the charging proceeds and the voltage of the accumulators increases. R_3 is the starting rheostat for the motor.

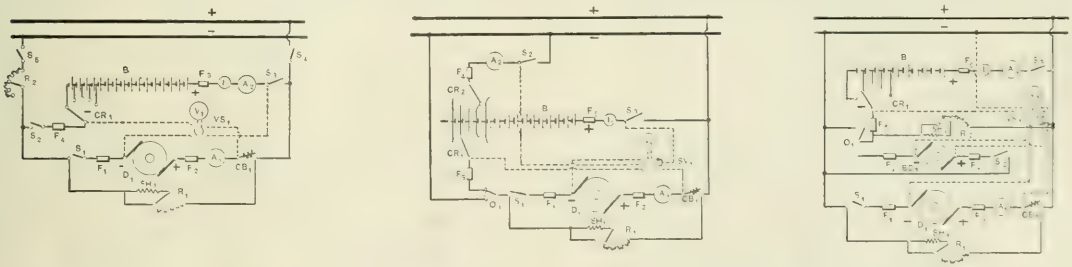
It sometimes happens that it is decided to install a storage battery after the generators have been installed, and that the latter, with their shunt rheostats are therefore not designed to give the necessary higher voltage for charging and that the expense of extra boosters is undesired, or is not warranted. Then the battery may be charged by dividing it into two sections and charging them in parallel, as shown in Fig. 6. R, R are resistances necessary to "kill" a certain predeterminable amount of voltage through the entire charge.

Fig. 13 shows the same diagram as applied to a three-wire system; in this case it is impossible to supply energy for lighting purposes during the time of charging because of the absence of the potential divider. Hence when charging it is necessary to open the switches S_1, S_2.

Fig. 7 shows Fig. 2 as applied to a three-wire system, and Fig. 9 shows a similar diagram, except that the generators are connected to the outer mains and develop twice the lamp voltage.

Figs. 8, 10, 11 and 12 show various methods of applying motor-driven boosters to three-wire systems.

Of all these diagrams Fig. 10 is the most general in use, for it combines the greatest simplicity with the greatest flexibility. Uninterrupted service can be given both from the generators and storage battery during the charging. There is only one booster, but each battery half may be separately charged, which becomes necessary from time to time, or the whole battery may be charged in series. In this diagram O_1 and O_2 are three-point switches. When O_1 is at a and O_2 at c the right hand battery may be separately charged; if O_1 is at b and O_2 at d then the left hand battery. To charge both right and left hand batteries simultaneously, switch O_1 to b and O_2 to c.



FIGS. 1, 2 AND 3.—DIAGRAMS FOR TWO-WIRE SYSTEMS.

It is to be noted that in Fig. 11, with the generators connected to the outer mains, the motor driving the booster must receive its energy from the opposite battery half of that on which that booster is working. Otherwise it is impossible to charge each half separately. In Fig. 8 this arrangement is, of course, not necessary, as the motor receives its energy from the generator.

Fig. 12 shows the booster dynamo driven by two motors, all three machines being mounted on a common shaft. The motors, in addition to driving the booster dynamos, act as equalizers. If there is perfect equilibrium in the two circuits then they run as motors, but if one circuit has a higher potential than the other, then the corresponding machine drives the other motor as a dynamo, adding po-

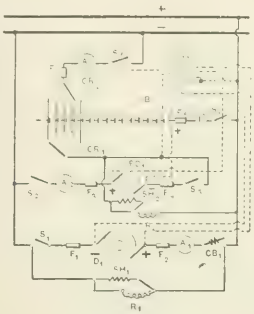


FIG. 4.

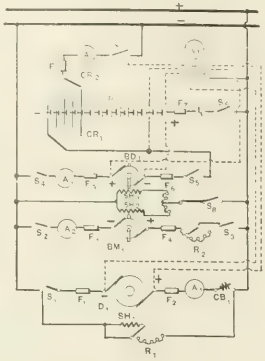


FIG. 5.

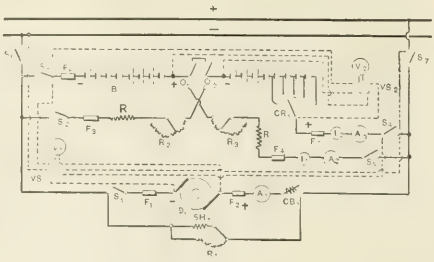


FIG. 6.

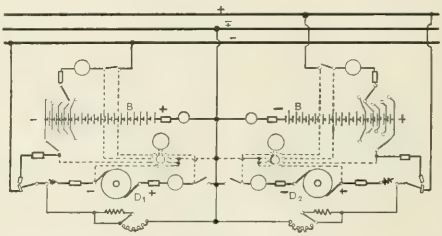


FIG. 7.

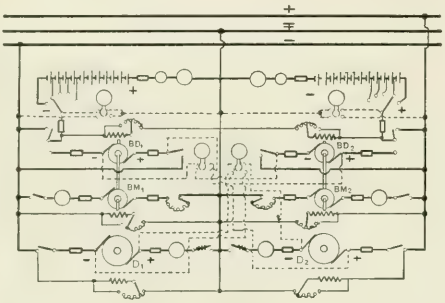


FIG. 8.

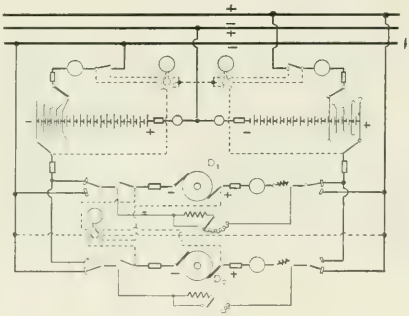


FIG. 9.

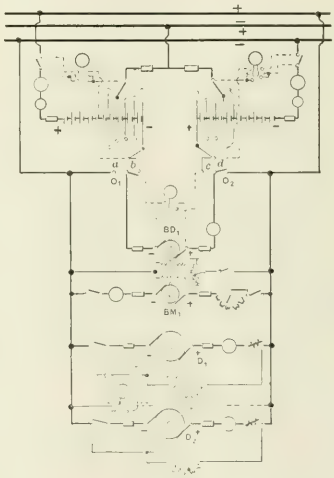


FIG. 10.

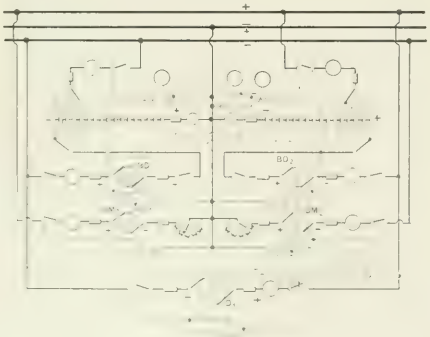


FIG. 11.

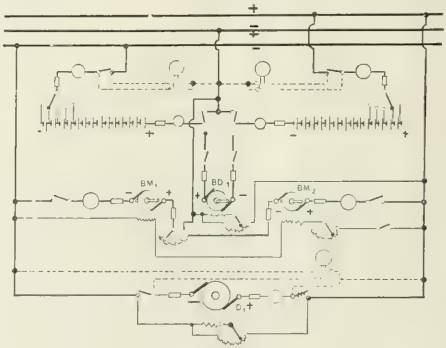


FIG. 12.

FIGS. 4 TO 12.—DIAGRAMS OF TWO-WIRE AND THREE-WIRE SYSTEMS.

tential to the other circuit, and at the same time reducing the potential of its own by taking energy from it. The motors are started by connecting them in series to the outer mains. The starting rheostat is so designed that the neutral wire is only connected after the last resistance is cut out. The field magnets of the motors are connected in series to the outer mains. It will be seen that the field windings of the generators are all shown connected to the bus-bars. This is considered better practice than to connect them across the brushes, because in the first place when suddenly breaking a heavy load, no undue strain on the insulation is produced through the otherwise usual kick in voltage, and secondly, because the generators can be brought up much quicker to their working voltage than would be the case if they have to develop their own exciting current.

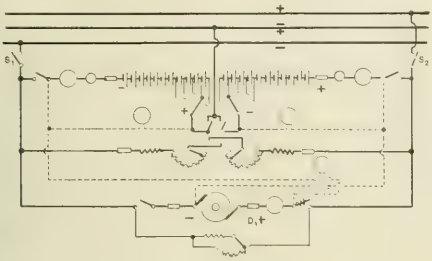


FIG. 13.—DIAGRAM FOR THREE-WIRE SYSTEM.

It is, of course, desired that the shunt windings be cut off the circuit when the generators are not working, and the preference is given to short-circuiting rather than to open circuiting the field magnets, as shown in the diagrams.

All circuit generators are supplied with a single-pole under-load circuit breaker to protect them from the possibility of the battery current reversing into them.

Storage Battery Auxiliaries—V.

By LAMAR LYNDON.

CONSTANT CURRENT BOOSTER.

The regulating boosters before described—the compound and the differential—are adapted to systems where the lines are long and line drop is high, as they maintain the line voltage at normal at the point of their connection to the circuit, whatever the external load may be.

In systems where the lines are short and the drop small, it is often desirable to have the e. m. f. fall on application of overload. The reason of this is that the overload is produced by the current rush due to starting of motors, and if the e. m. f. be lowered the motors start more easily and the accelerating current is decreased.

This condition prevails in buildings where elevator, printing press and other motors are used, which frequently start and stop. For such systems the constant-current booster is best adapted, and it is now sometimes used on railway and other circuits of a like nature, being installed instead of the compound or differential. Of this type of booster there are only two kinds—one being the invention of J. B. Entz, and the other that of the writer.

Patent No. 625,100, dated May 16, 1899, and issued to J. B. Entz, covers the system shown diagrammatically in Fig. 12.

In the diagram, G is the generator, B the booster armature, E battery, C series coil, f shunt coil, S_1 switch short-circuiting series coil, f shunt coil, R rheostat, $\times$, $\times$, $\times$, non-fluctuating load requiring constant potential, M M fluctuating load, and L L^1 the mains.

It is to be noted that all current used in the fluctuating load must pass through the series coil and armature, and that there is never a reversal of current in the booster; also that the voltage impressed on the fluctuating load is greater than that on the non-fluctuating load by an amount equal to the booster voltage.

The shunt coil creates an e. m. f. in the same direction as the generator e. m. f. The series coil opposes the shunt and generator e. m. f.

Should a load come on the power circuit, the generator tends to send additional current through the booster to meet this demand. The action of increased current is, however, to cut down the e. m. f. of the booster in a direct proportion, causing the generator with the booster to give an e. m. f. that varies inversely as the resistance of the power circuit, thus causing under any condition—up to full battery charge—a constant-current delivery from the generator.

On systems where the battery serves for regulation only and the charges and discharges are not widely different in amount, the booster carries only the *average* current and not the maximum of the fluctuations, as is the case with the series, compound and differential systems. The machine and its driving motor may therefore be considerably smaller than would be required if those types were used.

Following is an analytical discussion of the constant-current booster:

E_M = maximum generator voltage.

Let E_0 = normal line voltage on generator side of booster.

E_A = normal battery voltage.

E_x = battery voltage at any condition of charge.

E_B = booster voltage.

V = voltage due to shunt coil at normal battery voltage.

t = number of turns in series field.

I_x = generator current to power.

I_0 = current in external load.

R = resistance of battery circuit.

r = resistance of booster armature and series field.

K = volts produced per ampere turn on booster field.

N = number of cells in series.

h = volts drop at generator per ampere of generator current.

The minimum battery voltage should be the same as the generator voltage, as it is often desirable to connect the battery on to the generator circuit by closing S_2, and supply the lighting current for short periods during which the generator is shut down and disconnected from the circuit.

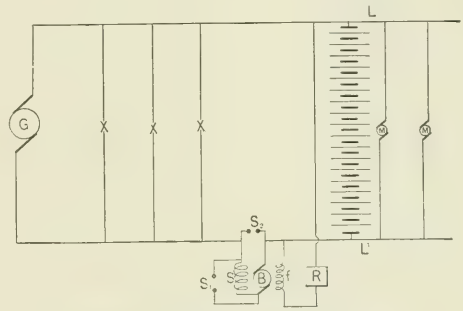


FIG. 12.—DIAGRAM OF ENTZ SYSTEM.

Therefore, $N = \frac{E_0}{1.8}$

The battery is installed with some of the cells on one end connected to points on an end-cell switch, and so arranged that when connected on the lighting load and discharging only, these cells can be cut in as the voltage drops. This arrangement will be explained later.

The number of end cells required are

$$N = \frac{E_0}{2.3} = \frac{E_0}{1.8} - \frac{E_0}{2.3} = .121\ E_0$$

The maximum voltage of battery, and consequently across the power bus-bars, is 2.5 N. The average voltage will be $2 \times N$. The voltage due to the shunt coil will, for purposes of calculation, be assumed as equal to the difference between the generator voltage and the maximum battery voltage, or 2.5 $N - E_0$.

When the outside load is normal and the battery is at normal voltage, the booster e. m. f. $= E_A - E_0 + r I_A$ (24)

and current flows neither into nor out of the battery. Therefore,

$$V - t I_A K = E_A - E_0 + r I_A \quad (25)$$

whence

$$t = \frac{V - E_A + E_0 - r I_A}{I_A K} \quad (26)$$

This assumes a constant permeability. Knowing V_1, E_A, E_0, K, r and also the average load or I_x, t is determined. Remembering that the voltage of the shunt coil will vary directly as the voltage of the battery to which it is connected, its e. m. f. for any battery voltage will be

$$V E_A = \frac{V R I_0 + V R I_x}{E_A}.$$

For any external load or battery voltage, the following is the equation of equilibrium:

$$V E_A = \frac{V R I_0 + V R I_x}{E_A}$$

$$I_x t K - I_x r - I_x h + E_0 - E_x = R (I_x - I_0) \qquad (27)$$

whence

$$I_x = \frac{E_0 + \frac{V E_A}{E_A} - E_x + I_0 \left(R - \frac{V R}{E_A}\right)}{t K + r + R - \frac{V R}{E_A} + h} \qquad (28)$$

Since for any given condition of battery, all the factors in equation (28) are constant, except I_0, the generator load varies with the external load. It is evident that the higher V is made the better the regulation will be.

If the shunt coil be connected across the bus-bars on the generator side, V will be a constant and equation (27) will become

$$V - I_x h - I_x t K - I_x r + E_0 - E_x = R I_x - R I_0 \qquad (29)$$

and

$$I_x = \frac{E_0 + V - E_x + I_0 R}{t K + r + R + h} \qquad (30)$$

This shows that the regulation is better with the shunt coil connected across the battery terminals.

The following example will illustrate the methods of calculation:

Assume a 125-volt, two-wire system furnishing current to lights and electric elevators. Assume

I_x average $= 50$ amperes.

I_0 maximum $= 300$ amperes.

$r = .2$ ohm.

$R = .2$ ohm.

$K = .02$.

$E_0 = 125$ volts.

$h = 0$.

$N = \frac{125}{1.8} = 69.6$, say 70

$E_A = N \times 2 = 140$ volts $=$ voltage across power mains.

Number of cells connected to end-cell switch $= .121\, E_0 = 14.7$, say, 15.

$E_{A\,max} = 2.5 \times 70 = 175$ volts.

$E_{A\,min} = 70 \times 1.8 = 126$ volts.

Range of voltage through which motors operate $= 49$ volts.

Assume $V = 100$ volts.

Then $t = \frac{100 + 125 - 140 - .2 \times 50}{50 \times .02} = 75$ turns.

Assume $I_0 = O$. Then

$$I_x = \frac{100 + 125 - \frac{140}{100 \times .2}}{75 \times .02 + .2 + .2 + \frac{140}{100 \times .2}} = 48.4 \text{ amperes.}$$

If $I_0 = 50$ amperes,

$$I_x = \frac{85 + 50 \left(.2 - \frac{.2 \times 100}{140}\right)}{1.756} = 50 \text{ amperes; and for } I_0 = 300,\ I_x = 57.8 \text{ amperes.}$$

The minimum generator current will be when the battery is at its maximum voltage, and

$$I_0 = O. \text{ Then } I_x = \frac{100 + 125 - 175}{1.756} = 28.5 \text{ amperes.}$$

I_x is a maximum when E_A is a minimum, and $I_0 = 300$. Then

$$I_x = \frac{100 + 125 - 126 + 300\,(.0572)}{1.756} = 65.8 \text{ amperes.}$$

Proper attention to the rheostat should prevent I_x from ever rising so high. If V were 50 volts, I_x would be 42.2 amperes for $I_0 = O$, and 88.5 amperes for $I_0 = 300$ amperes with E_A normal. With $E_A = 126$ volts and $I_0 = 300$, $I_x = 105.4$ amperes.

V then is determined by the regulation desired. The higher V is the better the regulation, but the size of the machine increases with increase of V.

While the generator current varies with any variation of E_A, the latter changes gradually, and does not cause any sudden fluctuation. If the battery is used only for regulation, its e. m. f. will vary but little; but if used to carry light loads or help the generator carry the peak of the load, E_A will vary from 2.5 N down to 1.8 N, and rheostatic control is desirable.

The size of the booster required in the example just given is maximum shunt voltage $\times$ armature capacity. If V be sufficiently high to send 10 per cent of the average current into the battery when E_A is maximum, it is great enough for all charging purposes. V maximum therefore never exceeds V. In the case under consideration, $I_{x\,max} = 68.5$ amperes, and $V = 100$ volts. The booster is therefore a 6.85-kw machine; 70 per cent of this, or 5 kilowatts, will be large enough to make this machine.

The size of motor required is fixed by the product of booster volts multiplied by amperes taken at the same instant and when at their maximum. This is when the maximum load is on and E_A is a minimum. In this case the booster voltage is 46.2 and current is 65.8 amperes. But the voltage is negative, opposing the generator e. m. f., and the booster is therefore acting as a motor.

The maximum positive volts multiplied by amperes is when the series field is short circuited by closing S_1 (See Fig. 11), and a charging current is being sent into the battery, and E_A is maximum. If this current $= 50$ amperes, $E_A = 175$; booster voltage $= E_A - E_0 = 50$. Therefore, the size of the motor is 2.5 kilowatts.

Improvement in the Metallurgy of Aluminum.

By Clinton Paul Townsend.

THE commercial process whereby all aluminum is now produced, known in this country by the name of Hall, and in Europe by that of Héroult, has remained without substantial modification for more than a decade. Bauxite, the crude native hydrate of aluminum, is purified by a laborious process involving its fusion with sodium carbonate, solution in water of the aluminate so formed, filtration, and precipitation of aluminum hydroxid from the filtered solution; this precipitate is then calcined, dissolved in a molten bath of mixed fluorids, and electrolyzed.

Crude bauxite, as mined in Georgia and Alabama, contains, in addition to hydrous alumina, oxides of silicon, iron and titanium, and is worth about $2.71 per metric ton (1899). On the other hand Roberts-Austen has estimated that the cost of the purified alumina constitutes 45 per cent of the expense of the production of aluminum. As two pounds of alumina suffice for the production of one pound of the metal, the discrepancy between the above figures will sufficiently indicate the costly character of the present purification methods. Furthermore, the procedure outlined is objectionable by reason of the practical impossibility of freeing alumina so obtained from the sodium carbonate employed for the initial fusion.

It has been heretofore proposed to dissolve the crude bauxite in the fluorid bath employed in the regular working and to purify it therein by fractional electrolysis, the current employed being sufficient to precipitate in metallic form the contained silicon, iron and titanium, but without the deposition of notable quantities of aluminum. This procedure has not been successful, for the same reasons that have prevented the use of fractional electrolytic methods generally; the voltage requisite for the separation of the impurities is so close to that needed for the principal metal that after the purification has proceeded to a very limited extent, all constituents of the bath are thrown down together.

The electric furnace methods for the purification of bauxite now disclosed by Mr. Chas. M. Hall, of Niagara Falls, and covered by three patents of recent date (June 25), are of the highest interest and should considerably reduce the cost of aluminum of certain grades. Hall's product differs entirely from pure alumina as heretofore known, both in appearance and properties, and cannot properly be designated by this name. It is a grayish-white crystalline body of vitreous lustre, having a specific gravity of 3.70 to 3.93, or intermediate between that of the calcined aluminum hydrate and that of alumina crystallized from fusion, and corresponding approximately

to the minimum specific gravity of the mineral corundum. In structure the fully treated product resembles a coarse sandstone, being coherent but readily crushed, and even friable between the fingers. It has a peculiar odor suggestive of the hydrocarbons and is partially soluble in hydrochloric acid and in caustic alkalis with liberation of methane (CH_4) and hydrogen. The former gas indicates the presence of aluminum carbid, and the latter is attributed by the inventor to the presence of a suboxid of aluminum having the formula Al_3O_4. The product, after being freed from any iron, exerts a reducing action upon acid solutions of potassium permanganate, showing that it is capable of undergoing further oxidation, and this is borne out by the observation that it gains weight by prolonged ignition in air, especially if preliminarily moistened with nitric acid. Analyses show a percentage of aluminum somewhat higher than corresponds to the formula Al_2O_3.

This remarkable product results from either one of two processes, covered by separate patents bearing the same date. The first of these is described with reference to a bauxite of the following composition:

Alumina	60 %
Ferric oxid	18 "
Silica	2—3 "
Titanic oxid	3—4 "
Water	17 "

After calcination, which may be in presence of carbon, the material is mixed with 8 to 10 per cent of carbon, and held in fusion for about an hour in an electric furnace having a lining and an electrode of carbon, the current being either alternating or direct. Under these conditions no aluminum is separated, for, as was shown some years ago by Moissan (*Comtes Rendus* 119, p. 935) molten alumina may be maintained in contact with carbon for considerable periods without reaction, and reduction occurs only when both oxid and carbon are in a state of vapor. The contained impurities, however, become reduced, and, especially in the presence of considerable amounts of iron, settle to the bottom of the bath as a fused alloy. When the iron content of the bauxite is low, or when it runs high in silica and titanic oxid, it is found advisable to add more iron, either as metal or oxid, to facilitate this separation.

The second method bears a close relation to that just described, but substitutes, in whole or in part, for the carbon employed as a reducing agent, metallic aluminum. This metal is added in quantity sufficient to combine with the whole of the oxygen of the silica, titanic acid and iron oxid known to be present, and the bath is maintained in fusion in the above described electric furnace for 1½ hours, after which time the foreign metals are found to have separated out as before, the added aluminum passing, of course, into the state of oxid without evolution of gas or disturbance of the quiet fusion. Here again it is important that sufficient iron be present to take up the silicon and titanium, and this is conveniently accomplished by adding, instead of pure aluminum, a readily comminuted ferro-aluminum containing about 50 per cent of each component.

It is to be inferred from the specifications that while the elimination of silicon and iron is practically complete, titanium has proven more refractory; indeed this is to be expected. The presence of titanium in small amounts in aluminum is rather advantageous than otherwise as regards its structural uses, but may limit its applicability in other directions; the question is an important one by reason of the peculiarly constant occurrence of titanic acid in American bauxites.

As has been said, Mr. Hall refers to the probable presence in his product of a suboxid of aluminum of the formula Al_3O_4. It would seem decidedly more probable that the excess of aluminum noted in the analyses, as well as the liberation of hydrogen from solvents, is attributable to the presence of the oxid Al_2O, first obtained by Pionchon (*Comptes Rendus* 117, p. 328) as a gray-black coating resulting from the incomplete oxidation of aluminum, and recently produced by Duboin (*ibid.* 132, p. 826), by what is probably the very reaction which occurs in the second of the above described processes—reduction by aluminum of the oxid Al_2O_3.

Certain processes heretofore patented abroad, for the manufacture of abrasives by the fusion of native emery in the arc in presence of carbon in quantity sufficient to eliminate the iron, bear a superficial resemblance to the first of these patented methods: but the resemblance is apparent only, since the raw materials differ in kind, the processes in the duration of the treatment, and the products in all essential characters.

The Nernst Glower Applied to Electric Furnaces.

The second United States patent granted for an application of the Nernst glower principle to an electric furnace, appears in the issue of June 25, having been issued to Arthur H. Eddy, of Windsor, Conn. This furnace is designed particularly for the fusion of enamels upon any of the usual earthenware or metallic bases, and consists of a series of tubes of such materials as are now known to conduct electrolytically at high temperatures. Within these tubes, but out of contact with their walls, are resistance rods of carbon, the ends of these rods, as well as of the tubes, being supported in appropriately formed water cooled metal clamps, which serve also as electrical connectors. The current, when the circuit is first closed, traverses the carbons, but as the tubular envelopes become heated a portion of the current is shunted through them, and in further work the carbons may be entirely withdrawn. It is proposed to construct a single pair of clamps to carry a number of tubular heaters, each with its interior carbon, the current passing in parallel through the group; a plurality of these groups, differing only in the number of units comprised in them, are then connected electrically in series, and arranged side by side, transversely, above a long narrow furnace hearth, in such manner that the articles to be heated, in passing along the hearth beneath the tubes, will be subjected to varying degrees of heat. If, for instance, it is desired to provide a furnace chamber wherein the temperature falls in either direction from a central point, as is common in annealing leers, the result is accomplished by progressively increasing the number of units in the series-connected groups in each direction from the center, and providing means for causing the articles to traverse the furnace from end to end at a definite rate.

The only other domestic patent for a furnace involving this principle was granted a year ago to H. N. Potter, of Göttingen. In form this furnace is merely a tube composed of a mixture of oxides, as magnesia and yttria or zirconia and yttria, provided at its ends with electrical connections, and enclosed, for considerations of strength, in a heavy jacket consisting of either one—but not both—of the oxides composing the inner tube. The whole is surrounded by the preliminary heater, in form a wire coil wound directly upon the jacket or upon an enclosing sleeve of talcite. As is well understood, a mixture of oxides or "dry electrolytes" is a far better conductor than any single pure component oxide; consequently the inner tube conducts the current and is the true seat of the high temperature developed, while the outer jacket, of an unmixed oxide, remains practically non-conductive, and by reason of its close chemical relation to the composition forming the inner tube, supports it without danger of fluxing it. If these dry electrolytic heaters are to be constructed of a size fitted for electric furnace work they must in most cases be provided with a suitable support extending over their entire length, and for this purpose the pure oxide, as suggested by Potter, would seem to be the only practicable material, all other refractory substances being either conductors or else capable of uniting chemically with the electrolytic oxides at the high temperature developed, with the formation of relatively fusible compounds.

Potter's furnace is designed especially for baking rod or tube shaped glowers for Nernst lamps, and provides for this purpose an even heat which will neither distort nor crack the glower. Eddy's furnace, as stated, is intended for enameler's use. It is for such purposes as these, where the temperature must be susceptible of minute regulation, and the furnace chamber entirely free from vapors of carbon and from the ash arising from its combustion, that these devices will find application. They would seem especially suitable for dental muffles, a class of furnaces requiring very high temperatures, and at the same time and in the very highest degree, cleanliness and ease of control.

To Arbitrate on Electric System.

A London dispatch states that at a meeting of the Parliamentary Committee on June 28 it was "decided that the Board of Trade should be asked to appoint an arbitrator to report as to whether the Ganz or the Yerkes electric system be employed on the old underground railway. It was also decided that the Board of Trade should give an official decision on the referee's report unless the officers of the Metropolitan District Railway agree upon a mode of traction within two months." This dispatch is not very clear, as the Ganz system is understood to have been rejected, and Mr. Yerkes is not the proprietor of any system, but the chief owner of the road.

Convention of the Northwestern Electrical Association

THE Northwestern Electrical Association held its summer convention at Sheboygan, Wis., June 26, 27 and 28, 1901. The headquarters were at the Lake View Beach Hotel, a summer resort on a line of the Sheboygan Light, Power & Railway Company, beautifully situated on a high bluff overlooking Lake Michigan, and about two miles from the center of town. The place selected and entertainment provided were excellent, but the attendance, especially of central station men, around whom the association is formed, was disappointingly and almost ridiculously small; as a result of which it seems now altogether likely that the summer convention of the Association will be abandoned, and the effort concentrated on the winter meetings, which have always been the most successful.

The first session was called to order at 10 o'clock Wednesday morning, June 26, by President E. L. Debell, of Sheboygan, who extended an informal welcome to the supply men present. The following new members were then elected: Delevan Light & Fuel Company, Edwin Schuette, Christensen Engineering Company, and Pass & Seymour.

Secretary Thomas R. Mercein, of Milwaukee, then read the report of the special committee appointed to investigate and report on "Gasoline Lighting," and its effect on the central station interests in the Association's territory. The report stated that inquiries were sent out covering every central station plant in the States of Michigan, Wisconsin, Iowa, Minnesota, North Dakota and South Dakota. Out of 370 inquiries sent out 160 replies were received in time to enter on the report. The number of plants reporting customers lost is 75, the principal of which are as follows: Council Bluffs, Iowa, 25 customers lost on account of gasoline plants; Missouri Valley, Iowa, 25; Lead, S. Dak., 10; Grinnell, Iowa, 12; Clarinda, Iowa, 12; Nevada, Iowa, 10; Mankato, Minn., 20; Marinette, Wis., 15; Tipton, Iowa, 13; Corning, Iowa, 12; Creston, Iowa, 50. Many other stations reported losing 5 to 10. Many report that customers come back after trying gasoline, so the net loss of actual customers in the district covered is remarkably small.

Reports show many different kinds of gasoline lamps and plants; some towns having 8 to 10. The most common are the hanging lamps, gravity burning and air pressure systems, with tanks or generators in the basement. An underwriter's list of approved gasoline devices was attached to the report. The underwriters lay great stress on the danger of all these lamps, but pass 40 kinds as safe. The moral is apparent. In only five cities are gasoline street lights reported. Minneapolis has 1500; St. Paul, 3000; Dubuque, Iowa, 100; Des Moines, Iowa, 100; Winona, Minn., 70. In the small towns they do not seem to be used at all for street lights. There is hardly a report that does not mention one or more accidents resulting from leaks or explosions of gasoline lamps.

Mention was made of a pamphlet published by the Illuminating Publishing Company of Cincinnati, entitled, "Is the Use of Gasoline and Acetylene Dangerous to Human Life," which contains a ghastly record of lives lost. The users of gasoline lamps seem, from the reports, to be mostly small merchants, barbers, grocers, saloons, restaurants and drug stores. It seemed to the committee that a proper discount to long-hour users would retain many of those who look to gasoline to keep down expenses, though many gasoline users are the undesirable class of customers that are always looking for something for nothing. The larger stores usually put in pressure tank plants and from the reports they are very short-lived, because of poor regulation, heavy cost of mantels and glassware.

The cities of Oelwein, Iowa; Lead, South Dakota; Marengo, Iowa; Corning, Iowa; Ouatonna, Minn.; Creston, Iowa; What Cheer, Iowa; Spencer, Iowa; Tipton, Iowa; Tecumsah, Mich.; Montevideo, Minn.; St. Paul, Minn., and Monroe, Wis., all report that the competition is serious. The other 90 per cent of the companies heard from do not consider the competition serious. They think that the people that use gasoline do not get satisfaction, and that they are not a permanent success. A certain percentage of people are always trying new things, and of course there will always be many lamps and machines that will look as if they might threaten the electric and gas plants. The general result is that where good service with gas or electricity is to be had at reasonable prices the gasoline lamp will only be used by the few kickers and cheap people that are to be found in all communities. Many companies report that nearly all the customers who experimented with gasoline have gone back to electricity. A few places report insurance rates as raised on gasoline lamp users. Most of the reports would indicate that there is no objection at all. If one agent objects, another, owing to the competition, stands ready to take risks at the old rate. The opinion of the Committee is that gasoline lighting plants, being recognized as very unsafe and dangerous, should be rigidly prohibited, not because of the competition they give in some cases, but because they are unsafe, dangerous to an extreme, and a source of danger to people on each side of them or above them, who do not use them.

In conclusion, says the committee, it would seem from these reports that each town has lost from a few to a large number of customers by reason of gasoline competition, but that most of these people have returned to the use of electricity, showing that while it may be a very cheap light, there must be great drawbacks to its general use. There are in every town lots of people looking for something for nothing, and the gasoline idea is a smooth one and catches their fancy. They do not know the origin of the fluid, its quick evaporation on exposure to the air, and its consequent danger; and it is only by actual experiment that they become convinced that it is no good, and usually after paying $150 or more for an outfit that cost about $25. "Of course it will not do to lose sight of this fact, that where many minds and much money is concentrated on one object that is it more than likely that some day a perfect gasoline lamp will be invented, and we must be on our guard and hold our customers by giving good service and good rates. But at present it is evident that it does not seriously threaten our interests." The report was signed by S. B. Livermore, chairman of the committee.

After the reading of the committee's report a communication was read from the International Association of Municipal Electricians asking members of the Northwestern Electrical Association to so time their Pan-American visits as to attend the convention of Municipal Electricians at Niagara Falls, September 2, 3 and 4. After transacting some routine business the convention adjourned until 2 p. m.

The Wednesday afternoon session was concluded by the reading of a paper on "Trades Training for Non-Technically Educated Men," by Prof. B. V. Swenson, of the University of Wisconsin.

The object of this paper was to call special attention to the short summer courses along this line recently established by the University of Wisconsin. This is known as the School for Apprentices and Artisans, and opens July 1, 1901, to continue six weeks. The plan of the school, which originated with Dean B. J. Johnson, has been worked out and will be carried on under the direction of the College of Engineering. The school, while bearing some relation in its courses of study to correspondence schools, is not in opposition, but should rather be considered as supplementary to them. At the School for Apprentices and Artisans those having acquired by correspondence or otherwise the theory of certain lines of practice, can spend their entire time in the shops or laboratories if they choose, and so put into practice and prove experimentally the scientific principles learned from books or by correspondence.

The school has been established for the benefit of machinists, carpenters, sheet metal workers and electricians; stationary, marine and locomotive engine men; shop foremen and superintendents; superintendents of water works, electric light and gas plants, power stations, factories and large office and store buildings; for business men interested in technical affairs, and for young men who wish to qualify themselves for such positions. For these employments the full four years professional courses in engineering are not required, and yet to satisfy the present demand on this class of men it is necessary for them to obtain a certain amount of technical knowledge. In the case of apprentices the purpose of the school is to give them a theoretical and practical instruction in the line of their trade, which they would not get in the shops, but it is not the purpose of the school to give the shop practice which they are expected to receive in serving their apprenticeship.

The machine trades lie at the basis of all manufacturing, and superiority in these very largely sustains our modern prosperity. The practical abandonment of the apprenticeship system also, as a result of the very general adoption of labor-saving machinery, and the common practice of confining a workman to the operation of a single type of machine, leaves our young men with no means of acquiring that wide and thorough knowledge of the machinists trade which formerly they could obtain in the workshops by a long apprenticeship. For these reasons some new kind of industrial education becomes imperative. Some examples may serve to illustrate the advantages to be derived in special cases.

Detailed information on the ground covered by the six week course of study was included in the paper, all of which can be obtained by application to the university authorities.

Thursday morning the convention was opened by the reading of an invitation to the members of the Association to attend an electrical exposition to be held in Milwaukee, Sept. 7 to 28, 1901, the invitation being signed by Chas. G. Armstrong.

Prof. Dugald C. Jackson was voted an honorary member of the Association.

The Efficiency Curve of a Shunt Motor and Its Relation to Operating Characteristics and the Cost of Operation.

The first part of a paper with the above title, read by Prof. Budd Frankenfeld at the Sheboygan convention of the Northwestern Electrical Association, was devoted to an investigation of the factors entering into efficiency, and the conclusion is established that the maximum efficiency is reached when the loss varying as the square of the armature current equals the fixed losses. After a study of the nature of the various losses, the method of testing for efficiency was outlined.

By far the most convenient and accurate method of testing efficiency is the stray power method. In this method the losses are measured after the machine has reached normal full-load temperature, and the efficiency curve is computed from the measured losses.

In making an acceptance test on any machine, it should first be submitted to a temperature run. This matter is so thoroughly covered by the rules of the American Institute of Electrical Engineers that nothing need be added as to requirements or methods. Before starting the temperature run, the motor should be adjusted for the best possible working conditions. The brushes should be properly set and fitted to the commutator and their tension adjusted for the least possible friction consistent with good commutation. Any necessary alignment of the bearings should also be attended to. This is but fair to the manufacturer.

Unless some means, such as a Prony brake, for measuring the power delivered by the motor is provided, the question as to just what the full-load current is will rise. This may be had from the manufacturer; absolute check on him will be obtained after the efficiency is calculated, and if there is any discrepancy a second temperature run may be made, using the corrected full-load current. Another method is to calculate the current from an assumed efficiency, and then make a second run at the corrected current. The motor may be loaded up either on an actual load or by some one of the three machine methods. In giving the method of test, it will perhaps make it clearer to follow out the steps in the test of a specific motor.

The motor is a four-pole, 110-volt, 5-hp machine, running at 1000 r. p. m. The full-load current is 41.5 amperes, of which 1.5 amperes is field current. It has been running for four hours at full load, and has been found to have reached a constant temperature, the thermometer on the field coils and the field current both having been steady for the last half hour.

The voltmeter across the terminals of the machine reads exactly 110 after correcting from the calibration curve of the instrument, and the corrected reading for the ammeter is exactly 1.5. The field loss is, therefore, $110 \times 1.5 = 165$ watts. Only the corrected readings are used in this test.

With a low-reading voltmeter tests are now made for loss in the lead wires of the machine and their contacts. The drop is found to be almost nothing, which speaks well for the design and workmanship. In this case the loss is so small that it may be neglected.

The motor is now shut down and a large water rheostat is placed in series with the armature. A low reading voltmeter, having a resistance of about 100 ohms per volt, is connected across segments that are under brushes of opposite polarity, the contact being made on the segments, not on the brushes. A current is now sent through the armature and readings of both voltmeter and ammeter obtained. This being a four-brush machine, voltmeter readings are taken under each pair of brushes. Four such readings are possible. This operation is repeated with five or six different currents, and the resistances found by dividing volts by amperes are computed and averaged. This average is 0.25 ohms. This same set of readings is necessary to compute the rise in temperature in the heating test.

The machine is now started up as a motor without belt or load. The voltage is adjusted to exactly 110, and it is found that the armature current is 2.42 amperes. The watts consumed by the armature used up as I^2R loss. This leaves nearly 265 watts as the stray power.

The various components of the stray power can be separated out by a somewhat involved method, but this is a problem of more interest to the manufacturer than to the purchaser.

The low reading voltmeter is again called into requisition. It is provided with a pair of flexible cords terminating in stiff, pointed copper rods about 6 inches long. Arrangements having been previously made, the machine is shut down and started up as a separately excited dynamo without load. One of the copper points is held on a brush close to the commutator, the other on the commutator opposite the center of this brush. This central position is determined by shifting the latter point until the voltmeter reads zero. Full load current is now thrown on, care being taken not to change the position of the point. The voltmeter reading is found to be very unsteady, and a condenser of about one micro-farad capacity is then shunted across its terminals, the trial being made again. This time a fairly steady reading of 1.25 volts is obtained, and it is found to be about the same for all the brushes, and also for various loads, excepting at currents below four amperes, where it appears to be negligible. Thus no correction need be made for brush drop in the stray power measurements. The total brush drop is then $1.25 \times 2 = 2.5$ volts.

The efficiency curve of the machine may now be calculated. Assuming an armature current of 10 amperes, the total intake in current will be $10 + 1.5 = 11.5$ amperes, and the efficiency will be:

$$\frac{110 \times 11.5 - 265 - 165 - 10 \times 2.5 - 10 \times 0.25}{110 \times 11.5} = \frac{285}{1265} = 62.1\%.$$

The rated output of the machine being 5 horse-power, or 3730 watts, the load at this assumed current will be $\frac{285}{3730} = 21$ per cent of full load.

The efficiency at any other current may be found in a similar manner, but the computation may be simplified by a graphical construction. In Fig. 1 the armature current is plotted along the horizontal line and the losses in watts vertically.

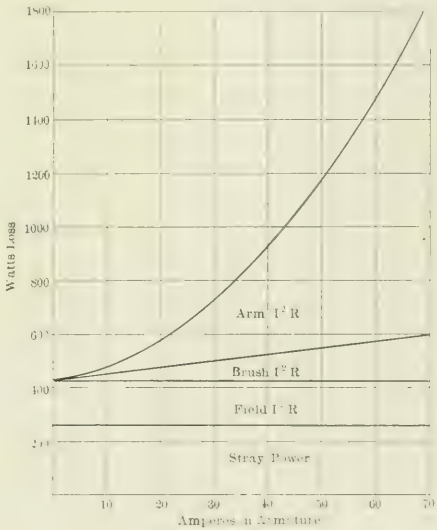


FIG. 1.—EFFICIENCY CURVES.

The first line from the bottom represents the 265 watts stray power; the next line above it is drawn at a distance representing 165 watts, the field loss. Both these losses are shown to remain the same regardless of the armature current. The other losses vary; the brush I^2R directly with the current, as shown by the slanting straight line, and the armature I^2R as the square, as represented by the distances between the slanting and curved lines. The distances between the slanting line and the upper curved line are calculated for several currents, their values being plotted and a curve thus drawn. The sum of all the losses at any assumed armature current can now be obtained by reading the vertical distance at that current from the base line to the upper curve.

An efficiency curve is thus calculated, and it is shown as efficiency curve, *I*, in Fig. 2.

SELECTION OF A MOTOR.

In order to bring out points in the selection of an electric motor, four machines of 5 horse-power each were designed and some of their

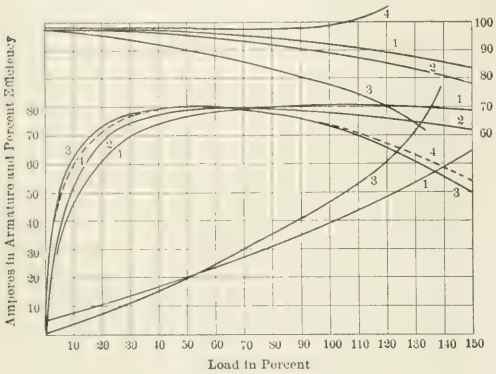


FIG 2.—EFFICIENCY CURVES.

characteristic curves plotted in Fig. 2. Only those features influenced by the form of the efficiency curve will be considered. Temperature and sparking limits are fully covered by the rules of the American Institute.

Motor 1 represents the average slow speed machine of a reputable manufacturer. Its maximum efficiency is reached at full load and is 80 per cent. The other motors have the same maximum efficiency. In 2 it occurs at three-quarter load and in 3 and 4 at half load. The speed regulation of machine 1 is shown by the curve marked 1 at the top of the cut.

Machine 2 has a smaller stray power and a higher armature resistance. The greater drop in volts for a given current, due to armature resistance, of necessity causes this motor to slow down more. Its regulation, as shown by the curve, is about 3.7 per cent lower at full load than that of 1, but this is not objectionable for most general purposes. It will be noticed that the efficiency curve is considerably higher at light load than that of 1, and that it is less than 1 per cent lower at full load.

Motor 3 has a still higher light-load efficiency and has the advantage of 1 in this respect up to 60 per cent load. At full load it is below 1 by 7.5 per cent. The speed regulation is something abominable.

Motor 4 has its maximum efficiency at the same load as 3, but it is differentially compounded for the same speed at full load as at no load. Its speed regulation is better than any of the others. A similar, though less marked, effect may be obtained by giving the brushes a large motor lead. It has a slightly lower light-load efficiency and a somewhat higher efficiency beyond 50 per cent load than 3. This is because of the change in magnetic flux with the load. This machine, if built in the ordinary way, is liable to spark under load, but there are designs that overcome this difficulty admirably. These designs involve some method of eliminating armature reactions. While more expensive to build, a lighter machine is the result and a higher efficiency is possible. Such machines are characterized by a relatively small amount of iron, a relatively large amount of copper on the armature and a small amount on the field. The curves, 4, really do not represent the commercial possibilities of this type.

One serious objection to a heavy differential compounding is the weak starting torque. A motor of this kind should not be used where a large starting torque is required. Another objection is the liability to reverse on a heavy over-load. This may be obviated by the use of a circuit breaker or a starting box having an over-load device. All motors should be so provided in any case.

The curves at the bottom of Fig. 2 show the armature current for different loads. Curve 1 applies to motor 1, and closely approximates motor 2. Curve 3 is plotted for motor 3 and closely approximates the performance of 4. At 50 per cent over-load machine No. 1 has the same current as 3 at 25 per cent over-load. This means that it will stand a heavier over-load than 3 for the same rise in temperature. No. 3 also requires 15 per cent more current at full load, but the current at light load is less.

The curve in Fig. 3 gives the cost of one horse-power at the pulley of a motor, for various efficiencies, the basis being 10 cents per kilowatt-hour. This price is taken merely for convenience. The correction for 12 cents would be obtained by multiplying by 1.2, for 8 cents by 9.8, and so on. It should be noticed how rapidly the cost increases as the efficiency drops off.

A comparison of the cost of operating motors 1, 2 and 3 will now be made on the basis of steady loads of several different values. The cost of operation is based on 10 cents per kilowatt-hour, and is figured for a working year of 300 days at 10 hours per day.

The accompanying table shows the cost at 25 per cent, 50 per cent, 75 per cent and 100 per cent load for each machine. It shows the advantage of working the motor at its point of maximum efficiency. A larger machine than the immediate needs demand is often installed in a small establishment on the faith of a growth in business. There is some reason in this. Motor 1, for instance, has an efficiency at half load of 76.7 per cent. It is doubtful if this could be beaten in a 2½-hp motor operating at full load.

Cost of operation of 5 horse-power motors, 10 hours per day, 300 days per year, at $0.10 per kilowatt-hour:

	25% *Load.*	50% *Load.*	75% *Load.*	100% *Load.*
No. 1	$426.50	$729.60	$1,054.80	$1,398.60
Less than No. 2	.....	.....	.....	15.90
Less than No. 3	.....	.....	24.30	146.40
No. 2	394.20	710.10	1,048.20	1,414.50
Less than No. 1	32.10	19.50	6.60	.....
Less than No. 3.....	.....	.....	30.90	130.50
No. 3	367.80	699.30	1,079.10	1,545.00
Less than No. 1	58.50	30.30	.....	.....
Less than No. 2	26.40	10.80	.....	.....

Motor 2 operating at half load will save $19.50 per year over 1; $6.60 per year at three-quarters load, and will lose $15.90 per year at

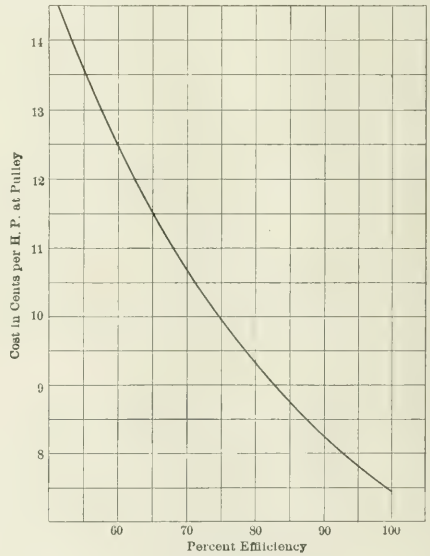


FIG. 3.—COST OF POWER AT THE PULLEY.

full load. In a term of eight years, 3 at half load, 1 at three-fourths load, and 4 at full load, the total cost of operation for machines 1 and 2 would be about the same; after that, if full load continued, 1 would be the cheaper machine. Where the future is in doubt, machine 2 is the better. It also saves $19.50 per year over a 2½ horse-power machine with a full-load efficiency of 76.7 per cent. A number of interesting comparisons of like nature can be made by a study of the table.

Let us now pass to the question of variable load. The following schedule is assumed:

4 hours at ¼ load.
2 " " ½ load.
2 " " ¾ load.
1 " " full load.
1 " " 1¼ load.

The average load is

$$\frac{4 \times 1.25 + 2 \times 2.5 + 2 \times 3.75 + 5 + 6.25}{10} = 2.475 \text{ H. P.}$$

This schedule may be taken as representing, roughly, the load in a small wood working shop, with a light running line shaft and several tools operating intermittently. The cost of operation for 300 days of 10 hours is as follows:

No. 1.— $1.25 \times 4 \times .1137^{*} = \$.5675$
$2.50 \times 2 \times .0973 = .4865$
$3.75 \times 2 \times .0937 = .7025$
$5.00 \times 1 \times .0933 = .4665$
$6.25 \times 1 \times .0941 = .5880$

2.8110
300

$843.3000

No. 2 = ... 833.73
No. 3 = ... 875.55

Machine No. 1 is $32.25 per year cheaper than No. 3, and 2 is cheaper than 1 and 3 by $9.57 and $41,82, respectively.

It is thus seen that the motor having its maximum efficiency at three-fourths load is the best all-round machine. This refutes the statement sometimes made that the maximum efficiency should occur at the average load; for 3 has its maximum at nearly average load, and is the most expensive to operate. Just where the maximum should occur depends upon the load schedule, and as this is seldom known and almost impossible to predetermine, it is at least safe to select a machine giving its maximum at about three-fourths load. Motor 2 meets these requirements. Its speed regulation is good enough for most purposes, and all other requirements can be easily met by the designer. Where absolute constancy of speed is demanded a differential compounding with some means for eliminating armature reactions should be employed.

Of course, there are all kinds of variable loads, and it is possible that under certain circumstances machine No. 3 may be the most economical. If direct connected to a tool where the load is light most of the time and full load is attained for an instant only, this motor would have a decided advantage. A heavy punch runs light excepting when the tool is being forced through the metal, and a planer requires a heavy current only during the moment of reversal. For such tools machine No. 3 is a suitable one. In some instances of this class it might even prove of advantage to compound it cumulatively, as close speed regulation is of no particular consequence.

The moral of this whole matter is to ascertain before hand the nature of the load and to specify the *value* and *position* of the point of maximum efficiency before purchasing a motor. *It is useless to specify any more points in the case of a shunt motor.* A large amount of data for getting the probable load is in the hands of manufacturers and consulting engineers. After purchase, the motor should be submitted to an acceptance test. Such tests are very commonly made where a large number of motors are installed under the direction of an engineer; but the average purchaser of a single motor usually buys "a motor" without knowing anything about it.

It is entirely possible that central station men would find it to their advantage to test motors free of charge for their small consumers, just as they have found it to their interest to test incandescent lamps and meters on request.

SUMMARY.

It should be borne in mind that most of the following conclusions apply particularly to small machines of not more than 15 horse-power capacity. Statements 11 and 12 are especially limited in this direction.

1. The point of maximum efficiency of a shunt motor occurs where the I^2R loss in the armature circuit (exclusive of brush I^2R loss) equals the sum of the fixed losses.

2. The earlier the maximum efficiency, the poorer the speed regulation.

3. An early maximum with excellent speed regulation may be obtained by a differential compounding.

4. Differential compounding, unless some device for eliminating armature reactions is employed, is likely to produce sparking.

5. If such device be used, a lighter machine of higher efficiency is possible. Its first cost will be higher.

6. A differential compounding should not be used where a great starting torque is desired, or where over-loads are likely to be heavy.

7. All motors should be protected with over-load devices for opening the circuit at a predetermined current.

8. In a shunt motor, the later the maximum efficiency, the greater the ability to withstand over-loads.

9. The cost of operation per horse-power hour, at the pulley, increases rapidly as the efficiency drops off.

10. Where the load is steady and always of the same value, a motor of a rating equal to the load should be used, the point of maximum efficiency being at full load.

11. If the load is steady but small, but is expected to increase due to growth of business, it might pay to install a machine of as high as double the immediate capacity. This does not hold for large units.

12. If the increased load is to come in a short time, say a year or two, the maximum efficiency should occur at full load; but if the time is distant and indefinite, but sure to come, the efficiency should reach a maximum at about three-fourths load.

13. For all-round service, where the load is subject to wide variations, the motor having its efficiency a maximum at about three-fourths load will give better economy than most of the present standard designs. Its speed regulation will not be so close, but still good enough for average shop purposes. The assertion sometimes made, that the maximum efficiency should occur at the average load, is not as a general statement correct.

14. In special work, such as the driving of metal planers and heavy punches, the maximum efficiency may be specified at as low as half load.

15. Ascertain the nature of the load before ordering the motor, then specify accordingly.

16. Test the machine before accepting it.

*From efficiency curve and Figure 3.

Incandescent Lamp Economy

A paper with this title was read at the recent Sheboygan Convention of the Northwestern Electrical Association, by Guy V. Williams, and as it possesses considerable practical value to the smaller central stations we abstract it quite fully.

During the past few years there has been but little choice in incandescent lamps insofar as initial claimed efficiency is concerned. 3.1, 3.5 and 4-watt lamps are offered; one chooses what appears best adapted for present needs, and takes what he gets.

An incandescent lamp is too often valued according to the number of lamp hours derived therefrom regardless of initial uniformity of candle-power, current consumption and candle-hours. Most of the prominent lamp makers may be depended upon to furnish initially satisfactory lamps, yet many lamps find their way to the market lacking in even this essential. A series of recent tests are presented to illustrate this.

Selected at random from a lot of 16-cp, 110-volt, 3.1-watt lamps and tested at their rated voltage:

17.0-cp.	50.0 watts
20.0 "	55.0 "
15.1 "	50.2 "
17.9 "	72.1 "
15.5 "	60.6 "

Average, 17.1-cp. 57.58 watts, 3.37 w. p. c.

Selected at random from a lot of 16-cp, 110-volt, 3.5-watt lamps, tested at rated voltage:

17.25-cp.	71.8 watts.
17.25 "	62.8 "
15.27 "	67.7 "
17.00 "	68.2 "
17.00 "	67.1 "
17.5 "	73.7 "

Average, 16.88-cp. 70 watts. 4.1 w. p. c.

The conditions shown by the above tests are not frequently met with now, another method having been adopted to secure the same

results, as shown in a test lot selected at random from a lot of 16-cp, 111-volt, 3.1-watt lamps:

14.6-cp.	49.0 watts.
12.5 "	49.5 "
14.5 "	49.0 "
14.05 "	49.8 "

Average, 14.06-cp; 49.33 watts; 3.5 w. p. c.

From a lot of 16-cp, 105-volt, 3.5-watt lamps:

11.25-cp.	58 watts.
11.00 "	50 "
10.25 "	54 "

Average, 10.8-cp; 55.3 watts; 5.1 w. p. c.

It will be noted that the total watts consumed by these lamps would not be excessive were they of full candle power, but it is excessive for the amount of light actually delivered. A watt-meter would not detect this fault in the third and fourth lots, but would in the first and second.

It is not meant to convey the impression that all lamp makers impose upon their customers in this manner, yet it is done more frequently than is generally believed. The only sure check is for every company to equip itself with a first class lamp testing outfit. It is not expensive and is really a necessity.

A standard portable voltmeter and an ammeter or wattmeter should be possessed by every electrical station. The photometer can be had at an exceedingly low price, so cheap, in fact, that no company can afford to be without one. The immediate result of persistently photometering all lamps is shown in a test selected at random from a lot of 16-cp, 110-volt, 3.1-watt lamps:

15.75-cp.	49 watts.
16.4 "	48 "
16.5 "	48 "
16.25 "	49 "
16.75 "	50 "

Average, 16.33-cp; 49.8 watts; 3.05 w. p. c.

From the statement made with reference to the initial efficiency of lamps it might appear that no advance has been made in the art of lamp making, but in fact there have been great improvements. The lamp of to-day has a better candle-power curve and is more uniform and when operated under similar conditions will give much better service than its predecessor.

It is unreasonable to expect the best results from lamps operated on a fluctuating voltage, particularly if the fluctuations carry the voltage above normal. They will doubtless stand 2 or 3 per cent increase, but the result will be shorter life and fewer candle hours. The following table shows the effect of increased voltage upon the candle-power total watts, watts per candle and life of the 3.5 watt lamp:

% voltage.	C. P.	Watts.	W. P. C.	% life.
100	16.	56.	3.5	100.
101	17.	57.2	3.37	81.5
102	17.9	58.4	3.26	67.8
103	19.	59.6	3.14	65.6
104	19.9	60.9	3.06	48.2
105	21.	62.2	2.96	40.2
106	21.8	63.5	2.9	30.

As to the loss of candle-power of lamps burnt above normal, the contrast between a new lamp and one that has burnt a few hundred hours is very slight when operated at normal, but becomes more marked as the voltage increases. Increasing the voltage to give a good light itself defeats the end most desired. Though the lamp will burn brighter at first, after a short while the candle-power curve shows a marked decline and soon falls below that of a normally operated lamp, so that during the latter part of the life it is really dimmer.

It is also erroneous to assume that a lamp burnt on a fluctuating voltage will give the best results, even though the average of the voltage is the same as the normal voltage of the lamp. As is well known, all lamps gradually lose their brilliancy almost from the moment they are put into service. A lamp's value is determined by its watts per candle-power and candle-hour area, or, in other words, by the amount of light derived from the current consumed.

The current consumed by a lamp during its life is worth ten-fold more than the lamp itself. It is estimated that the cost of free renewals will not exceed 15 per cent of the total expenses, so we may assume the 85 per cent representing fuel, labor and maintenance is the cost of the electric current, all of which is consumed in the lamps for the production of light. Is it not of importance, then, to know what is received for the greater part of the expense account? For this the use of a photometer is essential and should be a part of the regular work of every station. Unfortunately is it not, and inconsistent as it may seem, there are those who doubt the reliability of the photometer, while insisting strenuously that they want correctly rated lamps.

It is argued that the personal equation enters into the work with a photometer to such an extent as to render it almost impossible for two workers to agree, and that under the very best of conditions only approximate results can be obtained, consequently there is little satisfaction in working under the conditions ordinarily prevailing in a central station. Further, that as a number of factories furnish satisfactory lamps without being checked up, they will continue taking their chances, particularly as their employes are usually busy on other work which appears to yield a better and more immediate return.

Admitting that absolutely exact work cannot be done, we know that the photometer is exceedingly reliable and by using an incandescent lamp for a working standard and exercising proper care the percentage of error will be negligible, especially where comparative tests only are made.

That it is impossible to secure ideal conditions for testing lamps in the ordinary central station is also admitted. If the refinements of a lamp are to be brought out it is better to have the work done in a laboratory equipped for the purpose, but ordinarily it is more important to learn what results are being secured under the prevailing conditions. This will show what the customers are actually getting.

If the test shows the lamps to be unsatisfactory the trouble may be looked for in the voltage regulation, in the lamps or in both. In testing not only should different makes and types be tested, but also lamps of different voltages and efficiencies. It is frequently more desirable to make the lamp fit the voltage than to change existing voltage conditions. Particularly is this so if the voltage has been carried above normal, because, were it reduced the old lamps on the circuit would burn so dim as to make it necessary to replace them. Therefore it is better to determine just what lamps are best suited for the service and adopt them. By exercising great care in making these tests it will be possible in many instances to find 3.1 watt lamps so satisfactory that their use would be warranted.

The useful life of a lamp is determined by the number of hours it burns before losing 20 per cent of its rated initial candle-power. A simple method for determining the candle-hour area is to multiply the average candle-power by the number of hours in its useful life.

Until quite recently the highest efficiency offered in 220-volt lamps was 4 watts per candle-power, but now an exceedingly satisfactory 3.7-watt lamp is offered and recommended for general use. The filament of this lamp is unanchored. The useful life is about 650 hours and the area about 10,000 candle hours.

There is not nearly as much trouble in systematic lamp testing as is generally supposed. For a medium or small station an average of thirty minutes per day or three hours per week will usually suffice. If ten per cent of the lamps received are measured initially, a criterion of the entire lot is secured. If they are accepted, one lamp from each barrel should be placed in life test and another, as nearly as possible the same initially, preserved against the accidental breakage of the test lamp, when the test may be started again with this second lamp. The readings may be taken after every hundred hours burning, the candle-power curved plotted and the area calculated.

A suitable test rack may be placed at some convenient point where it is possible to keep an accurate account of the hours of burning. As the object is to learn the area or candle-power hours delivered to the customers it is neither necessary nor desirable to make an effort to deliver a more uniform voltage to the test lamps than to those in regular service.

This will place the lamp maker in a position to compete on the basis of the merit of his lamps and an incentive is offered for greater effort on his part to improve the quality thereof. There is no reason why lamps should not be brought on the basis of their true worth rather than as simply so many glass bulbs, brass bases and filaments.

A series of tests made by a large central station on five makes of lamps is presented to illustrate the value of making tests as above outlined. Each lot consisted of ten lamps. Lot 1 gave the best results and was used as a standard for comparison. The lamps tested were 111-volt, 3.1-watt. The comparative value of the lamps is as follows:

Lot 1—Average area, 8200.0 candle hours, or 100.0 %.
Lot 2—Average area, 4032.0 candle hours, or 49.2 %.
Lot 3—Average area, 3927.9 candle hours, or 47.9 %.
Lot 4—Average area, 2522.2 candle hours, or 30.8 %.
Lot 5—Average area, 615.7 candle hours, or 7.5 %.

The comparative value of the lamps is proportional to their candle-power area. The accompanying illustration gives the curves of one test, in which the candle-power area of Lot 2 is 62.9 percent of Lot 1.

Taking Lot 1 as the standard for comparison, Lot 2 having an area of 49.2 per cent as much, the lamps are worth just 49.2 per cent of

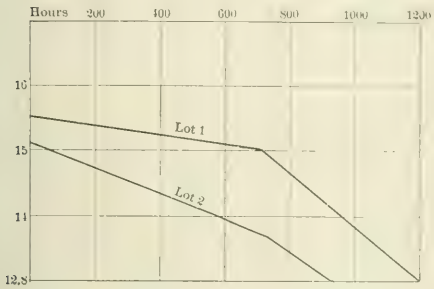


FIG. 5.—CURVES OF LAMP TEST.

those in Lot 1. On this same basis the value of each of the other competing lots may be determined.

With this in view it would appear that the photometer is really quite valuable when properly used and the benefits to be derived therefrom are greater than can be derived from any other source for the same outlay.

The Industrial and Electrical Situation in Germany.

By DR. LIONEL FLEISCHMANN.

UNDOUBTEDLY many people in this country have been surprised to hear of the unsatisfactory financial conditions now prevailing in the German electrical industries as emphasized by the collapse of the Kummer concern in Dresden. Still, to the unbiased onlooker who was cognizant of the state of affairs prevailing in the United States after 1893 this has not come unawares.

If we want to grasp the existing situation fully we must go back to the nineties. Up to that time the German industries had made slow but steady gains, owing to conservative management and careful and painstaking work. The wealth of the country was accumulating, interest on money declined, and Herr von Miquel, then Minister of Finance of Prussia, created the new type of 3½ per cent and 3 per cent German Government loan. This conversion took place during the same years when all financial conditions in the United States were unsettled, causing many German holders of American securities, afraid of free silver, to sell out. Both these events created a plethora of money which was looking for paying investments. The numerous industrial banks were quick in grasping the situation. Electric power transmission over long distances had been proven a possibility during the International Electrical Exhibition in Frankfort, and the lay world was only too willing to believe that this new force would in a very short time revolutionize all then existing modes of travel and lighting.

A number of smaller electrical concerns doing a limited business were then in the field. The banks bought them up and floated the shares, the first issues of which were sold at a moderate premium. All larger German towns were then contemplating the erection of lighting and power plants. Each concern tried to secure as many orders as possible, and nothing was done to distribute this demand over a larger number of years. The then only medium-sized shops had to be enlarged rapidly, demanding new capital which the public was only too willing to subscribe at a high premium, as actually big orders were in hand. This was the first period.

Of course the number of towns being limited outright orders did not continue coming in as fast as in the beginning. The shops, once erected, had to be kept busy, and the electrical concerns, like the man who buys horses and a truck in order to cart the feed for these very same horses, began founding subsidiary companies. With what result we shall see. Contrary to the practice in this country, public franchises are not given away as a present in Germany. Then the subsidiary companies stepped in as bidders, and there being as many of these companies as factories, a scramble began and prices for franchises went up. In some cases the municipality had the plant built by an electrical concern, leased it to the subsidiary company, which not only guaranteed a fixed interest on the invested amount, but also promised to divide the net earnings, giving the greater amount to the municipality. Besides, horse car lines were bought up and converted into electric lines. These for some time proved to be the most profitable undertaking. But this, too, came to an end. Then the subsidiary companies turned their activity towards foreign countries. Buying up water-power plants wherever they were to be found came to be the fashion. At one time, calcium carbide factories were the fad, in consequence of which the price of this article is to-day so low that a good many of those factories work at a loss. The financial relations between each minor company and its factory were such that each held a large amount of the other's shares, and as the German laws prescribe that in the balance sheet valuation of stocks the latter have to be either carried at cost or at their market value, the lower always having to be taken, a sort of pyramiding in decline or rise was the consequence.

This gives the clue to the present situation. There is no doubt in my mind that the remedy for all these troubles will be the one which has worked such wonders within the last five years in the United States, namely, consolidation.

Conversion from Alternating-Constant Potential to Constant-Alternating Current.*

In a paper with the above title, read at the recent convention at Ottawa of the Canadian Electrical Association, Professor R. B. Owens, after referring to the several methods of street-arc lighting, considered in detail the constant-current transformer system, and in particular pointed out the advantages of a method of obtaining constant current from constant potential by means of a combination of impedance coils and condensers.

The special merits of the first-mentioned system are stated to lie in its high efficiency and close regulation, and the small space required as compared with motor generator sets, and the insulation of the arc circuits from the generator. The power factor is, however,

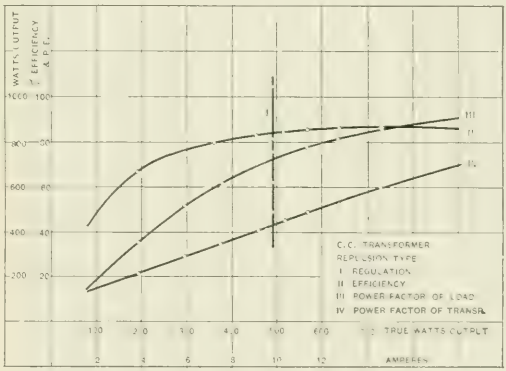


FIG. 1.—TESTING SMALL CONSTANT-CURRENT TRANSFORMER.

poor, about 80 per cent under favorable conditions at 60 cycles, and 70 per cent at 125 cycles, and decreases rapidly with the load.

Fig. 1 gives the results of tests of a small constant-current transformer—1 kilowatt, 1000 volts, 1 ampere—of the repulsion coil type. The performance of so small a unit is not as good as can be obtained in larger sizes, but, as all sizes possess certain characteristics in common, the results shown will serve purposes of comparison.

Curve 1 is the regulation curve, and shows that with proper adjustment the regulation may be perfect. Curve 2 is the efficiency curve, and shows that while the maximum efficiency is not high in

*Abstract of paper read at the Ottawa Convention of the Canadian Electrical Association.

this particular size, nevertheless a good efficiency is maintained throughout a considerable range. Curve 3 is the power factor of load, and curve 4 is the power factor of the transformer and load. It will be noted that the power factor of the combination is uniformly lower than the load power factor, which is characteristic of all sizes within the limits of commercial practice.

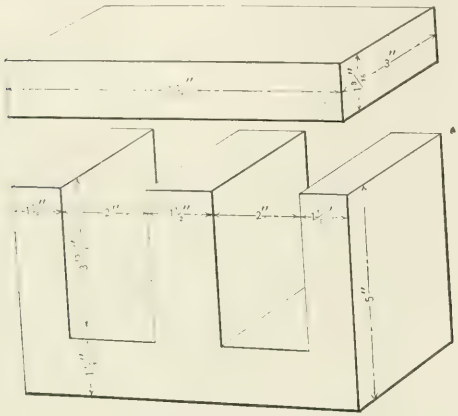


FIG. 2.—FORM AND DIMENSIONS OF CORE.

The particular object of the paper is to emphasize another method of constant potential-constant current transformation which, while known for some time, in the opinion of the author has not apparently received the attention it deserves. This consists in the combination of impedence coils and condenser shown in Fig. 2, due originally to Leblanc, and treated mathematically by Steinmetz and others.

From the theoretical consideration it can be shown that when a constant potential is applied to two equal magnetic reactances with a variable non-inductive receiver circuit, the receiver circuit and one reactance being shunted by a condenser whose capacity reactance equals either magnetic reactance, the current in the receiver circuits will remain constant and be independent of the receiver circuit resistance.

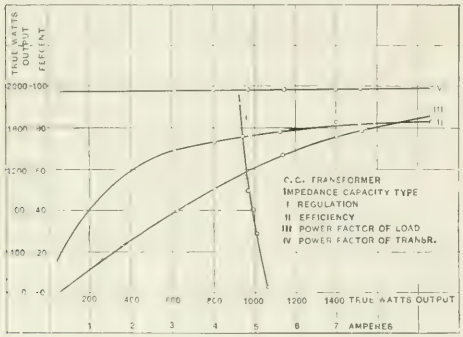


FIG. 4.—RESULTS OF TEST.

To test such an arrangement practically two impedance coils were constructed, their reactances being made variable by the insertion of strips of rubber under their keepers, and connected in series with a smaller coil of constant reactance and a variable non-inductive receiver circuit. The form and dimensions of the core are given in Fig. 2. The coil consisted of 490 turns of No. 12 B. & S. wire, having a resistance of .98 ohm. The laminations of the core were of 16 mil iron.

Fig. 3 shows the arrangement of the apparatus. A 28 microfarad condenser shunted the receiver circuits and the two impedence coils. The reactance of the two coils in the receiver circuit was made as nearly as possible equal to the reactance of the remaining impedance coil and also of the condenser. Five hundred volts at 55 cycles were then applied to the main circuit, and the efficiency and the power factor of the combination noted, as well as the current in the receiver circuit.

The results of the test are given in Fig. 4. As the power factor of the receiving circuits is varied from a small value to something over 80 per cent, it will be noted that the power factor of the main circuit remains throughout practically unity.

The efficiency is nearly constant through a wide range, although not high in this particular case, due to the design of the impedence coils. The regulation curve shows that the current in the receiving circuit varied only some 6 per cent between half and full load, a sufficiently satisfactory result. Perfect regulation, however, can be obtained with better proportioned apparatus.

On the whole, the results, though not as good in some particulars as can evidently be obtained after a full development of the system, are nevertheless of considerable interest to central station managers, as they clearly point to a method of constant potential-constant-current transformation possessing the characteristics of high efficiency, unity power factor, close regulation, absence of moving parts and requiring a comparatively small floor space. In conclusion, Professor Owens expressed the hope that some of our larger makers will devote further attention to the method.

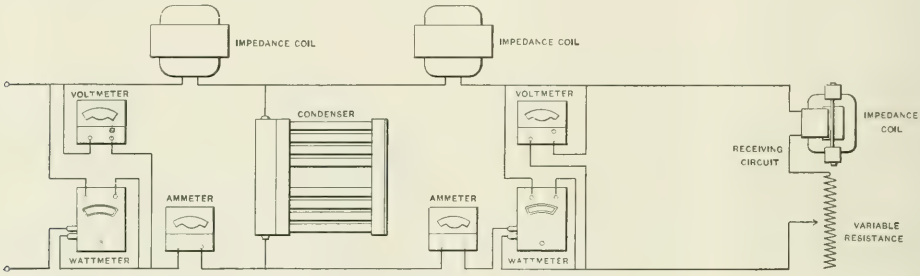


FIG. 3.—ARRANGEMENT OF APPARATUS.

The Telephone in Railroad Service.

In a paper with this title read by Mr. F. P. Valentine before the recent Buffalo meeting of the Association of Railway Telegraph Superintendents some very interesting facts were given, which show the remarkable growth in the use of the telephone in the operation of railroads. It is estimated that to-day, in the United States, there are some 200 private branch exchanges operated by the various railroad companies, connecting over 5000 stations. The growth which has taken place in the last three or four years has been such as to indicate unlimited possibilities in the way of development within the next few years.

Mr. Valentine then noted a few of the many uses to which the telephone is now applied in railroad work. Among these are calls for reservations, information as to time of arrival and departure of trains, and a multitude of other questions. It was stated that the ticket office of the Fall River line in New York is one of the busiest in the country from a telephone point of view. As an illustration of what the public has to suffer from insufficient telephone facilities, it is interesting to note that even with a branch exchange having five trunk lines to the public, with a telephone in the ticket office, with one man giving his entire time to the reservation of staterooms and with the switchboard operators relieving him of many calls by giving general information when reservations were not needed, the lines were still reported busy 1600 times in one day. As may be

imagined, such a condition of affairs brought serious criticism from the public, and it was necessary in this case in order to relieve the congestion on the wires, to double the number of trunk lines, holding them exclusively for incoming business while other lines were installed for the outgoing traffic. A small turret switchboard was installed in the ticket office, having several lines to the main branch exchange switchboard. This enabled the clerk in the ticket office to handle several lines at once, and in an emergency two clerks could be taking the calls and giving out the reservations. When the number of calls for the ticket office was greater than could be handled on the lines between the switchboards, the operators were instructed to take the numbers of the subscribers and call them up in rotation as they were able to handle them. The conditions in this case were almost the reverse of the usual use of a branch exchange for, ordinarily, calls coming in over the trunk lines are switched to many different points, while here the bulk of the business was for one office. Like conditions, undoubtedly, prevail at many points, perhaps to a less extent.

He next pointed out the utility of the telephone in freight offices, where calls for rates and information as to shipment or delivery can be quickly furnished. At one of the largest freight yards in the country there is a completely equipped branch exchange in which three clerks are employed to furnish such information. Many receivers of freight are notified by telephone at once of the arrival of goods, thus securing prompt removal of the freight and relieving congestion in the freight houses. Where there is much competition for business between different roads, it is often necessary for a traveling agent to get into immediate touch with his superior. If he can step to the nearest pay station and call up the local switchboard of his company and through them be connected with headquarters of his company, in two or three minutes the matter may be settled, perhaps resulting in the securing of business that otherwise would go to a competitor.

Insufficient telephone equipment, resulting in the constant inability of prospective shippers to get into communication with railroad offices will often lose a large amount of business when an immediate decision must be made, and it is found that the offices of a competing road are, through adequate telephone facilities, easily reached. A certain telephone company, noticing such a situation, took pains to have the lines of two competing railroads monitored and the result showed that the road whose telephone was constantly reported "busy" lost enough business to its competitor in one day to pay the rental of a complete branch exchange equipment for a year.

Mr. Valentine then instanced the use of the telephone at a large terminal where every tower and switch cabin is connected to a switchboard in the passenger station, thus keeping dispatchers, yardmasters, towermen and switchmen in close touch with one another. All concerned being kept posted as to the situation within the yards it was now possible to extend and continue to a safe time limit the switching movements involving the main line tracks, whereas, before this use of the telephone, delays to trains on the main line were inevitable. Other resulting economies were effected, one being the saving of two switch engines.

One of the largest passenger terminals in the country has a very complete telephone service, the main exchange being located in the office building. Every official has direct connection from his desk to the exchange. The general yardmaster, the trainmasters, towers and cabins are all connected to the switchboard, besides having direct lines to the points with which they have most business. The main interlocking tower, which controls all the yard movements incidental to handling 775 odd trains pr day, has a special switchboard, to which are connected the outlying towers, switch cabins, yardmasters, signal bridges, etc., with trunk lines to the main exchange. Incoming trains are reported to the operator by telephone, and he is constantly in touch with every movement being made. Not a telegraph instrument is in use at any of the yard points, the telephone being the only means of communication. The yardmaster also has a small switchboard, giving him direct connection with the various points he has to reach. In case of a bad fog, when the signals cannot be readily seen, men are stationed at the signal bridges on which are placed telephones in boxes connecting with the switchboard in the interlocking tower, and the trains are handled without delay and with safety. There is hardly a place in the immense plant where any man is stationed, having special duties, that he cannot be reached at once by telephone. All wires are underground—not an overhead wire in the yard—and there has yet to be an instance of any failure in the service night or day.

In installing telephone systems a great mistake is often made by railroad companies, Mr. Valentine said, in endeavoring to economize in the number of instruments. Enough should be provided to care for every branch of the service under any conditions that may arise. This is especially true in relation to offices handling train service. The branch exchange should not only afford connection with points in the immediate vicinity of the terminal, but it will be found advantageous to extend the lines to the outlying towers and stations, supplementing the telegraph service, and in many cases economizing in the number of telegraph operators it is necessary to employ, as there are many stations and towers where it is unnecessary to issue train orders and the use of the telephone relieves the telegraph wires of miscellaneous business which often delays more important matters. If the extension of these lines from the switchboard is carried out so that a pair of wires is run along the main line through the more important divisions, such wires also become valuable in emergencies. If a wrecking car is equipped with a compact telephone set, as soon as the car arrives at the scene of the wreck, instant communication may be established with the dispatchers and division headquarters by means of these division lines. Several instances have occurred recently demonstrating the value of this emergency service, where a telephone was attached to a telegraph pole within a few feet of the wreck, connected with the wires running to the switchboard at division headquarters, allowing the division superintendent, who was on the ground before the wrecking car arrived, to keep in touch with the dispatcher and the towers on each side of the wreck, and, as soon as one track was clear, permitting the movement of a number of delayed passenger trains with little loss of time. In this case no telegraph was available, but it was the opinion of the superintendent that, had it been, the work could not have been accomplished with equal satisfaction or expedition.

He pointed out the advantage of connecting the various block signal stations by telephone as well as by telegraph. In some instances block stations on entire divisions have been equipped by telephone on lines running to switchboards at division headquarters to the exclusion of telegraph, and all business with and between the towers is transacted by telephone. He next referred to the advantageous use of the telephone in connection with the train ferry service in New York Harbor, where the railroads are required to float their cars from the docks of one road to those of another. By the use of the telephone dispatching system an appreciable increase has been made in the number of cars handled daily, and an economy in tug movements.

While it is universally admitted that the use of the telephone under the branch exchange system at terminals is essential, it is only recently that progress has been made in connecting the various terminals by long distance lines. This has opened up a new field, and the results obtained by connecting the various switchboards in different cities along the line of the railroads are leading to serious consideration on the part of railroad officials of extensive additions to this service. The fact that a general officer, sitting at his desk, is enabled to communicate almost instantly with his subordinates at all points on the line effects great economy in the transaction of business and excels in value the use of the telegraph or train mail. The fact that principals can deal direct with one another instead of through the medium of a telegraph operator has much to do with this. Five minutes conversation will often accomplish more, with definite results, than half a dozen letters or telegrams, with the delay involved in handling the matter by the latter means. The railroads that have established these long distance lines are finding them increasingly used, from the executive down.

While the expense of installing these lines makes it necessary to economize in their use, it is astonishing how much business may be transacted daily over one pair of wires, if the service is properly handled. From records taken, the average length of time consumed per connection on railroad business for calls between distant points appears to be about three and one-half minutes. This would permit in nine business hours about 150 messages. If such lines extend over a large territory, connecting several switchboards, of course, the different parts of a line may be worked simultaneously without interference. To obtain the best results a careful study of the use made of the lines by the various departments and of the handling the calls must be made. This will show that by properly systematizing the operation it is possible to increase the capacity of the line surprisingly. A long distance line in operation by one of the leading railroad companies of the country, connecting branch ex-

changes in four cities on its main line, thus breaking the line into three sections, is handling some 250 calls per day very comfortably, and it is estimated that some 10,000 letters and telegrams per month are saved. This cannot but have its effect on all branches of the railroad service. It is not thought that the maximum capacity of the line has yet been reached. The operators have been carefully trained in the handling of the calls for the various officials, preference being given to those highest in authority.

By discriminating between calls, and by intelligent operation, practically instantaneous service is afforded the executive officers, while other calls of importance are handled next, leaving less important business to fill in the time on the wire. To accomplish such results, a system of tickets carefully checked is necessary. These tickets should show time call was received, forwarded, connected and disconnected, with a code record of all attempts made to complete connection, reasons for delays, etc. The facts thus shown are often of value in case of dispute, and, from these tickets, a chart can be readily made, showing just what the line is doing at any minute during the day. From such a chart defects in operation can be immediately detected and corrected. With the development of this class of service many problems arise which require careful study, as many of the conditions attaching to public service do not apply to the railroad service.

As to the equipment best suited to the needs of the various departments, Mr. Valentine thought the subject worthy of some attention. Originally a desk set was considered somewhat of a luxury, but in the case of an official having to answer from 30 to 40 calls per day, much time is saved by the telephone being right at hand instead of his being obliged to leave his desk for the call. Some rather interesting figures have been taken giving the comparative results of the use of the desk stand as compared with the ordinary wall equipment. In the case of two railroad exchanges connected by a long distance line, one being equipped mostly with wall and the other with desk stand sets, it was found that it took, on an average, 50 seconds longer to get the person ready to talk with wall sets than with the desk stands, which, on the number of long-distance calls per day, amounted to a loss of one out of six busy hours in the use of the circuit. The rental of the line amounted to several dollars per day, while the cost of proper equipment was but a few cents per day.

In closing his paper, Mr. Valentine called attention to several matters of practical importance in developing and equipping a railroad telephone system. He advocated uniformity of equipment, and held that a properly organized force to make repairs, inspections, etc., should be maintained. The residences of operating officials should be equipped with a telephone so that such officials could be quickly reached out of business hours in case of emergency. He pointed out that a great deal of dissatisfaction with telephone service, resulting in claims of liability to error in the transmission of messages by telephone, was due to the fact that only about 10 per cent of the users of telephones know how to talk and use the instrument properly. Telephone patrons should be taught to use the instrument.

It has been found of some advantage to utilize stenographers as switchboard operators, so that messages may be taken in the absence of the person desired, and on his return can be delivered to him. The use of stenographers and typewriters in connection with railroad telephone service will, Mr. Valentine thought, be developed with the extension of the service. It is imperative to use only the best class of equipment to give satisfactory service. Much of the criticism as to the danger of transmitting train orders by telephone has been justly based on the poorly constructed lines and cheap equipment used by many of the railroads under the belief that economy in initial cost is the principal thing to be considered. "It can be predicted," said Mr. Valentine in conclusion, "that the next few years will see some developments in the application of telephony to railroad service that will surprise some of those whose conservatism has led to the long delay in the appreciation of what seems destined to become the chief means of communication of the future."

In the discussion of Mr. Valentine's paper, Mr. Henry W. Pope, of the Buffalo Bell Telephone Company, gave a very interesting account of his company's methods, and how some of the problems mentioned in Mr. Valentine's paper had been solved. Touching the subject of party line service he stated that he did not believe in it, and that all such service, especially on business lines, had been rooted out in Buffalo. He advocated a more liberal use by railroads of trunk lines, and pointed out how easy it was for railroads to lose business by not having adequate telephone facilities. The successful operation of branch exchanges depended much upon the operator. He advised getting operators from the telephone companies for branch exchanges, because they were better trained to the work. He pointed out that many of the alleged troubles with the telephone service were not due as much to the telephone as to the person using it. Not one person in a hundred, he said, knows how to use a telephone properly. The people required to be educated in this respect, and he proposed to make this subject a matter of thorough study when his company got things in shape. In speaking of the wide field of application of the telephone, he referred to the use of telephone street boxes on electrical railways in Buffalo. There were many of these boxes in use. A flash lamp was used at each box, thus enabling headquarters to reach cars out on the line by flashing the lamps. On seeing a lamp flash the conductor or driver is required to dismount from the car and communicate with headquarters from the box for instructions.

The Edison Storage Battery.

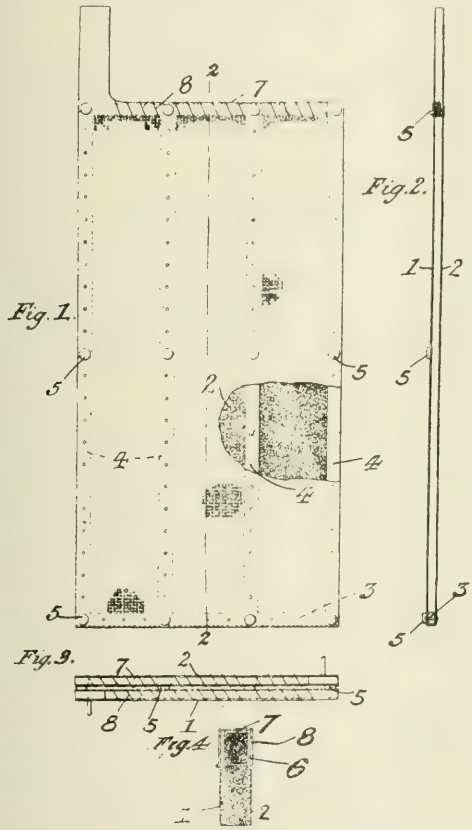
We reproduce below from the June issue of our English contemporary, *The Electro-Chemist and Metallurgist and Metallurgical Review*, what appears to be the full specifications of an English patent recently granted to Edison, and relating to the type of cell which formed the subject of a paper recently read by Mr. A. E. Kennelly before the American Institute of Electrical Engineers.

In the drawings, Fig. 1 is a face view of one of the plates for supporting the elements, having pockets or receptacles, and showing the front wall partly broken away; Fig. 2 is a section on the line 2—2 of Fig. 1; Fig. 3 is a plan showing two of the plates forming a single combination, and Fig. 4 is an enlarged detailed section.

Each plate is formed with two walls 1 and 2 of very thin sheet nickel (say, about .125 mm. in thickness) bent around a horizontal frame 3, from which extends the vertical spacing frames 4, 4, to all of which frames the sheet is secured by nickel rivets to form a strong, rigid, hollow plate with pockets or receptacles between the vertical frames 4, 4. The walls 1 and 2 of the plates are perforated with small holes arranged very close together and about .75 mm. apart. These holes may be punched in the plates as shown, but they are preferably formed by merely stretching the metal without removing it, forming burrs projecting inwardly from each hole, thereby greatly increasing the area for contact between the metal and the active material. Nickel is preferably used in the construction of the plates, as it is not electrically oxidizable in an alkaline solution, but iron may be employed if carefully and perfectly plated with nickel, or the frames 3 and 4, instead of being made of nickel or of nickel-plated iron, may be made of hard rubber or other inert material, to which the perforated sheet is riveted. A number of insulated spacing blocks 5, 5 are secured to the plates to prevent them from touching when immersed.

In the manufacture of the new oxidizable element, monosulphide of iron is first preferably taken and crushed so that the particles will pass through a screen having about 6.4 openings per square millimeter, and about eight parts by weight thereof are mixed with about two parts by weight of flake graphite, the particles of which are somewhat larger than the perforations in the plates. This mixture is moistened with a 20 per cent solution of potassic hydroxide, and the dampened mass is packed into the pockets or receptacles of the proper plates by a suitable tamping tool, after which a wad of asbestos fibre 6, about 6 millimeters in thickness, is introduced into the pocket or receptacle above the mass, being held in position by a strip of sheet nickel 7 secured in place by nickel wires 8. The element thus formed is subjected to electrolytic oxidation in a solution of potassic hydroxide, sulphur being set free and combining with the alkali to form a potassium salt, which diffuses out of the mass, and the iron being converted to an hydroxide thereof. The diffusion of the alkaline sulphur compound is facilitated by alternately reversing the oxidizing current to subject the contents of the plate to successive oxidation and reduction until the whole of the sulphur is eliminated. The element will then be ready for use when the iron has been reduced to the metallic state. Since iron does not decompose water, there is no local action between it and the graph-

ite. The iron oxide formed as explained increases the bulk, and, being mixed with graphite, produces considerable pressure on the walls of the plate, thereby preventing any disturbance of the initial state of the mass, even when internal gas is strongly generated by overcharging. The object in using the monosulphide is to secure the greatest amount of iron oxide in the smallest space and in the peculiar form capable of being reduced to the metallic state electrolytically. Dried oxides of iron are not reducible to any extent by the current; spongy iron reduced by hydrogen from different iron salts is oxidizable only to a slight extent by the current; iron hydrates are very bulky and difficult of use without drying, which operation effects some obscure change therein to render them nearly inert in the presence of a reducing current; and bulky ferric hydroxide is capable only of slight reduction. In fact, the only oxide of iron capable of reduction appears to be that produced as explained or when monohydrate is produced by boiling ordinary ferric hydrate



FIGS. 1, 2, 3 AND 4.—EDISON STORAGE BATTERY.

for many hours in water; but in the latter case the increased bulk prevents the introduction of as much iron into the pockets as with the hydroxide obtained by the oxidation of the monosulphide. By forming the oxide in the first instance, as explained, from the monosulphide, the oxide is secured in very compact form and capable of being perfectly reducible by the current. Furthermore, finely divided iron obtained as described, when subjected to electrolytic oxidation, does not form a soluble ferrate. The improved oxidizing element is therefore absolutely permanent, so that the electrolyte is not changed at any stage of the working.

As to the improved oxygen storing element, the inventor has discovered that the lower oxides of nickel and cobalt, when in contact with a conductor in an alkaline solution, can be almost wholly raised to a higher stage of oxidation electrolytically, which higher oxides revert to the lower stage by reduction with extreme ease, and he has therefore constructed an oxygen storing element which is capable of great capacity, of less weight, and of higher permanency than any electrode for the purpose which has heretofore been applied. Neither nickel oxide nor cobalt oxide is appreciably soluble in an alkaline electrolyte. Both give nearly the same voltage in use, but nickel is preferable on account of its cheapness. I therefore preferably first precipitate the hydrated oxide of the metal, say, nickel, which oxide is slowly dried at ordinary temperatures, being then powdered and passed through a screen having about 6.4 meshes per square millimeter. Seven parts by weight of the powdered hydrate are mixed with three parts by weight of flake graphite, and moistened with a small quantity of water, the dampened mass being inserted in the pockets or receptacles of the proper plates in small quantities at a time, and being thoroughly tamped at each accession. Finally the mass is covered with a layer of asbestos held in place by a plate of nickel secured in position by nickel wires, as described in explaining the make-up of the oxidizable element. These plates are then immersed in a solution of potassic hydroxide in water, and subjected for a considerable time to an oxidizing current of about 8 milliamperes per square centimeter of surface, thereby converting the first oxide to a higher oxide, whereupon the element is ready for use. The object of employing graphite is to offer a great extent of surface against which nearly the whole of the oxide is in contact, this being necessary since the electrolytic reduction and oxidation do not extend to a great distance from the conducting surface against which the oxide is in contact, although the higher oxides of nickel and cobalt seem to be conductors. Graphite is neither affected by electrolytic oxidization, nor is there local action between it and the oxides. Nickel hydrates instead of other nickel compounds are preferably used because they are easily prepared, and by absorption of the liquid they swell within the pockets to insure intimate contact and stability, while they are not reduced to the metallic state electrolytically.

The elements are preferably utilized together in a solution of 25 per cent of potassic hydroxide in water. Owing to obscure reactions when the battery is discharged, and to a change of resistance in the electrodes, the voltage of the improved cell is invariable, but averages 1 volt, rising as high as 1.38 volts when freshly charged. The battery can be over-charged, fully discharged, or even reversed and charged in the opposite direction without injury. Over-gassing does not disturb the initial state of the elements. All the ingredients are insoluble. The plates are unattacked by electrolytic oxidation, and the whole operation is independent of the strength of the solution; so that the battery is of great permanence and of remarkably light weight.

A German translation of this patent is also contained in the *Centralblatt fuer Accumulatoren und Elementen-Kunde*, June 15, to which the editor of that journal adds the following critical note:

"The patent in its essential parts combines only known elements. Higher nickel oxydes have been used by Michalowski for the positive plates, and iron was long ago proposed for the negative plates. Only the constructive details and the formation are new."

References are made to patents of Michalowski and of the Accumulatorwerke System Pollak. Michalowski (German patent, April 19, 1899) patents the use of peroxide of nickel Ni_2O_3 as positive plate in an alkaline cell with zinc as negative plate. He forms the nickel plates as follows: He heats a metallic nickel plate in pure oxygen or in gases containing oxygen, to a temperature above 300 degs. C., below the red heat temperature; the oxydizing action is accelerated by applying a high pressure to the gases. Not only the ordinary oxygen, however, but also nascent oxygen causes a good oxydation of nickel at a temperature above 300 degs. As the oxydation does not enter deeply below the surface, the unattacked metal remains as a support of the active mass and guarantees good conductivity and good adhesion. Nascent oxygen is obtained by heating with oxydizing reagents, which give off their oxygen between 300 and 600 degs., such as nitrates, chlorates and others. Ammonium nitrate is especially adapted, because this salt does not leave any residue after the heating. Porous nickel is impregnated with the fused salt and heated cautiously; after this treatment has been repeated several times all pores of the nickel are entirely filled with the solid oxide. It is also possible to oxydize nickel with nascent oxygen by using the nickel as an anode in a fused electrolyte, containing oxygen, between 300 and 600 degs. This also gives a solid and compact cover of oxide.

Accumulator plates of iron, positive as well as negative, which are claimed to be very solid and to have a high capacity, are made

by the Accumulatorenwerke System Pollak, according to a German patent of Aug. 17, 1898. Iron powder or compounds of oxygen with iron are compressed while wet, and are then heated, so that they come into a porous but solid state. The electrodes are then formed electrolytically, in an alkaline solution, for instance, NaOH. The iron powder or the oxygen compounds of iron are generally moistened with nitric acid or another oxidizing agent, and are afterward compressed. The oxydizing agent is then removed by heating to a red heat, or in any other manner. As electrolyte with electrodes of this kind, such solutions can be used which either form insoluble compounds or none at all, with the electrodes as, for instance, alkalines, bichromate of potassium, phosphoric acid, etc.

From these patents it is evident that the "passive state" had not kept inventors from using nickel oxyde and iron plates in batteries, as had been claimed. On the other hand, the cell, described above, of Michalowski, is not of the type of the new Edison battery. Michalowski uses zinc as negative electrode, and zinc dissolves. The Michalowski cell is therefore of the type of the old Edison-Lelande cell. Furthermore, Michalowski speaks of Ni_2O_3 plates, while Dr. Kennelly, in his paper on the new Edison cell, expressly states that the charged nickel plate in the Edison cell is nickel hyperoxide NiO_2, a higher oxide than the peroxide.

Interuban Trolleys in Indiana.

There are now 200 miles of interurban electric road out of Indianapolis, connecting with the principal cities of the Indiana gas belt, and there are in round numbers 1000 miles projected at present for Indiana. The interurban roads afford an hour schedule for passengers, and less frequent freight hauls into the city, and are heavily patronized by the farmers along the line and the residents of the towns and cities which they connect. That they are successful in their efforts to get business is evidenced in the efforts of the railroads, whose tracks are now paralleled by the electric lines. Where there are parallel lines the railway companies have cut the local rates and have put a better train service into operation. Some observers believe that the solution of the difficulty can only be by the death or absorption of the interurban lines, or the abandonment by the railways of their local business. At present there seems to be hardly enough business for both. There are those who hold that the railroads will absorb the electric lines, but there is no tendency observable in the present situation that will justify such a contention. Both sides are preparing to fight, and of the contest, in its initial stages, no accurate forecast of the outcome can be made.

A likely development is a combination of the major part of the interurban lines in the hands of a single syndicate. The Elkins-Widener people have lately acquired the Union Traction Company's lines, which are the most extensive in the central part of the State. They also control the Indianapolis Street Railway Company and the Cincinnati street lines. Out of Cincinnati they control a line going north into Indiana. Lately they are reported to have acquired the Indianapolis and Greenfield line. There is at present a line projected from Greenfield to Dayton, Ohio, which will complete the chain from Indianapolis to Dayton, and lines which will ultimately connect Chicago and Cincinnati by way of Indianapolis are talked of. It is believed that before many years the Union Traction Company will absorb most of these traction companies, and that there will be a unified system connecting Indiana, Ohio, and Illinois.

The last Indiana Legislature made it possible for this outburst of traction building to occur by giving the traction companies the same right of eminent domain, allowing them to condemn land, as the railroads. In this way companies which have been unable to get rights of way over the highways are now getting private rights of way. The road between Indianapolis and Logansport, which has been retarded for two years for this reason, is one that shows the utility of the last Legislature. The Indianapolis *News* publishes a map showing the present and projected trolley lines in the vicinity of that city. They are so numerous as to present the appearance of a spider's web, with Indianapolis as the central point. The *News* says: "That the railroads feel that they are to be confronted by a powerful rival is apparent from the effort the Big Four, the I. & V., and the J. & M. & I. companies are already making to meet competition. It is believed by many that the railroads will eventually be forced into buying up the electric lines in order to save themselves, as it is not thought they can continue the competition for long when the odds in operating expenses are so heavily against them. It is even now rumored that some of the steam roads are interested in the franchises that are being obtained for electric lines that will parallel them."

Data on New York Conduit System.

Justice Earl, of the Court of Appeals, sitting as a referee, gave a hearing last week in the fight that is being made by many large corporations in this city against the constitutionality of the Franchise Tax law. The case of the Consolidated Telegraph & Electrical Subway Company, of New York, was heard. William J. Sefton, secretary and treasurer, testified that the original capital of the concern was $3,000,000, of which amount $732,000 has been expended for patents and property acquired by the proceeds of the sale of stock, the market value of which, at the present time, he declared, is only $3 per share. There are outstanding $4,225,000 in bonds, $1,875,000 in stock and $545,405 in unpaid coupons of the company, which owns 142 miles of subway, of which only part is earning a profit. The State Board of Tax Commissioners has assessed the company's property at $5,000,000, but the company appealed to the Supreme Court, asking that the amount be reduced to $1,000,000, and has declared itself in default on its bonded indebtedness to the extent of $784,000 in interest. Last year the company's operating expenses, Mr. Sefton said, fell $12,000 short of the earnings.

Since 1898, he said, there has been only one sale of the company's bonds, which were then purchased by the New York Gas & Electric Light & Power Company. The company's stock, he said, is held at the par value of $100. The balance sheet of the company, he said, would show a deficit of about $48,000 for 1900.

Edwin R. Quinby, the engineer of construction of the subway company, testified to the cheaper methods of construction that are possible to-day, chiefly through the substitution of vitrified clay for iron in the manufacture of ducts. While the original cost of construction was about $2,000,000, the company having been compelled by the city to lay many conduits from which it received no income whatever, the system could be reproduced now, he believed, for about $890,000.

Wisconsin Independent Telephone Meeting.

At La Crosse, Wis., last week the Wisconsin independent telephone companies had a meeting, there being delegates present from 26 companies in the State. The meeting was held in the city council chamber, when Mayor Boschert welcomed President Hutchinson and his associates, and the president made an interesting address. Mr. R. S. Abbott read a paper on telephone conditions in Michigan and Wisconsin. During the afternoon a visit was paid to the new La Crosse telephone exchange.

At the second day's session a hot discussion relative to the relations with the Bell company occurred. The matter came up on a motion to exclude all members who are in any way affiliated with the Bell people. The discussion showed a unanimity of determination to fight to the bitter end. A resolution was passed that all companies having any business relations with the Bell company be disciplined. A resolution was also passed that a committee of grievances be appointed to thoroughly investigate all cases where independent companies are, or are suspected of affiliating with the Wisconsin (Bell) Telephone Company.

A resolution to establish uniform toll charges all over the State was passed unanimously. A committee was appointed to take charge of the matter, and it is thought probable that a big reduction of toll rates will be made in the committee's report.

Mr. Burch, of Madison, read an interesting paper on the maintainance of the best telephone service and many important ideas were brought before the convention in this way. The convention adjourned at noon, to meet again next February in Milwaukee. They expressed themselves as highly pleased with the reception and entertainment they had received in this city.

Tunnel Under the Narrows.

Tunneling the Narrows of New York Harbor for an electric road is now proposed. The New Jersey & Staten Island Junction Railroad Company, which was first proposed by Erastus Wiman, and which increased its capital stock to $10,000,000 last January, has begun active work. The purpose of the company is to run a double steel tube tunnel under the Narrows, build 12 miles of railroad on Staten Island, and connect with several trunk lines in New Jersey across the Kill Von Kull bridge. The estimated cost of the tunnel is $3,500,000.

CURRENT NEWS AND NOTES.

REMITTED TAXES.—This week the war taxes of 1 cent on all telegraph messages and 1 cent on all 15-cent telephone messages goes off. So ends a great nuisance for which there was little offset in the shape of revenue.

ELECTRICAL CONTRACTORS.—The national meeting of the Electrical Contractors' Association will be held at Buffalo, on July 17. Mr. W. H. Morton, 31 Catharine Street, Utica, is secretary. Information also can be obtained as to rooms, etc., from Mr. H. I. Sackett, president of the Buffalo Contractors' Association, Builders' Exchange, that city.

ELECTRIC EXPRESS SERVICE IN NEW YORK.—Four express cars were started over the surface lines of this city on June 27 as the first step in the system recently projected by the Metropolitan Street Railroad Company. Preparations are already under way to establish terminals in White Plains, New Rochelle, Yonkers and all the towns in the southern part of Westchester County. The old mail cars formerly used on the old Third Avenue Line are being pressed into service. The formal opening took place on Monday last, when 10 cars were put into service.

POLYPHASE ARC LAMP.—A patent granted June 25 to the Edwin W. Rice, Jr., describes an arc lamp for use with polyphase currents. As illustrated applied to a two-phase system, there are two lower stationary carbons connected to two of the leads of a two-phase circuit, and a larger upper movable carbon connected to the third lead. For use on a four-wire, two-phase system, the movable carbon may have a common connection with two of the leads. With this arrangement some one of the phases is always active in maintaining the arc, and a steady light is produced at a much lower frequency than is possible with a single-phase current.

ELECTROLYTIC GLOW LAMP.—A patent issued June 25 to Isidor Kitsee relates to means for starting up electrolytic lamps when introduced into circuit. When a pencil of this kind of lamp is moistened with a solution containing a slight percentage of metallic salt it becomes a partial conductor, and the method invented consists in spraying the pencil with a liquid consisting of a solution of two per cent of magnesium or one per cent of acid. When the switch connecting the pencil to the circuit is closed the pencil is sprayed with the liquid by means of a bulb attached to the lamp. The passage of the current will then raise the temperature of the pencil to such a high degree that the moisture will evaporate and leave the pencil with a temperature sufficiently high for the passage of current even after the moisture has entirely disappeared.

NATIONAL STANDARDIZING BUREAU.—The act of Congress establishing the National Standardizing Bureau provided for a visiting committee of five members, to consist of men prominent in the various interests involved, and not in the employ of the Government. In conformity with this requirement the Secretary of the Treasury has named the following committee: Professor Elihu Thomson, Professor E. L. Nichols, Professor Ira Remsen, Dr. Henry S. Pritchett, president Massachusetts Institute of Technology, and Henry Ladd Colby, secretary American Association of Steel Manufacturers. The duty of the committee will be to visit the Bureau at least once a year and report to the Secretary of the Treasury on the efficiency of its scientific work and the condition of its equipment. We understand that Professor E. B. Rosa has accepted the position of physicist to the Bureau.

CARBIDE FURNACE WITH SERIES ARCS.—A patent recently issued (June 25) to Dr. Hugo Koller, of Nuremberg, Bavaria, describes a carbide furnace adapted particularly for use with currents of higher voltage than are usually employed for work of this character. It is provided with two carbon terminals or end electrodes, entering a long narrow furnace structure from opposite ends, and a number of intermediate unconnected carbon blocks, functioning as bi-polar electrodes, and serving to produce several arcs, or at least several zones of high temperature, in series. The conception of series arcs for industrial purposes is not new, having been applied by Hunter to an arc lamp of double power, by Girard and Street to furnaces for the graphitization of carbon, and by Hopkins to a laboratory furnace for the study of high temperature reactions. Indeed, it is probable that many of the carbide furnaces in which a body of the product lies between the terminals operate in this manner, and one at least, that of Cowles, is so described; the precise form taken by the current in the interior of the furnace charge is, however, not easily determined. The simplicity of Koller's construction suggests especial practicability for large units. The hearth may be of any desired length, the terminal electrodes being simply heavy carbon blocks built into the end walls. The intermediate carbons are supported above the furnace bottom, in the plane of the terminals, and in number depending upon the available voltages, the usual charge of coke and lime being heaped around and above them. The effect is to sub-divide the furnace into a series of zones of reduction corresponding to the intervals between the blocks. It is in these reaction zones that the formation of carbide occurs, and to prevent its contact with the hearth additional blocks of carbon, either in the form of heavy plates or of shallow crucibles, are placed beneath the adjacent ends of the raised electrodes and directly upon the bottom of the furnace. These blocks may also serve to some extent to conduct the current, and by virtue of their position below the regions of maximum temperature they act as receptacles or supports for the carbide formed.

ELECTROLYTIC TREATMENT OF COPPER ORES.—Some years ago Dr. Karl Hoepfner proposed a process for the treatment of copper ores, consisting substantially in laminating them with a solution of cupric chloride containing sodium chloride, and subjecting the resultant cuprous chloride solution to fractional electrolysis to precipitate one-half of the copper at the cathode while simultaneously regenerating the solution by reoxidation to the cupric state, at the anode; the regenerated solvent was then to be returned to the ores and the process repeated. In practice the method has scarcely fulfilled expectations by reason of the very low reaction velocity between the sulphide and chloride of copper. While there is no doubt that cupric chloride will react as stated, the time element must be considered, and this is found to be much greater than is the case with the ferric salts employed in an analogous manner in the well-known process of Siemens and Halske. The U. S. patents of June 25 contain one to John C. Kessler, of Milwaukee, Wis., which bears a close resemblance to the Hoepfner method. Kessler's process is intended for the treatment of ores containing native copper, and his solvent, like Hoepfner's, is a cupric compound, but in ammoniacal solution. A solution of hydrated oxide of copper in ammonia, or any of the cuprammonium salts, as the carbonate, sulphate or chloride, may be used, and in practice this solvent is admitted to the tanks in quantity sufficient to cover the ore, the evaporation of ammonia being checked by a surface stratum of water. As in the prior process the solution becomes reduced by taking up the metal to the lower state of oxidation, and electrolysis is invoked to regenerate it with recovery of one-half of its copper. It is stated that 24 to 48 hours suffices to entirely exhaust the ore of its copper, that other metals present are unattacked, and that the action is accelerated by the addition of ammonium salts to the solution. It is not stated, however, with what strength of solution or with what grade of ore these results were obtained, nor is the proportion between solvent and ore given. The difficulty of handling solutions containing much free ammonia is well known, and it will be necessary to show high efficiency and rapid action to establish a commercial value for the new method.

LETTERS TO THE EDITORS.

Combination Dynamo Fields.

To the Editors of Electrical World and Engineer:

Sirs.—In the case of combination field frames of either cast and wrought iron ,or cast iron and steel, all the authorities and writers appear to have clearly established the great importance of increasing the contact surfaces between the two materials joined. This letter would be unduly lengthened were it to mntion the many references I have at hand corrborating this statement. Limiting myself to one authority, I quote as follows from the very useful treatise by Mr. A. E. Wiener on "Dynamo Electric Machines":

"If wrought iron and cast iron are butt-joined, the capacity of the joint is reduced to that of the cast iron, whereby the advantage of

the high permeability of the wrought iron is destroyed and the permeance of the circuit is considerably increased; in order to have the full benefit of the wrought iron, the contact area of the joint must be increased proportionally to the ratio of the permeability of the wrought iron to that of the cast iron at the particular density employed."

The practice, however, of the leading manufacturers of dynamos in America and Europe, with very few exceptions, is simply to butt-join the cast iron with the wrought iron or cast steel parts. Is the disaccord between the books and actual practice due to the fact that in the mechanical construction of the frame the former introduces cylindrical or conical fits, while the latter involves only easily produced plane surfaces? Would not this difference be more than compensated for by gain in economy in exciting power due to the higher permeability of the magnet frame?

LIMA, PERU. A. GRIEVE.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Weight Economy of Electromagnetic Machines.—SEEFEHLNER.—A paper, read before the Electrotechnical Society of Vienna, in which he draws from a large number of statistical data of actual machines, conclusions concerning the weight of a machine per unit of power, as a function of the power. The results of his statistical compilations are given in diagrams. He first gives a diagram of transformer weights, from data of transformers made by fifteen different manufacturers; then also diagrams of induction motor weights, three-phase generators, and direct-current motors; finally he gives a diagram showing the average weights for these different machines. Among other things the diagram shows the following facts. A difference in the weights of single phase and three-phase transformers is not to be recognized in the diagrams; in general the single phase transformers are even lighter than the three-phase transformers, while according to the theory the latter should be lighter by 30 per cent. All the curves show the same character; up to a certain size the weight of material per unit of power decreases very rapidly with increasing capacity, while for higher capacities the weight per unit of power is nearly constant and changes only very slightly with increasing capacity. Of all the machines considered, the transformer shows in general the best weight economy. From the diagram of the average curves the following data are taken: For a capacity of 5-kw the weight in kilogram per unit of power is 43 for the induction motor, 47 for the transformer, 70 for the direct-current motor; at a capacity of 10-kw the weight per unit of power is 36 for the transformer, 37 for the induction motor, 55 for the direct-current motor, 75 for the three-phase generator; at a capacity of 20-kw the weight is 30 for the transformer, 33 for the induction motor, 52 for the direct-current motor, 58 for the three-phase generator; at a capacity of 100-kw the weight is 28 for the transformer, 31 for the induction motor, 40 for the direct-current motor, and 42 for the three-phase generator.—*Zeit. f. Elek.*, May 12, 19.

REFERENCES.

Speed and Size of Three-Phase Generators.—SIEWERT.—A mathematical article on the influence of the surface speed upon the dimensions and the active weight of material of three-phase generators. He discusses the question, what dimensions and weight will an economically designed three-phase generator have, if for constant speed and frequency the surface speed is increased?—*Elek. Zeit.*, June 6.

Winding Magnet Coils.—An illustrated description of a winding machine for magnet coils, and of a counter provided to count the number of turns of the coils.—*Am. Mach.*, June 20.

Shunt Regulating Resistances.—HAHN.—A brief article in which he shows how to calculate shunt regulating resistances for dynamos; he also gives a numerical example.—*Elek. Anz.*, June 6.

LIGHTS AND LIGHTING.

REFERENCE.

Regina Arc Lamp.—A diagram showing the results of photometric tests, made by Wedding, of the Regina arc lamp which was noticed in the Digest June 1.—*Elek. Anz.*, May 26.

TRACTION.

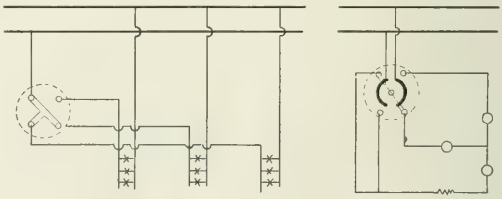
Polyphase Plant.—EBORALL.—The conclusion of his article on polyphase generating and substation plant. He reaches the following general conclusions relative to substation work in general, it being assumed that it is necessary to convert the polyphase current into direct current by means of converting substations. First, for tramway and railway work, and for those cases in which the amount of lighting to be done is relatively small, rotary converter substations, operated at 25 cycles, will give the best results, whatever the type of engine. Second, for lighting work, the use of motor-generators operated at 40 to 50 cycles in the substations, will give the best results; this is also the case when the lighting load in the substations forms the greater proportion of the total output of the latter. "Of course, for industrial power work of large magnitude, or for such power work combined with lighting, spread over a large area, it is hardly conceivable that any experienced engineer would lay down nowadays any system but a polyphase system throughout, preferably three-phase."—Lond. *Elec. Rev.*, June 14.

REFERENCE.

Switzerland.—EDSTROM.—A review of the construction and operation of electric tramways in Switzerland.—*Traction and Transmission*, June 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switches for Lighting Installations.—HERZOG.—An article with 17 diagrams showing different switches for making various special connections in lighting installations. The following cases are dealt with: of several groups of lamps only one group or two groups shall be lighted at the same time; the switching in and out may be accomplished continually by a small electromotor such as is used for advertising signs; connections for dimming the light of electric lamps by switching in resistances or by connecting in series two lamps which are regularly connected in parallel; various connections for arc lamps. Of the two diagrams reproduced, one shows a switch, by which for three positions of the switch, one of three groups of lamps



FIGS. 1 AND 2.—SWITCHES FOR LIGHTING INSTALLATIONS.

is disconnected, while the other two are lighted; for the fourth position of the switch all three groups are disconnected; in the position shown in the diagram the group of lamps at the left is disconnected. The second diagram shows a switch, by which two of three arc lamps are connected in series, while the third is disconnected; this may often be used in practice.—*Elek. Anz.*, May 23.

Best System for Small Plants.—A discussion of the question whether the two-wire, 220-volt, direct-current system or the three-wire, 2x110-volt, direct-current system is to be preferred for a small plant. It is said that one or two years ago the question would have been answered in Germany in favor of the two-wire 220-volt system on account of the following advantages: a cheaper network, cheaper and simpler connections, easier operation. It is said that in the meanwhile the following disadvantages have been brought out in

practice: It was expected that the same line insulation, switches, fuses, etc., could be used for the 220-volt installations as for 110 volts, but this has not been found to be the case. It was furthermore expected that a more economical 220-volt incandescent lamp would be made when the demand for it would grow; this expectation has not been fulfilled; while a 16-cp, 110-volt lamp consumes 3 to 3.5-watt per candle, the average commercial 220-volt, 16-cp lamp consumes 4 watts per candle. These circumstances have increased the cost of installation and operation of the 220-volt, two-wire system beyond the expectations. The conclusion is drawn that the three-wire 2x110-volt system must be preferred at present.—*Elek. Anz.*, June 2.

REFERENCE.

Storage Batteries in Power Stations, Controlled by Reversible Boosters.—HIGHFIELD.—An illustrated reprint in full of his recent papers, an abstract of which was noticed in the Digest, June 15.—Lond. *Elec. Rev.*, June 14; an illustrated reprint in full begins also in Lond. *Elec.*, June 14.

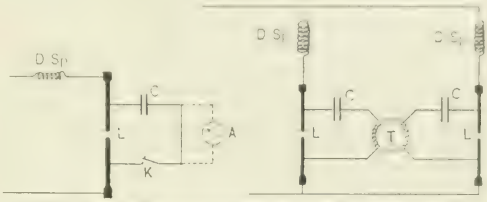
WIRES, WIRING AND CONDUITS.

Protection Obtained by Earthing.—UPPENBORN.—An illustrated paper read before the Union of Electric Works at Wuerzburg. He describes experiments which he made, and which relate to the case of a point of a high tension line touching an iron pole when there is an earth at another point of the line. The questions were, whether it is dangerous to touch that iron pole, and what success may be obtained in general by a good earthing. The arrangement of his experiments was as follows: One pole of a dynamo was connected to an earth plate, placed in a creek, the other to an iron mast, which was sunk into the ground for a depth of one meter; this iron mast was also connected to an earth plate, placed in a river. The current and the e. m. f. between the iron mast and the earth at various distances from the mast were measured. The results are given in a diagram. He found that at a supply e. m. f. of 2000 volts, the e. m. f. between the iron mast and the earth at a distance of half a meter, was 580 volts, so that touching the mast would be very dangerous. He concludes that the earthing of the pole is good only when the resistance of this earth is much smaller than the resistance of the other earth. With ordinary earth plates the resistance can scarcely be made smaller than 20 ohms. Iron masts are a source of danger and should be covered as well as possible; to earth them is not advisable. He has made some special experiments with iron poles as used for trolley lines; he advises not to earth these iron poles. There was a long discussion following the paper. Wilkens suggested placing in the earth at the foot of the iron pole a concentric metallic plate, the size of this plate depending upon the conductivity of the earth; he claims that this would prevent potential differences between the feet, and also between the feet and the hands. Uppenborn will make experiments with this device.—From a separate publication of the Union of Electric Works at Wuerzburg; reprinted also in *Elek. Zeit.*, April 25.

Bloemendal.—A communication referring to Uppenborn's paper. He mentions a case from practice, in which an imperfect earthing was found to be dangerous. In the same way as Wilkens, he uses in high tension installations, a metallic passage around the generators and switchboards, which is connected to parts carrying no current. —*Elek. Zeit.*, May 30.

ELECTRO-PHYSICS AND MAGNETISM.

New Actions of the Direct-Current Arc.—PEUKERT.—An illustrated description of experiments to which he has been led by the demonstration of the "musical arc" by Simon and Duddell. He has succeeded in producing acoustic actions with the arc without the use of a microphone or telephone, merely by producing the current variations in the arc itself. The arrangement is shown in the first of the adjoining figures. The carbons of the arc were shunted by a condenser *C* of 7.7 microfarad, consisting of a paper condenser of 6.4 microfarad, combined with a rubber condenser of 1.3 microfarad. When the key *K* is pressed down and the arc *L* has a certain length, about 0.75 mm, the arc gives a high sharp tone which continues as long as the condenser circuit is closed. The length of the arc may be varied in small limits, the pitch of the tone is then also changed. As soon as the arc length is above a certain limit, the tone stops, but starts again when the arc is brought back to its original length. The induction coil *D Sp* in the figure keeps the oscillations off from the main circuit. This is a very simple arrangement for producing alternating currents of high frequency and low voltage; in two experiments made by him the frequency was 8800 and 9200, the voltage 40 and 43. By this device all the well known experiments for demonstrating the characteristic features of alternating currents can be made, especially the experiments of Elihu Thomson. The tone from an arc can easily be transferred to a second arc by means of the ar-



FIGS. 1 AND 2.—DEMONSTRATION OF THE "MUSICAL ARC."

rangement shown in the second figure. *T* is a simple ring-transformer. The two lamps burn in parallel. When the two arcs have a certain length and the condenser circuit of the first lamp is closed this lamp begins to give off a tone and the other then follows.—*Elek. Zeit.*, June 6.

Properties of the Ether.—GRAETZ.—An exposition of a theory of the properties of the ether which he has developed in order to clear up the obscurities attached to Maxwell's electromagnetic theory. He claims that his theory is free from contradictions, either in itself or with experiments. He assumes the ether to be an elastic solid, and therefore attributes to it the same properties as Fresnel and Neumann did. In ponderable matter the ether experiences an influence which is manifested as force as soon as there is a displacement in the ether. The force exerted by the molecule upon the ether is manifested in a local change of the density of the ether, while the ether retaliates by displacing the molecule from its normal position. Those parts of a material body in which such a displacement exists permanently, are the ions. This action and reaction between the ether and the molecules leads to Maxwell's equations. The so-called magnetic polarizations, or displacements, are determined by the torsion of the ether elements, while the electric forces, all except some characteristic ones, are the velocities of the ether particles. The magnetic energy of a body is the potential energy of the ether contained in it. The electric energy consists of two parts, one of which is the kinetic energy of the ether, while the other is the potential energy of ponderable matter. "True magnetism" assumed to be zero in Maxwell's theory, has no meaning whatever. The magnetic properties of iron may be brought in as special molecular torsion. The so-called "true electricity" consists of the amount of ether contained by a given volume in excess or defect of the normal amount. A current consists of the transformation of rectilinear motions of molecules into heat vibrations. The conceptions that the ether surrounding every molecule is attached to it implies that a totally independent relative motion of ether and matter, is impossible.—*Ann. der Physik.* No. 6; abstracted in Lond. *Elec.*, June 14.

Velocity of Different Ions.—CHILD.—In previous researches he found that when a discharge passes between a flame and a neighboring metallic plate, the quantity discharged varies nearly in proportion to the square of the difference of potential and inversely as the cube of the distance. He found that the velocity of the negative ions exceeded that of the positive ions by 25 per cent in the average, which result was in striking contrast to the measurements made with the electric arc, where the positive ions exceed the negative ions in velocity by 100 per cent. Zeleny's method of measuring the velocity of X-ray ions was applied by him to the arc, and the positive ions again showed double the velocity of the negative ones. The author has since investigated an arc between mercury electrodes in mercury vapor, where no second substance intervenes. The greatest potential gradient was then at the anode, so that the positive ions move fastest. The author makes the interesting proposition that whenever gases are ionized, the negative ions move most rapidly, but whenever metallic vapors are ionized, the positive ions move most rapidly.—*Phys. Zeit.*, May 18; abstracted in Lond. *Elec.*, June 7.

Electric Oscillation Experiment.—PELLAT.—A description of the following experiment which appears somewhat paradoxical at first, but which is easily explained by electric oscillations. Two condensers of very unequal capacities, say, a battery of six large jars and a small Leyden jar, are connected by means of a commutator mounted on ebonite columns, so as to be able to deal with high potentials. All the armatures, or at least three of them, are insulated.

Two discharging rods are attached to the small condenser, and they show a spark when the difference of potential reaches a sufficiently high value. If now the condensers are charged so as to give sparks, or even a little less, and the connections are reversed, the spark passes between the rods. Since the reversal makes the positive coating of one condenser communicate with the negative coating of another, the difference of potential should diminish. Nevertheless, the discharge shows that at a certain moment the difference of potential between the coating of the small condenser must have doubled at a certain moment. This is of practical importance, as it shows that reversal of connections may produce dangerous potentials. He gives a full explanation of the phenomenon, based upon the current theory of electric oscillations.—*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

Dark Cathode Space.—WEHNELT.—An account of an investigation of the distribution of potentials in discharge tubes. The equipotential surfaces are concave with respect to both anode and cathode. The curve of potential is continuous in every case, and sharp bends, as found by Graham, must be attributed to faults in the method.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 14.

Discharge by Flame Gases.—VON WESENLONCK.—In an investigation of the destruction of gaseous conductivity by smoking liquids, he found that the conductivity of flame gases depended largely upon the state of the surface of the metallic electrodes to be discharged. He has since accumulated further evidence of the importance of the electrode surface. An account of his observations is given. He suggests that flame gases may have a peculiar radiation of their own which produces the change of surface conditions.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 14.

Nickel at High Temperatures.—CAMPBELL.—The conductivity of pure, modern, nickel is very much lower than that of the purest obtainable some years past. He tested two specimens, both commercial products, one bought this year, the other five or six years ago. Their resistivities at 0 deg. C. were found to be 8 and 12 microhm-cms respectively. He investigated their behavior at different temperatures up to 700 deg., the results being given in a diagram. Both temperature and resistance curves have the well-known bend at about 300 deg. C. The older and presumably less pure specimen has less variation with temperature than the other, of which the mean temperature coefficient is slightly over 0.5 per cent per degree from 0 to 200 deg. —Lond. *Elec. Rev.*, June 14.

Permeability of Nickel Steels.—PAILLOT.—An account of measurements of the permeability of nickel steels in intense magnetic fields. The first series of measurements was made with samples of "irreversible steel" containing 24.1 per cent of nickel and 0.3 per cent of carbon. It was shown that there is a distinct increase of permeability in raising the field intensity from 20,000 to 30,000 units. On the other hand, two samples of "reversible steel" containing some 27 per cent of nickel, retained a constant permeability while the field varied from 4000 to 30,000 units. This is quite in accordance with Guillaume's predictions. When the steel, besides the addition of nickel, also contained small quantities of chromium or manganese, the permeability showed a decided diminution with increasing field intensity.—*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytically Made Emery Wheels.—RIEDER.—An interesting illustrated article on emery wheels, disks, slabs, etc., made electrolytically in the following way: The grinding kernels of emery or carborundum are fixed on to metallic surfaces by the electrolytic deposition of metals, especially of copper. The simplest case is that of a plane surface to be covered on one side with emery; a layer of emery kernels which have been made conducting by means of graphite, is placed on the cathode which is at the bottom of the electrolytic bath, and the electrolysis is started. The mixing with graphite is done as follows: wax or paraffine is dissolved in benzine and the emery sand is moistened with this solution; after having been dried, each corn is covered with a fine layer of the dissolved material and then mixes easily with the graphite if shaken with it. One may also put the graphitized emery into a porous cup, and this into the electrolytic bath, so that the anode is outside of the porous cup; when the metallic body to be covered with emery is put into the emery sand in the porous cup as cathode, the kernels are fixed on the surface; the layer of copper is then increased in a free bath. Another method is to first mix the emery intimately with a paste "soluble in the bath"; he generally uses gelatine for this purpose; when the deposition has progressed so far that the kernels adhere without paste, all traces of paste are destroyed by dipping into hot lye, and the deposition is then continued. Finally the emery is laid open by grinding; one may also bare the kernels still more by etching. Such electrolytic emery wheels and slabs differ greatly from others. Each kernel is enclosed or "set." To this fact is due the small wearing away of the grinding surface. Of a grinding disk 140 mm diameter, 10 grams of the grinding surface were lost when 70 gram steel were ground, while with other grinding disks at the same number of revolutions and the same loss of grinding material, only 20 grams of steel were ground. The relation can be improved still more by using higher speeds; he then estimates "a maximum loss of 10 per cent for steel." On the other hand more time is required with an electrolytic wheel to grind a certain amount of material; but the number of revolutions may be made several times that of the ordinary wheels. One will also prefer the much harder carborundum to emery, as the higher price is insignificant on account of the small loss of grinding material. He does not intend at present to use this electrolytic method for large rough grinding wheels, but rather for the smaller grinding instruments to be used in workshops. Several forms are described and illustrated; among these are a plane grinding disk for polishing and smoothing off metallic surfaces, small grinding wheels for making holes; a conical grinding shaft for making conical holes, riflers for engravers, etc.—*Elek. Anz.*, June 2.

REFERENCES.

Alkylammonium-Amalgam. — CROTOGINO. — A German Electro-Chemical Society paper, of a more chemical interest, on the electrolytic production of alkylammonium-amalgam.—*Zeit. f. Elektrochemie*, May 23.

Production of Lithium.—An illustrated description of the Becker process of the electrolytic production of lithium from a mixture of chloride of lithium and alcaline chlorides (with the exception of magnesium chloride).—*L'Ind. Elec. Chem.*, March.

The E. M. F. of Metals in Cyanide Solutions.—CHRISTY.—The first part of a long article. In this part he gives a review of the modern theory of electrolysis of aqueous solutions.—*Elektrochem. Zeit.*, June.

Bleaching by Electricity.—WALSH.—A brief description of the processes of Hermite, Brochoki and Leclanche.—*Elec. Rev.*, June 15.

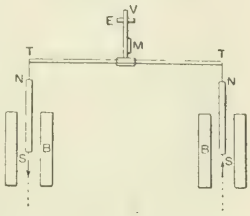
German Electro-Chemical Society.—An account of the eighth annual meeting held in April in Freiburg. Ostwald suggested changing the name of the society into the German Bunsen Society. Van't Hoff was re-elected president. Abstracts of all of the papers have or will be abstracted in the Digest.—*Zeit. f. Elektrochemie*, May 16, 23, 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A Perfectly Astatic Galvanometer.—LIPPMANN.—A description of a galvanometer which is quite independent of the magnetic field of the earth. The principle is as follows: A magnetic needle is suspended by a cocoon fibre and allowed to settle in the magnetic meridian. The poles project into coils whose axis is oriented in the same way, and which are traversed by the current to be measured. Hence the needle is displaced in the direction of its own length, and as the earth's magnetic field does not tend to displace a needle in the direction of its own length, that field is without influence upon the displacement, and is as good as non-existent. The needle is, therefore, perfectly astatic. Its suspension is attached to one arm of a torsion balance, which gives the resistance to the displacement. That resistance can be made as small as desired, and the sensitiveness of the apparatus can be thus increased indefinitely. In a galvanometer devised by Becquerel the needle is attached to the arm of an ordinary balance, and sucked into a coil in the same manner. But it is obvious that the substitution of a torsion balance for an ordinary balance greatly increases the sensitiveness. He obtained the best effects by using a thick and heavy needle strongly magnetized. —*Comptes Rendus*, May 13; abstracted in Lond. *Elec.*, June 7.

Electric Balance.—CREMIEU.—Lippmann's perfectly astatic galvanometer (described in the above abstract) has led the present author to construct a balance on a similar principle, which may be used as a galvanometer, an electrodynamometer or an absolute electrometer. It is shown in the adjoining diagram. Between the two branches of a brass frame *CC*, is suspended an aluminum plate *aa*, by a cocoon thread ff^1. An aluminum tube *T V T*, bearing a movable nut *E*, is attached to the aluminum plate so that it is normal to the plane of the

cocoon threads. The whole represents a balance without knife edge. The moving parts are very light, weighing only 0.8 grammes. The nut *E* serves to regulate the sensitiveness, and the mirror *M* to indicate the deflections. Two cylindrical permanent magnets *N S* are suspended at *T T* by cocoon fibres. They can travel along the axis of the coils *B B*. With a period of 8 seconds, the balance indicates a displacement of 12 mm. at 1 meter distance for a current of 10^{6} ampere. The balance is well damped and perfectly astatic. On replacing the magnets by coils carrying currents an electrodynamometer is obtained. An electrometer may be made by mounting a plate and guard ring on one arm.—*Comptes Rendus*, May 28; abstracted in Lond. *Elec.*, June 14.



ELECTRIC BALANCE.

German Reichsanstalt.—The first part of an abstract of the official report of the work of the German Reichsanstalt in 1900. The cadmium standard cell which had been severely criticized by Cohen, was intimately investigated and its practicability for use as a standard cell was proved. There are, however, irregularities in the behavior of the cells containing 14.3 per cent of amalgam in the neighborhood of 0 deg. More dilute solutions, containing 12 to 13 per cent of amalgam must be used; such cells show no irregularities. A detailed account is given of an exact determination of the capacity of a condenser. The conductivity of the chlorides and nitrates of the ordinary alcaline metals had been determined, and that of the iodates has now been measured. Up to one-tenth normal solution the specific conductivity can be represented by an empirical formula, so that the variation of the calculated value from the measured value is not more than one-thousandth of the value. This formula is valuable, as with its aid the conductivity of very dilute solutions may be calculated from measurements of more concentrated solutions.—*Elek. Zeit.*, June 6.

REFERENCES.

Industrial Magnetic Measurements.—MONTPELLIER AND ALIAMET.—The continuation and conclusion of their long illustrated serial. They deal with industrial hysteresis meters. After general remarks about the methods of plotting a hysteresis loop, they describe the hysteresis meters of Ewing and Blondel.—*L'Elec.*, May 18, 25, June 1.

Localization of Breaks.—RYMER-JONES.—The conclusion describing a method for the localization of high resistance breaks in submarine cables. He gives a numerical example and makes some general remarks on the test and on the galvanometer used.—Lond. *Elec. Rev.*, June 14.—Some remarks, by Kempe, on this article in Lond. *Elec. Rev.*, June 14.

Measurements in a Cable Factory.—KREJSA.—A long and well illustrated paper, read before the Electrotechnical Society of Vienna, on instruments and apparatus used for electric tests and measurements in a cable factory.—*Zeit. f. Elek.*, May 12, 19, 26.

Meters.—ARMAGNAT.—Illustrated descriptions, taken from British patent specifications, of a number of new meters, devised by Peloux, Hookham, Price, Schmidlin, Beaumont and Nunns.—*L'Eclairage Elec.*, May 18.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Photographone.—RUHMER.—A description of improvements of his instrument, with which he has achieved some very notable successes. The vibrating flame of an arc lamp is photographed on a kinematograph film, and the sound vibrations are thus translated into dark and bright stripes on the film. The light is concentrated upon the sensitive film by means of a cylindrical lens. When the impression of the voice has thus been taken, the film is developed and fixed in the usual way. To reproduce the sound the film is moved past an ordinary projection lamp, and a sensitive selenium cell provided with telephones and a dry battery is placed behind it. The changes in the illumination of the selenium cell produce changes in the current corresponding to the original sound vibrations. The velocity of the film is 2 to 3 metres per second, but even with 20 c. m. per second good photophonograms are obtained. From one negative any number of positive films may be obtained, and either the negatives or positives may be used for reproduction. He hopes to record pictures and sounds on the same film. An interesting development proposed is the synthesis of human speech from its elements, obtained from the photophonograms or from an artificial film suitably shaded.—*Phys. Zeit.*, May 25; abstracted in Lond. *Elec.*, June 14.

Some editorial notes in which this instrument is compared with Koenig's manometric analyses and Bell's phonautograph; the former made a record that was both transient and inaccurately shaped, while Bell's instrument, although making a fairly accurate trace of the sound waves on smoked glass, was incapable of being used for reproduction of the actual sound. From a purely graphical point of view Bell's phonautograph was superior to Ruhmer's photographophone, the former showing the complex sound-waves in Cartesian curves, the latter indicating them merely by the irregularity of tint or shade in a photographic strip. Bell's instrument, however, suffers from defects due to inertia, while the use by Ruhmer of the practically inertialess machinery of a ray of light, effectively eliminates that source of error. Ruhmer's instrument should be very useful for acoustical researches.—Lond. *Elec.*, June 14.

High Speed Telegraphy.—An editorial review of recent systems of high speed telegraphy. A comparison of six systems is given regarding the numbers of attendants required and the numbers of words which can be transmitted per minute. With the Morse system, two attendants transmit 15 words per minute, with the Hughes simplex system four attendants 25 words, with the Hughes duplex system six attendants 50 words, with the Baudot quadruple system 8 attendants 120 words; with the Baudot sixfold system 12 attendants 180 words; with the Rowland eightfold system 12 attendants 320 words. These systems are also compared under consideration of the question whether they enable one to send messages over the line in opposite directions. The Baudot system is much in use in France, and is also used in Vienna, London and Berlin, for telegraphy with Paris. With the Rowland system, experiments are being made at present. It is said that there is no great need for the new systems in Germany, as the telegraph service has not increased excessively, and that it is doubtful whether these systems will be introduced there, as the companies owning the patents generally demand exorbitant prices.—*Elek. Zeit.*, June 6.

REFERENCES.

Protection of Telegraph Lines.—The first part of a reprint of a set of rules, issued by the Austrian Ministry for Commerce. General technical regulations are given regarding the protection of telegraph, telephone and signal lines, against installations with strong currents. —*Zeit. f. Elek.*, May 26, June 2.

Block Signals.—PRASCH.—An illustrated paper, read before the Electro-technical Society of Vienna, on the most recent forms of the block signal system of F. Krizik in Prague.—*Zeit. f. Elek.*, May 26, June 2.

Rowland Telegraph.—ROBICHON.—A continuation of his long illustrated description of the Rowland multiple telegraph system.—*L'Elec.*, May 18.

MISCELLANEOUS.

Copper in 1900.—An abstract of the annual statistical circular on copper, issued by Merton & Company. In spite of high prices only 14,000 tons more copper were produced in 1900 than in the previous year, the exact figures being 486,084 and 472,244 tons respectively; the output of the United States was 268,787 tons, against 262,206 in 1899. Figures of the output of different mines in the United States from 1895 to 1900 are given. The production of Canada is slowly but steadily increasing.—Lond. *Elec.*, June 14.

REFERENCES.

Glasgow Exposition.—DARY.—A brief article on the electric generating sets and the lighting of this exposition.—*L'Elec.*, June 1.

Paris Exposition.—REYVAL.—Illustrated descriptions of a 700-kw, 600-volt, direct-current dynamo of Schuckert & Company and of a 400-kw, 500-volt, direct-current dynamo of the Societe Bacini.—*L'Eclairage Elec.*, May 18.—An illustrated description of a 682.5-kw, 250-volt, direct-current dynamo of the Company Generale d'Electricite de Creil.—*L'Eclairage Elec.*, May 25.—An illustrated description of two 415-kw, 250-volt, direct-current dynamos of the Decauville XX Company, driven by one steam engine.—*L'Eclairage Elec.*, June 1.—Illustrated descriptions of three direct-current dynamos of

Alioth & Company, giving 225-kw at 550 volts, 30-kw at 125 volts, and 7-kw at 125 volts respectively; also of a 176.5 kilovolt amp three-phase generator of the same company, the voltage at the terminals being 3000 volts; also of two converters of 300 and 200-kw, of the Societe des Applications Industrielles.—*L'Eclairage Elec.*, June 8.

New Book.

ELEKTRISCHE VERBRAUCHSMESSER DER NEUZEIT. Von Johannes Zacharias. Halle: Verlag von Wilhelm Knapp. 351 pages, 195 illustrations. Price, 15 marks.

As the author states in his introduction, there is, considering the importance of the subject, an amazingly small amount of information available in book form concerning the important field of electric meters. To meet the presumable demand for a work of this kind the present volume was written.

After a gratifying brief introduction and only two pages devoted to the now historical Edison chemical meter, the subject of the modern mechanical types is at once attacked. The Aron differential clock meter is carefully described in over thirty well illustrated pages, in which the theory and mechanical details are alike considered. Then follow the motor meters for direct current of the Thomson and analagous classes, and finally the actual though not avowed main subject matter—motor-meters for alternating current—which presumably receive the principal attention because their theory is less generally understood and because the types on the market in Germany are very numerous, just as is the case in the United States. The manufacturers have co-operated well with the author, so that not only are there many schematic and perspective illustrations, but calibration curves and other actual test data abound. A scheme not generally adopted in this country, but which would seem worthy of imitation in many cases, is the not uncommon continental practice of equipping meters with so-called "testing terminals," by the aid of which a standard meter may at any time be cut in for checking purposes without interrupting the service.

Of two-rate meters, only two are mentioned, one by Aron and the other made by Schuckert & Company, neither of which, however, receives extended attention. Prepayment, maximum demand and true recording meters, i. e., those which record on charts the current variation, are likewise described very briefly and in but few forms.

The last 143 pages are given up to a patent digest which is claimed to include specifications from all of the German patents on the subject. The names of the patentees, titles of patents and in some cases very brief descriptions of the inventions, are given, but there is not a single illustration even of much reduced size; and as the patent drawings are frequently referred to in the specifications, a record which might otherwise be of much interest becomes of but slight value.

The presswork and paper are both good, but the binding is typically German, flimsy and ready to fall apart after but a few days handling.

Some Electrical Features of the Glasgow Exhibition.

As an exemplification of the beauties of electric lighting the Glasgow Exhibition cannot be classed as a success, and very little effort seems to have been made to have produced any illuminating effects. To most of us who have seen the World's Fair Exhibition in Chicago of 1893 or the recent Paris Exposition or the Pan-American Exhibition in Buffalo, and who are accustomed to look for a magnificent illumination in the evening at an exhibition the effect is quite disappointing. The grounds of the Exhibition themselves are lit with gas, producing, it is true, a good illumination, but lacking altogether in artistic effect. There is absolutely no illumination of the buildings and the only effects produced are the various signs on a few of the special pavilions in the Machinery Avenue, such as those on the British Westinghouse Company or the searchlight of the British Scuckert Company. In Machinery Hall the exhibits in general are good and give fair examples of typical British practice in generator and engine designs. Of tramway specialties there is next to nothing outside the manufacture of generators themselves, Dick, Kerr & Company being practically the only exhibitors of a complete line of tramway apparatus, including generators, motors and cars.

The Machinery Hall, already described in these pages, is a large building outside of the real exhibition grounds, reached by means of a covered bridge, and contains some 300 exhibits of various engineering specialties. In one corner of the building are situated the engine and electrical exhibits, most of them comprising engines coupled direct to generators. Throughout the whole grounds, however, are situated other electrical exhibits, and it might be stated that the British Westinghouse Company's exhibit is entirely outside of the Machinery Hall, and in a different part of the grounds. This company has found it necessary to build a pavilion for themselves on Machinery Avenue, while the British Schuckert Electric Company have also got various exhibits distributed throughout the whole exhibition. The Glasgow exhibition might be classed as a purely industrial exhibition, and as such is extremely good, though more attention might well have been paid to artistic illumination and amusements for the visitors. The main building, however, is distinctly handsome, architecturally, and indeed the whole site of the exhibition in the daytime presents a most pleasing effect, all the buildings being clustered in the valley of the Kelvin, overlooked on the one side by the heights on which the university is situated and on the other by the slopes of Kelvin Grove Park, surmounted by Park Terrace, one of Glasgow's most handsome residential thoroughfares. The buildings in general are pleasing to the eye, and a few of them, notably the Russian buildings, with their odd style of architecture, give a most charming vista, situated as they are among the natural beauties of the Park.

WILLIANS & ROBINSON exhibit one of the largest steam electrical plants ever shown in operation by a single firm at an exposition of this kind, with the exception, perhaps, of the Paris Exposition of 1900, where they were also largely represented, and showed a 3000-hp engine coupled to a dynamo. The exhibit at Glasgow is of the same total power as that at Paris, but is divided into two engines, each having a normal output of 1200 horse-power and a maximum of 1500 horse-power. The engines are triple expansion, of the firm's usual vertical central-valve type, and run at a speed of 230 r. p. m. They are supplied with steam at 180 lbs. pressure, and are intended to work with condensation. One engine has a small fly-wheel faced to form a coupling, and the other merely a coupling disk, the necessary fly-wheel power being provided by the revolving part of the dynamo. In both cases the couplings are bolted directly to flanges upon the armature castings, not to couplings upon the shafts. One engine is coupled to a compound-wound, continuous-current dynamo, made by Crompton & Company, having a normal output of 700 kilowatts at 520 volts, and a maximum for one hour of 960 kilowatts at 510 volts. The other drives a dynamo of the same output by the British Schuckert Electrical Company.

E. GREEN & SON, of Manchester, have an interesting exhibit of their well-known economizers in various parts of the Exhibition. In Machinery Hall are one economizer of seventy-two tubes, suitable for one steam boiler, with small engine attached to the gearing frame for driving the scrapers; one 5-inch double ram pump for feeding economizers and steam boilers; one 5-inch horizontal steam engine for driving economizer scrapers, and specimen economizer castings, including tubes burst at a pressure of over 3000 lbs. per square inch. There is also the bronze model of Green's economizer, which gained the highest award for economizers at the Paris Exposition last year. A special pavilion in Machinery Avenue has been built in which is erected a larger size economizer, containing 192 tubes, arranged on the most modern principle, in three groups, couples together at the top and bottom with expansion elbows, and with space at the back affording easy access to all parts of the apparatus. The scraper motion of this economizer is actuated by a 1-hp motor in a glass case. This economizer contains nearly 2000 square feet of heating surface. A 5-inch double-ram pump is coupled up to the machine, showing the method of feeding. One high-pressure economizer of 192 pipes, in sections of eights, arranged in groups, has been loaned to the Exhibition authorities, and is working in connection with four Lancashire boilers, supplying power for driving the machinery plant in the Exhibition. The scrapers of this economizer are worked with a small independent engine attached to the gearing frame. One economizer of 120 pipes, in sections of sizes, arranged in two groups, working with a battery of Davey-Paxman boilers, which are supplying power for the electric light in the Exhibition. Both these economizers are fitted with the usual blow-off and safety valves, and are constructed for boiler pressures of 200 lbs. to the square inch. The scrapers on this economizer are also worked by a small independent 3½-inch cylinder.

THE LAHMEYER ELECTRICAL COMPANY, LIMITED, of London, exhibits a motor generator of 100 horse-power, consisting of one syn-

chronous motor for single-phase alternating current, driving a 65-kw, shunt-wound dynamo, which is running as a motor on account of no alternating current being available. The company also shows one starter for the above, one regulator for the exciting circuit of the synchronous motor, one automatic hoist controller, one 5-horse-power totally enclosed dust and water-tight motor, one three-phase, 3½-hp asynchronous motor, one crane controller, and one double crane controller with universal gear.

THE GENERAL ELECTRIC COMPANY (1900), LIMITED, of London and Manchester, show a fine steam dynamo, comprising a high-speed engine direct coupled to a multipolar dynamo made at the Manchester works. The capacity is 420 amperes at any voltage from 460 volts to 500 volts on lighting load, and 500 volts to 550 volts, 300 amperes, on traction load. These dynamos can be overloaded 20 per cent. on lighting load, and 25 per cent on traction load. The machine is, of course, overcompounded for traction work, the compounding being cut out for lighting service. The magnet frames of the generator

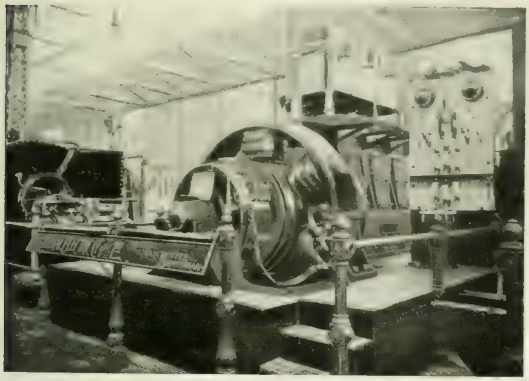


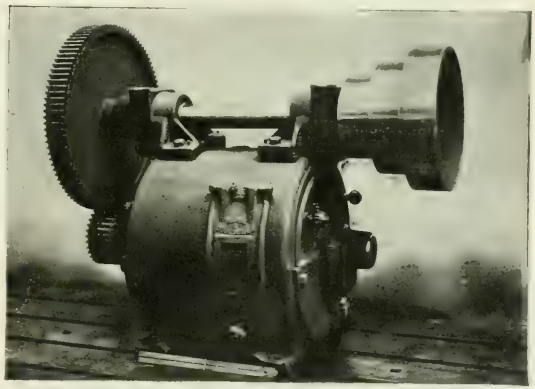
EXHIBIT OF GENERAL ELECTRIC COMPANY, LIMITED.

are divided on the horizontal diameter, and have especially light fields and yokes much resembling the typical American standard. The pole pieces and field coils are of cylindrical shape. The armature is of the fly-wheel type of large diameter, with slotted core. The carbon brushes can be retained in fixed position and run sparklessly from no load to 25 per cent overload. The engine is of the well-known "Peach" type, made by Davey, Paxman & Company, and develops 360 horse-power. It is a three-crank compound engine, with centrifugal governor, and runs at a speed of about 380 r. p. m. The dynamo supplies power to the General Electric Company's motors, which are driving various sweetmeat manufacturing machines and other machinery for various purposes in different parts of the Exhibition. There is also a fine general exhibit of electrical apparatus.

THE BRITISH SCHUCKERT ELECTRIC COMPANY, of London, has exhibits in various parts of the grounds. One is a continuous-current dynamo (which is eventually for the use of the Glasgow Corporation), designed to give 600 volts and 1920 amperes, at 230 r. p. m. It is coupled direct to a Willans & Robinson engine, and is erected in Machinery Hall near the company's main exhibit. In its own stand is shown a power transmission plant, operated by single-phase alternating current. It consists of a continuous-current motor, coupled direct to a single-phase, alternating-current dynamo, and various transformers for stepping the current up and down. There are also a number of motors for various uses, which are being driven by this current. In a pavilion on Machinery Avenue are exhibited machines and apparatus for railways and mining apparatus, as well as smelting works and collieries, consisting of pumps, motors, etc., etc. Interesting features are an electric crane and a complete exhibition of electric tramway apparatus, consisting of a Brill car and truck equipped with Schuckert motors. The company also exhibits its apparatus for underground conduit and a complete section of the new surface contact system, which was recently described in these columns. It also shows a motor with controlled for automobile purposes, and motors for almost every purpose, with all the necessary switchboard, resistances, etc., etc. It has erected a searchlight tower about 120 feet high and equipped it with a searchlight, which is operated from the foot of the tower. It is also interesting to note that the water chute is driven by a Schuckert motor.

THE BRITISH INSULATED WIRE COMPANY, LIMITED, has made a very comprehensive exhibit of electric wires, cables and all the various details necessary for underground work, and comprises many interesting features. A large collection of samples of the various types of paper insulated cable manufactured by the company, the most noticeable of which are: A 1 square inch triple cable, of which 27 miles have been supplied to the Glasgow Corporation, a 312-pair telephone cable, which is being laid at the present time for the Glasgow Corporation in connection with its municipal telephone department. A similar type of cable has been supplied to the British Government for the trunk line from London to Birmingham; .15 square inch three-core armored cable for 5000-volt three-phase working, of which 33 miles has been supplied to the Manchester Corporation, is exhibited, as well as a .14 square inch twin concentric cable for two-phase, working at 7500 volts. Another interesting cable is a concentric cable for working at 11,000 volts. This cable has been constantly at work for the last five years without a single fault at Deptford. The same type of cable has been put to work by the Metropolitan Electric Supply Company, Limited, in the trunk main from Willesden to London; 1.6 square inch single cable, as used by the Bradford Corporation. All the main cables for the exhibition buildings and grounds have been supplied by the British Insulated Wire Company.

MAVOR & COULSON, LIMITED, Glasgow, exhibit several of their combination sets, in conjunction with engine builders. A 500-hp generating set is shown, consisting of a slow-speed, continuous-current dynamo, and is exhibited jointly with Robey & Company, Limited, of Lincoln. The engine is of Robey & Company's cross-compound type, and the dynamo one of Mavor & Coulson's eight-pole generators. The dynamo, which is the largest yet built in Scotland, is mounted upon the crankshaft of the engine between its main bearings, and is designed to give an output of 630 amperes, at 550 volts at a speed of 90 r. p. m. The field magnets are of Charles Cammell & Company's steel, the armature disks are by Joseph Sankey & Son, the micanite by Bergtheil & Young, and the conductors by the Tele-



MOTOR WITH GEARED COUNTER-SHAFT.

graph Manufacturing Company, Limited. Another combination set is shown consisting of a 270-hp, high-speed generator, direct-connected to a three-crank, compound engine, made by Alley & MacLellan. The company also exhibits some fine illustrations of the concentric wiring, which it has made a specialty for many years.

THE TUDOR ACCUMULATOR COMPANY, LIMITED, of London, has a comprehensive exhibit, showing a complete battery composed of twenty-eight Tudor cells, type No. 102 LA 5, having a capacity of 140 ampere-hours. This battery is in working condition, and it is an example of the smaller batteries supplied by the company for isolated plant and of the method of mounting. The battery is regularly worked, being charged by a Bruce Peebles motor-generator, running from the Exhibition mains. Among the various sample cells exhibited by the Tudor Company, the most interesting is one of the type No. 130 LC 37, of which one side has been removed to show more clearly the internal arrangement. This cell is capable of giving an output of 1000 amperes, for four hours, and weighs, complete with acid, over 1¼ tons. Four batteries, each composed of 102 cells of this type, are already working in sub-stations of the Charing

Cross Company in London, and four more batteries of the same size are to be supplied to the same company before the end of the year, forming by far the largest battery plant in Great Britain.

THE BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, LIMITED, has, as noted, a fine pavilion, which is herewith illustrated inside and out, and which is certainly one of the leading electrical features of the Exhibition, being 75 ft. long and 30 wide. Its central item is a Westinghouse three-cylinder gas engine, 125 horsepower driving a standard railway generator, which furnishes current to all the lights and operative machinery of the pavilion at 125 volts. One main circuit from it goes to a Westinghouse rotary converter of 50-kw capacity, in which the 125-volt current is transformed into two-phase alternating at 400 volts, at a frequency of

FIG. 1.—BRITISH WESTINGHOUSE PAVILION.

60 periods, utilized for driving a 10-hp induction type motor. In turn this motor is belted to a small multipolar direct-current generator. The other main circuit from the larger generator goes to a motor-generator in which the current is stepped up to a pressure of 500 volts. The output of this combination unit is utilized for driving as a motor the largest dynamo in the pavilion, a Westinghouse 325-kw shunt-wound machine, shown attached to a Markham engine, which it turns as a load. Another prominent feature of the exhibit is a full-size Milnes trolley car, with Brill truck and West-

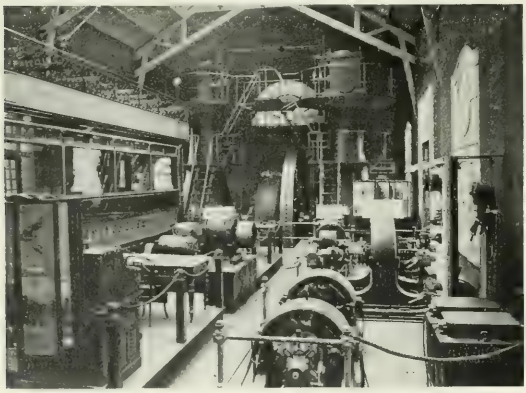


FIG. 2.—BRITISH WESTINGHOUSE EXHIBIT.

inghouse motors, controllers, switches, etc., of the type used on the Glasgow City Tramways. A notable point about this car is that it is equipped with an electro-magnetic brake of the Westinghouse Newell type. It consists practically of a magnet suspended by springs immediately over the track rail head, connected by a system of levers with the wheel-rim brake-shoes. Adjustments are so made that the thrust of the magnet on the track rail is taken up with an increased pressure on the wheel rims. The current is taken, of course, from the car motors running as generators. The proportion of track breaking to wheel-braking is finely variable to get the best effect without skidding. In conclusion it may be noted that the car has Sawyer-Man lamps, in regard to which a large, handsome sign makes itself conspicuous at one end of the pavilion.

KELVIN & JAMES WHITE, LIMITED, of Glasgow, have an exhibit, which consists of the switchboard controlling the distribution of electricity for light and power purposes to the whole of the exhibition. The board is arranged for the three-wire system, and panels are provided for twelve generators and eight feeders, dealing in all with 5800 electrical horse-power. The middle panel is fitted with Kelvin thistle-pattern feeder and dynamo voltmeters, a recording voltmeter, earth current recorders, etc., and is connected to the middle wire of

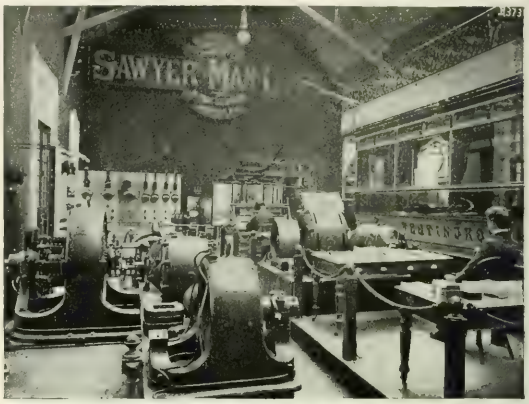


FIG. 3.—BRITISH WESTINGHOUSE EXHIBIT.

the system of distribution. Each dynamo has a positive and a negative panel, one mounted directly above the other. The positive panel is fitted with a Kelvin ampere gage and a main switch of the edgewise type, with carbon breaks. The negative panel is fitted with a Ferguson & White's automatic return current cut-out, with blowout screens, the dynamo field regulator hand wheel, and a pair of sockets for a Kelvin paralleling voltmeter. Each positive and negative feeder panel is fitted with a Kelvin feeder log and an edgewise switch for 750 amps. All the panels are of polished white marble, supported by a steel framework. A polished teakwood molding is fitted on the top and sides, and the whole is surmounted by an electrically synchronized clock controlled by a regulator at the other exhibit of Kelvin & James White, Ltd., in the Main Avenue, consisting chiefly of optical devices, barometers, etc. This regulator also controls the clocks in the Kelvin feeder logs.

BABCOCK & WILCOX, LIMITED, of London, have a useful exhibit of their boilers which, in conjunction with others, are supplying steam for power purposes in the Machinery Hall. There are two water-tube steam boilers, each containing 5137 square feet of heating surface, and constructed for a daily working pressure of 160 lbs. per square inch, set together in one battery or nest. Each boiler is composed of eighteen sections of tubes, each section having twelve tubes from top to bottom, with an additional row of tubes constituting the Babcock & Wilcox patent Scotch furnace. These tubes are 4 inches in diameter and 18 feet long, and are connected at the front and rear to two steam and water drums 48 inches in diameter and about 23 feet long. Connecting these two drums is an extra steam chest 20 inches in diameter. These boilers are fitted with patent superheaters, as well as patent chain-grate stokers, designed for the most efficient and smokeless combustion of semi-bituminous fuel. In addition to the above, they are exhibiting a marine boiler built for 1000 indicated horse-power, and constructed for a daily working pressure of 200 lbs. per square inch. This is the type of boiler which has been supplied for war vessels and the mercantile marine.

THE ELECTRICAL CONSTRUCTION COMPANY, LIMITED, London, has an interesting space containing an electrically driven, triplex ram pump, exhibited in conjunction with Joseph Evans & Sons, of Wolverhampton; polyphase motors, direct-current motors, and one of the standard upright bipolar dynamos, made by the company, and

particularly intended for battery charging work and small lighting installations. A type of E. C. C. motors is made so as to allow for partial or complete enclosure, and an example of this style is exhibited. These motors are most extensively used as series-wound machines for crane and hoist operation and kindred applications, but as compound and shunt-wound motors, they form a most satisfactory motor, driving all classes of machine tools, etc.

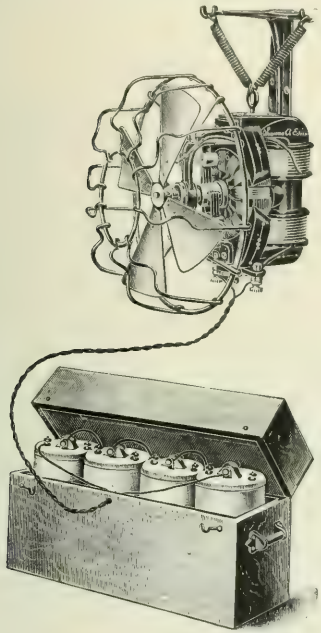
THE WHEELER CONDENSER & ENGINEERING COMPANY exhibits one of its rectangular surface condensers, with 1230 square inches of cooling surface, with pumps, and a similar condenser of about one-quarter the capacity. There is also one 400-hp heater of the vertical type and lagged, and also one 10-hp heater of similar design. With the above is a model cooling tower of the company's fanless flue type, and one 8-inch centrifugal pump with 40-hp motor, and one 8-inch centrifugal pump with 6-inch x 6-inch vertical engine.

THE EDISON & SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, of London, is exhibiting a 4-pole dynamo, built for an output of 520 amperes, at 250 volts, and coupled direct to a Browett & Lindley 200-hp engine. It also exhibits several small enclosed motors, 1-horse-power and 2-horse-power, driving various exhibits. Their special features are perfect enclosure, high efficiency, perfect sparklessness with fixed brushes and the small amount of attention required.

ISIDOR FRANKENBURG, LIMITED, of Manchester, has gathered together an interesting exhibit of specialties in insulated wires and cables. Their cable stand is situated in Machinery Hall, where is shown a cone over 17 feet high, built up of fifteen drums of cable. At the base is 37-12s., 2500-megohm steel-wire armored cable, and at the top 1-18s., 600-megohm wire. There is also exhibited two small piles of wire and cable, one of 600 megohn and the other of 2500 megohm grade, coiled up and wrappered in the usual manner for shipping. A sample case containing sections of various sizes and classes of cable, large and small, with lengths of the respective cables stripped back at one end to show method of construction, and two sample boards of vulcanized india rubber wires and cables.

Battery Fan Motor Outfit.

The illustration shown above is of a new suspension battery fan motor outfit now being placed on the market by the Edison Manufacturing Company, of New York. This outfit includes an Edison suspension battery ball-bearing motor with a nine-inch fan and four Edison-Lalande cells, together with the necessary connecting cords, etc.



BATTERY FAN MOTOR.

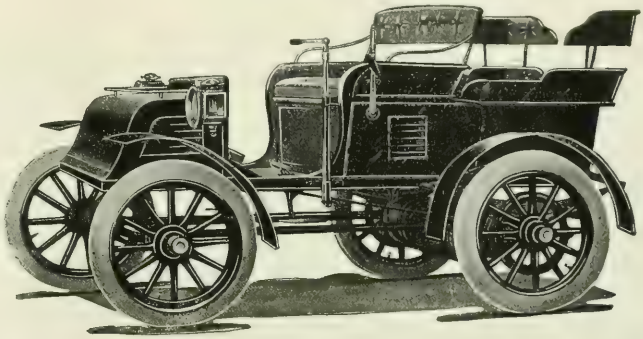
The motor, as will be seen, is suspended on springs from a wall bracket, this method of suspension rendering the operation of the motor noiseless. The outfit is, therefore, exceptionally well suited for use in bedrooms, sick-rooms, etc. One charge of the battery will, it is stated, operate the outfit 150 hours.

The motor is of the Pacinotti ring type, open field. The armature shaft is mounted on ball bearings so as to reduce the frictional loss. The diameter of the armature is 3¾ inches, and the torque of the motor is quite noteworthy for its size. The speed, when it is operated by four Edison-Lalande cells, with fan attached, is about 850 r. p. m.

A New Electric "Tonneau"

The attractive automobile illustrated herewith is what is known as a "tonneau." It is rather of the gasoline type in appearance, owing to the box in front, which in this instance is used for carrying part of the battery. As a standard type it is furnished with an operator's seat, accommodating comfortably two passengers, with a tonneau body, which furnishes room for two additional passengers. This tonneau is removable, and in its place may be substituted either a surrey seat for two passengers, or a rumble seat for an attendant, or a hamper for light luggage, while, if desired, the rear space can be left vacant to hold heavy luggage.

There is a double motor equipment, and as already noted, the battery is distributed over both the front and the rear axles, equalizing the weight and increasing the capacity for hill climbing. All the four wheels are of the same size, 32 inches, with 3½-inch pneumatic tire, and the body hangs low, rendering it easy to mount and dismount. The total net weight is 2490 lbs. There are 1100 lbs. of battery, and 400 lbs. of body. Each motor is of 1¾ horse-power. There are 40 cells of battery and a maximum speed of 14 miles an hour can be reached, the radius being 40 miles. This Columbia electric tonneau is built by the Electric Vehicle Company, of New York City.



ELECTRIC "TONNEAU."

A Telephone Test at Reading, Pa.

Several weeks ago the Schuylkill Valley Telephone Company, of Allentown, Pa., awarded the American Electric Telephone Company, of Chicago, the contract for supplying the Reading telephone exchange system with apparatus comprising switchboards, power board, cross-connecting boards, storage batteries, chief operator's and wire chief's desk and a full equipment of Burns' terminals and central energy telephones. Before placing the order for the telephone apparatus required at Reading, the directors of the Schuylkill Valley Telephone Company sent notices to leading telephone manufacturing companies requesting them to submit bids and samples of their apparatus, and they responded by forwarding a full line, and also arranged to have representatives present during a test of the apparatus submitted. In order to facilitate the making of these tests, each manufacturing company submitted a complete switchboard system in miniature together with a pair of telephones, and when a given system was under consideration a test would be made from telephone to telephone through the switchboard containing the circuits which would be used in the system proposed. In order to make the test a fair one, arrangements were made to use a loop cir-

cuit from Allentown to Wilkesbarre, and another loop from Allentown to Hazelton. These circuits gave the desired conditions for testing under actual service conditions.

After the engineers for the Schuylkill Valley Telephone Company

DESK TELEPHONE.

had made a test of all of the apparatus submitted and reported the results of these tests to the board of directors, they decided to award the contract to the American Electric Telephone Company, because of the high efficiency and superior mechanical construction of its transfer multiple central energy switchboard as well as of the powerful and distinct articulation of its telephones.

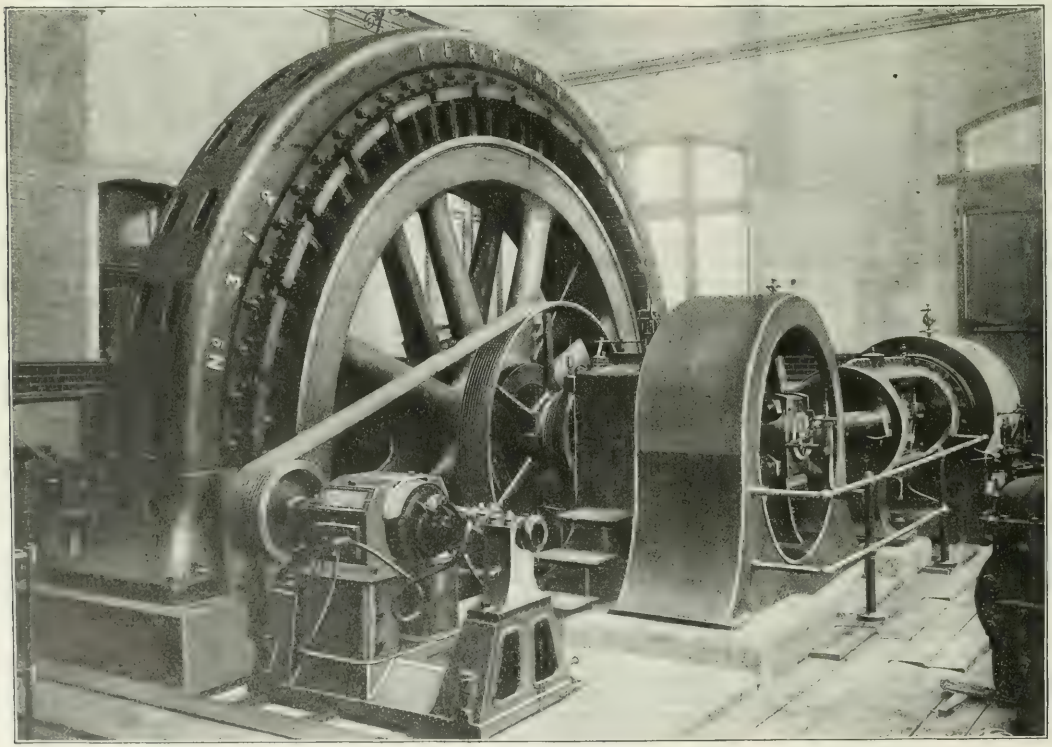
Desk Telephone.

The neat and handsome form of Bell type of desk telephone herewith illustrated is being introduced by Haines & Noyes Company, of Chicago. It is made for use on bridging, series, central energy or intercommunicating work. It has a heavy cast base, with an upright of copper, all exterior metal parts being heavily nickeled. The contacts are in the base and are platinum pointed, besides being free from dust or corrosion from exposure, they virtually cannot be broken or jarred loose. The terminal cords are under one woven cover of silk or worsted. The transmitter front and parts are of solid brass, with a special transmitter of liberal volume of sound and sharp, clean articulation. The bipolar pony receiver has permanent adjustment, with a water shrunk hard rubber cell. The induction coil is silk-wound, with fiber ends, and is mounted on a fiber base with nickel binding posts. This instrument is furnished either with or without a button in the base, and separately, or with intercommunicating plug box, or other apparatus pertinent.

Ferranti Iron-Type Alternator.

The accompanying illustration shows a 600-kw slow-speed Ferranti iron type alternator similar in general features to those first introduced in England by Mr. Ferranti so long ago as 1893, being of the revolving field and stationary armature type. The machine, which runs at 94 r. p. m., and gives a voltage of 2100 at a periodicity of 50, is one of four erected within the last 12 months. The armature is 18 ft. inside diameter, and the outside diameter of the frame is 23 ft. The laminations are held in the frame in sections by insulated bolts passing through the back of the stampings. Each section is detachable and complete in itself so far as the winding is concerned, spanning over a pitch equal to two poles. A special feature of this armature is the excellent manner in which the armature winding is insulated and protected. This is done by enclosing the armature winding as it leaves the stampings in strong ambroin boxes.

The armature sections are built up of laminated charcoal iron



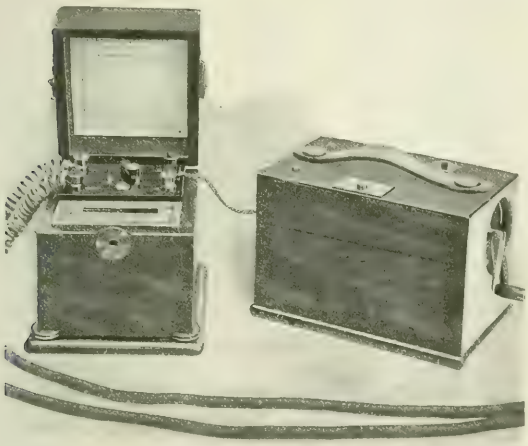
FERRANTI IRON-TYPE ALTERNATOR.

plates papered on one side, and separated at intervals by ventilating spaces across the width of the armature. Tunnels are punched on the inner edge and the winding, which is of stranded copper cable double cotton-covered and braided, is wound through these tunnels, being insulated from the stampings by strong micanite tubes. The armature coils are conencted in series round the machine.

The frame is of cast iron of massive section, and is supported on box section girders. The field magnets, 64 in number, are of high permeability cast steel securely held to the rim of the flywheel. The field winding consists of one coil per pole of flat strip copper wound on edge, thus exposing every turn for cooling. The coils are insulated from the magnets by layers of insulating material wound on the body of the magnets, and from the wheel by stout fiber washers. The field is, of course, excited in series, the exciter as shown by the illustration being driven from a rope pulley on the engine shaft. The engine to which the alternator is connected was manufactured by Daniel Adamson & Co., of Hyde.

A New Testing Set.

For some time there has been on the English market an instrument for indicating directly the value of a resistance, known as the Evershed ohmmeter. This instrument is particularly adapted to the



OHMMETER.

measurement of high resistances, and is of importance in testing the insulation of both ærial and underground cables, dynamos and wiring installations of every kind. On account of the high rate of import duty, this testing set has had but a limited sale in the United States and its usefulness is not widely appreciated. The growing need in this country for a moderate priced apparatus of this type has induced the firm of Queen & Company to secure the American rights for the manufacture of this instrument, and they are now prepared to furnish promptly a variety of these ohmmeters suitable for testing resistances from 100 ohms up to 50 megohms.

The testing set as shown in the illustration consists of two parts, the one being the generator, which is in reality a small dynamo. This is capable of being driven at a high rate of speed and can be wound so as to produce voltages ranging from 10 volts, used with the testing set for measuring low resistances, up to 1000 volts, used for measuring the highest resistances. The weight of the generator is only a few lbs., and the effort required to drive it is very small, the friction in the bearings being reduced to a minimum by the use of rollers, and the collecting brushes being in the form of elastic disks rolling in contact with the ring segments of the commutator, a device which lessens friction to almost a negligible extent and at the same time insures perfect contact at all speeds. The driving handle is permanently fixed on the axle, so that it is impossible for it to become mislaid. It is held in position for turning by means of a spring catch, and when not in use is turned back in a recess in the wooden case. The generator is also provided with a spring drum inside the case on which a twin flexible cord is coiled and provided with a [illegible] device so that it can be held at various lengths. The two ends of the flexible cord are attached to the connector for clamping under the ohmmeter terminals.

The indications of the ohmmeter are produced by the action of three sets of coils on an astatic needle. This needle is also magnetized by the current from the generator, and therefore renders the reading independent of the direction of the testing current, that is, reversal of the connections between the instruments, or the direction of the rotation of the generator, does not injure the ohmmeter in any way nor affect the accuracy of its readings.

This set has the great advantage that the simplicity of its construction allows it to be put in the hands of the ordinary workman, who can secure as accurate results as one having a great deal of experience in testing work. Furthermore, the potential which is applied to a cable or line of wires under test is the same as, or greater than, would be the case in actual operation. In this respect, it is said, the plan is preferable to the ordinary method of testing now in vogue, of using a high sensibility galvanometer and a few cells of battery. In this latter method the cable is only subjected to a pressure of a few volts, not sufficient to break down a weak point which might, however, be broken down by a considerably less voltage than would be ordinarily used on the line. A generator can be employed which produces sufficient voltage to make such a test properly.

Abroad, this set has, it is stated, come into general use for its simplicity, convenience and accuracy, it being adopted by nearly all the leading supply houses, wiring contractors and dynamo builders.

Northwestern Convention Notes,

As usual at Northwestern Electrical Association conventions, the supply men were very much in evidence, in fact, much more so than the electric light and power delegation, as will be seen by the following notes:

Richard Smith, of Keelyn & Smith, Milwaukee, represented his firm.

George White, of Macomber, White & Company, Chicago, was on hand.

Julius Andrae Sons, Milwaukee, were represented by Mr. Schmitbauer.

The H. T. Paiste Company was represented by Edward A. Jenkins, of Chicago.

The Baseball Game, Wednesday afternoon, was a thrilling affair to those who participated.

The McRoy Clay Works, Brazil, Ind., was represented by General Manager Kirkpatrick

The Supply Men were entertained with a dance at the Lake View Beach Hotel, Wednesday evening.

The Illinois Electric Company had its interests looked after by C. W. Bacon, its Wisconsin representative.

Secretary Thomas R. Mercein, of Milwaukee, was as active as ever both in and out of convention sessions.

The Sawyer-Man Electric Company was represented by Geo. A. Nellis, acting manager of the Chicago office.

Kurts & Root, of Appleton, Wis., and Evans Almiral & Co., Chicago, were admitted as associate members.

William D. Kurtz, of Kurtz & Root, consulting electrical engineers, Appleton, Wis., was one of the late arrivals.

The American Circular Loom Company had Western Manager Thomas G. Grier and the red trade mark much in evidence.

W. C. Phelps, of the Phelps Company, of Detroit, maker of incandescent lamps, was present during one day of the convention.

"G. I." Raymond.

John W. Brooks, manufacturers' agent, 303 Dearborn Street, Chicago, was present in the interests of the various companies he represents.

The Electrical Press, outside of the Electrical World and Engineer, was represented by Chas. K. Thomas, W. F. Collins and F. L. Perry.

Geo. J. Cadwell, sales manager of the motor department of the Christensen Engineering Company, went up from Milwaukee to attend convention.

The Electrical World and Engineer was represented by J. V. S. Church, western manager, and James R. Cravath, of the editorial staff, both of Chicago.

M. B. AUSTIN & COMPANY, of Chicago, sent A. Meinema, who was on the ground early and helped receive the Chicago and Milwaukee crowd on its arrival Monday evening.

THE GREGORY ELECTRIC COMPANY, of Chicago, was represented by R. H. Watson, of the sales department, whose sterling gentlemanly qualities make him a favorite everywhere.

HUSKIES.—Two husky-looking country lassies, Misses Upham and Cadwell, rode in from the woods on a boneshaker to attend the Thursday morning session, but were rather late.

EVANS, ALMIRALL & COMPANY, owners of the Evans exhaust hot water heating system, 1001 Monadnock Block, Chicago, were represented by C. Locke Etheridge, mechanical engineer.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, was represented by the manager of its northwestern office, James B. Coale, of Minneapolis, who came all the way from South Dakota to attend.

THE WAGNER ELECTRICAL MANUFACTURING COMPANY and BULLOCK ELECTRICAL MANUFACTURING COMPANY were represented by Fred. Foster, manager of the Chicago joint sales office of the two companies.

HARRY BYRNE, the Wisconsin representative of the Western Electric Company, joined the Chicago party at Milwaukee and was warmly welcomed. A good singer and story teller, he added much to the enjoyment of the crowd.

GRIER'S special dinner card, which was served along with other things at the Lake View Beach Hotel, Thursday noon, was a piece of "Tom" foolery enjoyed more than the dinner itself, from the Mercein radishes down to the Schmitbauer toothpicks.

THE DEARBORN DRUG & CHEMICAL WORKS, of Chicago, sent some good luck pieces to be distributed by James W. Harkins, its Illinois and Wisconsin representative. These pieces served to remind that little savings make big dividends.

THE BRYAN-MARSH COMPANY had reason to especially congratulate itself on its representation. Guy V. Williams, of Minneapolis, manager of its northwestern district office, read the paper on "Incandescent Lamps" before the Association Wednesday afternoon.

O. C. LITTLE, president of the O. C. Little Pulley Coating Company, came down from his home at Menasha, Wis., bringing his dynamometer testing model for demonstrating the difference in the pulling power of a belt when running on coated and non-coated pulleys.

THE FORT WAYNE ELECTRIC WORKS, which do an extensive business among delegates to Northwestern conventions, had their Chicago manager, W. S. Gall, and Frank McMaster in attendance. These gentlemen brought along an exhibit of Fort Wayne apparatus.

CENTRAL STATION MEN attending the convention were: G. C. Gum, Delevan, Wis: John Fox, Manitowoc, Wis.; E. L. Debell, Sheboygan, Wis.; T. F. Grover, Fon du Lac, Wis. But they did not seem particularly lonesome, as each one had 25 supply men paying him attentions.

AT THE theatrical entertainment, to which the convention visitors were invited Thursday evening, the occasion was taken to present Mr. James Wolff, of the New York Insulated Wire Company, with a loving cup as a token of the high esteem in which he is held by the supply men of the Northwest.

OLD-TIMERS were agreed that there was more horse-play to the square inch at this convention than at any other electrical gathering ever held on American soil. Whether this is a subjct for congratulation or indignation is a point the old-timers are now deciding. "Horse" play is not the right term, according to some of them.

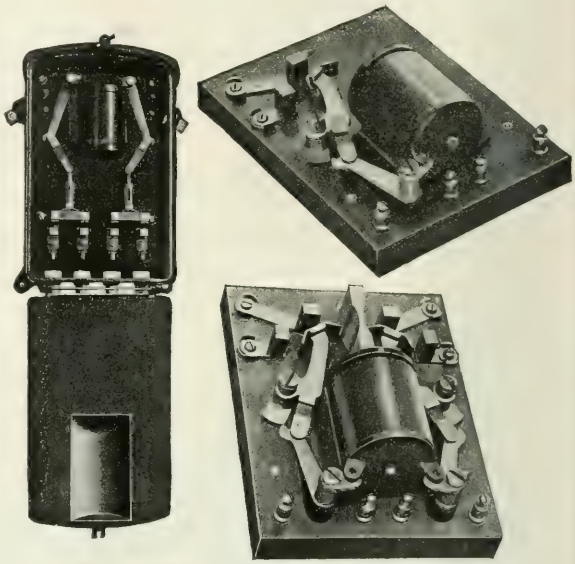
THE ELECTRICAL APPLIANCE COMPANY, of Chicago, sent W. P. Upham to look after its interests. Mr. Upham distributed porcelain bushings and a dice block bearing on four of its sides the various transpositions of ohms law, and with the mark of "Brunt," East Liverpool, Ohio, maker of porcelain electrical goods, on the other two sides.

THOMAS FERRIS, of the General Electric Company's Chicago office, was among the supply delegation. He had with him some samples of the new 4-candle-power, 106-volt lamp on standard screw base which promises to offer quite an improvement over the old scheme of putting a number of low candle-power lamps in series on signs and display lighting.

JAMES WOLFF, Chicago representative of the New York Insulated Wire Company, organized the Chicago delegation and secured a special car on the train leaving Chicago and Milwaukee Monday evening. Mr. Wolff is always one of the leaders among the supply men at these conventions, but bears the place of honor awarded him by common consent with becoming dignity.

Remote Control Switches.

The accompanying illustrations show a type of switch made by the General Electric Company for a system of remote control in connection with arc lamps, motors, groups of incandescent lamps, etc. The switches are so constructed that any number up to 10 can be placed in series and operated by a single-pole double-throw switch at the controlling point. The switch is particularly adapted for use by central stations which may have a number of customers who, on account of cheaper rates, desire to purchase power only during certain hours. In the case of a number of large transformers banked for power or light distribution, the losses in some of the transformers may be avoided during the light load period by cutting them out and leaving only a sufficient number to carry the load. The switches may be readily arranged to cut out first the transformer secondaries, and then the primaries.



FIGS. 1, 2 AND 3.—SWITCHES FOR REMOTE CONTROL.

If multiple arc lamps are used for city lighting, the lamps can be run directly from the main distribution circuit by placing one of the small switches at each arc lamp or group of arc lamps, and arranging in series all switches controlling certain portions of the system.

The switches are furnished with an iron box, as shown in Fig. 1, or unenclosed, as shown in Figs. 2 and 3. Fig. 1 shows a switch of the double-pole type, and having a capacity of 100 amperes. Fig. 2 is a single-pole switch, and Fig. 3 a double-pole switch, the capacity of each being 25 amperes.

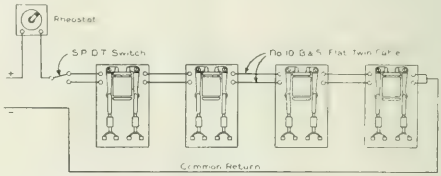


FIG. 4.—DIAGRAM OF CONNECTIONS.

The method of connecting is shown in Fig. 4. A rheostat is placed in the circuit merely to limit the flow of current in case less than the maximum number of switches is used with a certain voltage. For the conducting wire, No. 10 B. & S. flat twin cable may be employed, while for the common return a No. 10 B. & S. single wire is employed, or either leg of a two or three-wire system. If the switches are to be used in connection with an alternating-current circuit, they may be operated by the exciter current. To open all the switches the single-pole double-throw switch is thrown one way for an instant only, and then opened. The switches are closed by similarly manipulating the controlling switch, but in opposite direction.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market the following quotations were recorded at the close of the week: Six per cent, nominally, for call money, the rate having reached as high as 15 per cent after the closing of the doors of the Seventh National Bank by the Controller of the Currency on Thursday. Most of the loans, however, were made at 6 or a little above that figure; 4 per cent is quoted for time money for all periods. Mercantile paper is quoted at 3¾ a 4¼ per cent for 60 to 90 days' indorsements; 4 a 4½ for choice four to six months single names, and 5a5½ for others. The stock market was somewhat disturbed last week by the troubles of the Seventh National Bank and the failure of a prominent brokerage house, but nothwithstanding these influences it behaved exceeding well. Continued fair crop prospects, active business conditions and railroad earnings, which present increases even over the very large total of a year ago, rendered the market immeasurably insensible to any adverse outside influences. There was an apparent lack of outside interest, and the support extended by bull pools and large interests to various specialties was notable, although there is general confidence in "The Street" that better speculative conditions will prevail after July 1, provided there are no further unsettling incidents in banking circles. The question of dividends on United States Steel stocks occupied much interested attention, but nothing definite in this direction was developed. Among the traction stocks Manhattan was firm, but Brooklyn Rapid Transit was most active, reports of good earnings being prevalent, and the covering of shorts giving the stock a certain measure of support. The sales of this stock aggregated 108,750 shares, the result of the week's trading being a net gain of ¼ point. Metropolitan Street Railway was not particularly active, the sales for the week amounting to 43,300 shares, the closing price being 174¾, ex dividend, which represents a net gain of 2 points. General Electric was very firm, the trading was restricted in volume, only 4250 shares having changed hands during the week. The price continues to advance, being 267 at the close—a net gain of 7 points. Western Union was the exception in the electric list, suffering a net loss of three-eighth point on sales of 11,110 shares. Dealings in outside securities were not marked by any features of prominence. Most of the stocks remain at practically unchanged quotations. The exception was Electric Boat, of both issues, common losing 5 points and preferred 3 points. Electric Vehicle, both common and preferred, advanced 1 point each. The following lists show the closing quotations at the four points named:

NEW YORK.

	June 2.	June 29.		June 2.	June 29.
General Electric	260	267	Electric Vehicle	8	9
Brooklyn Rapid Transit	82½	82¾	Electric Vehicle, pfd.	16	17
Metropolitan Street Ry.	174½	174¾	General Carriage	1⅝	2
American Tel. & Cable	100	—	Illinois Elec. Veh. Tran.	⅝	⅝
Western Union Tel.	94¼	93⅞	Hudson River Tel.	120	120
American Dist. Tel.	—	34	N. E. Elec. Veh. Tran.	3	3
Commercial Cable	—	184	N. Y. Elec. Veh. Tran.	14	13½
Electric Boat	22	17	Tel. & Tel. Co. of Am.	5	4
Electric Boat, pfd.	50	47	N. Y. & N. J. Tel.	173	173
Electric Lead Reduc'n	3	2½			

BOSTON.

	June 2.	June 29.		June 2.	June 29.
New England Telephone	—	*140	Erie Telephone	55½	50
Mexican Telephone	2½	2½	General Electric, pfd.	—	—
Westinghouse Electric	—	*70¼	Am. Tel. & Tel.	160½	156
Westinghouse Elec., pfd.	78	*80	Boston Electric Light	—	—

PHILADELPHIA.

	June 2.	June 29.		June 2.	June 29.
Electric Storage Battery	67	77	Philadelphia Electric	5½	5½
Elec. Storage Batt'y pfd.	68	75	Pa. Electric Vehicle	1	1
Elec. Co. of America	8	7¼	Pa. Elec. Veh., pfd.	1	1
General Electric Auto	—	—	Am. Railways	41½	42

CHICAGO.

	June 2.	June 29.		June 2.	June 29.
Chicago Edison	177	177	Chicago Telep. Co.	275	*276
Chicago City Ry.	206½		Union Traction	19½	19
National Carbon	18	16	Union Traction, pfd.	58	60
National Carbon, pfd.	87	86	Northwest Elev. com.	47	47

*Asked.

BROOKLYN RAPID TRANSIT.—The lease of Brooklyn Union Elevated to the Brooklyn Heights Railroad Company has been filed with the Secretary of State, to expire June 30, 2900. The lessee covenants to pay annually in quarterly installments all reasonable expenses of maintaining the corporate existence of lessor company, not exceeding $3,000 a year, and the lessee further agrees, as part of rental, to pay to the lessor company before each Sept. 30, after June 30, 1902, until and including Sept. 30, 2900, all of the annual earnings received by the lessee from the operation of the Brooklyn Union Elevated Railroad property after deducting therefrom the several amounts specified, as part of rental, these net earnings after deductions aforesaid, shall not be less for each of the fiscal years ending June 30, 1902, 1903 and 1904, than $150,000, or less for each of the fiscal years 1905 and 1906 than $200,000, or less for each year thereafter and during the continuance of the lease less than $250,000.

DIVIDENDS.—The Edison Electric Illuminating Company, of Savannah, has declared the regular semi-annual dividend of 3 per cent, payable July 1. The Cleveland Electric Railway Company has declared the regular quarterly dividend of 1 per cent, payable July 5. The Washburn Wire Company has declared a dividend of 1¾ per cent on its preferred stock, payable July 1. Directors of Brooklyn Union Elevated Railroad have declared a dividend of 2 per cent on its preferred stock. Brooklyn, Queens County & Suburban Company directors declared dividend of 1 per cent, and Seabeach directors declared a 1 per cent dividend, all payable June 29. In each instance these are initial dividends. Brooklyn Heights road will hereafter guarantee interest and principal of Brooklyn Union Elevated 1st mortgage bonds and Kings County Elevated 4 per cent bonds. The Philadelphia Company, of Pittsburg, has declared a dividend of 1½ per cent on its common stock, payable July 20.

BERGEN COUNTY COMPANY STOCK.—As the result of the failure of the Seventh National Bank and of Henry Marquand & Co. last week, there were sales under the rule at the Stock Exchange of 300 shares of Gas & Electric Company, of Bergen County, stock at 30 cash, and 100 shares at 32 cash. The last previous quotation, regular way, was 101a101¼. The sales are supposed to be for the account of Henry Marquand & Co. Other sales have been made under the rule, but at normal prices. The stock of the Gas & Electric Company, of Bergen County, has since rallied. It is understood that both the Standard Oil Company and the United Gas Improvement Company are seeking control of the property. The company has an excellent business and territory, and has been admirably conducted.

A WILD RUMOR.—Some stock exchange reports are crazier than others. The subjoined is one of them, printed by leading Wall Street papers. The General Electric Company is on excellent terms with Mr. Edison, and proposes to stay so. Here is the report: Certain developments of late seem to foreshadow an active contest between the General Electric Company and the Edison Storage Battery Company, recently incorporated in New Jersey, with Thomas A. Edison as president. It is understood that the General Electric Company is about to close negotiations which will give it control of the storage battery invented by Mr. Strowger, of Rochester, N. Y. And more to the same effect.

CENTRAL UNION ASSESSMENT.—Central Union Telephone stockholders are not taking kindly, it is said, to the proposed assessment to put the company on a sound basis. It is hardly probable that the shareholders will accede to an assessment, and as the laws of Illinois prohibit a forced assessment, the only course open is to issue 4 per cent debenture bonds. The stock of this company shows particular strength in view of this condition. The American Bell owns half the six million of stock.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has declared its regular quarterly dividend. James C. Marshall, for five years auditor of the Farmers' & Shippers' Leaf Tobacco Warehouse Company, was elected assistant treasurer.

ST. LOUIS LIGHTING.—Messrs. Battles, Hays & Harrison, of New York City, have sold a controlling interest in the Imperial Electric Light, Heat & Power Company, of St. Louis, to Messrs. Bertron & Storrs.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade, crop and industrial developments last week were largely favorable, according to *Bradstreet's* summary, temporarily firmer money, owing to July interest disbursement preparations, and slight financial troubles, due to improper banking methods, not detracting from the generally satisfactory and confident feeling with which the half year in business closes. Iron and steel show few notably new features. The price of Bessemer pig has been definitely fixed for the third quarter of the year, and, it is thought, heavy business has been done recently. Foundry pig is rather quiet; the machinists' strike has hurt this line of business, but this trouble appears to be subsiding. American steel billets are

being offered on the British markets at very low prices. This fact is taken to indicate that American manufacturers are in the export business to stay. All the building trades are active and large quantities of materials are passing into consumption. The hardware trade makes very favorable reports. Anthracite coal is without change, although there were exceptionally heavy movements last week, for this season, due, it is thought, to the probability of continued advance in price. The failures for the week, as reported by *Bradstreet's*, numbered 196, compared with 188 the week previous, and 185 the same week a year ago. In the metal market, copper was quiet and dull; manufacturers are busy, but not buying much. The leading producers are holding firm, but what little business was done was taken by others at concessions. Quotations are: 16¾c. for Lake; 16¼a16⅜c. for electrolytic in cakes, wire bars and ingots; 16a16⅛c. in cathodes; 16¼c. for casting copper.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the Port of New York for the week ended June 19: Antwerp—43 packages electrical material, $2,726. Amsterdam—4 cases electrical material, $54. Aberdeen—6 packages electrical machinery, $500. Brazil—21 packages electrical material, $390. Bremen—1 package electrical machinery, $327. Bristol—11 cases electrical machinery, $500. Berlin—1 package electrical machinery, $275. British East Indies—1 package electrical material, $57. British Australia—14 packages electrical material, $2,080. British Africa—11 cases electrical material, $3,384. Brussels—1 package electrical material, $100. Barcelona—2 packages electrical machinery, $102. Belfast—15 cases electrical material, $990. British West Indies—16 packages electrical material, $371. Cuba—35 cases electrical material, $375. Central America—1 case electrical material, $13. Copenhagen—1 case electrical material, $26. Dundee—3 packages electrical material, $150. Ecuador—2 packages electrical material, $33. Glasgow—20 packages electrical material, $1,193; 22 reels cable, $10,669; 25 packages electrical machinery, $2,000. Havre—49 cases electrical machinery, $25,221; 14 packages electrical material, $1,688. Hamburg—1 package electrical machinery, $10; 71 packages electrical material, $8,087; 12 auto vehicles, $1,275. London—78 cases electrical machinery, $2,365; 144 cases electrical material, $4,756; 9 motor vehicles, $3,780. Liverpool—24 packages electrical machinery, $2,000; 56 packages electrical material, $2,858. Manchester—3 cases electrical material, $1,365; 543 packages electrical machinery, $60,323. Moscow—1 case electrical instruments, $90. Mexico—88 cases electrical material, $710. Newcastle—2 packages electrical material, $100. Preston—20 packages electrical material, $900. Peru—1 package electrical material, $70. Southampton—3 cases electrical machinery, $490; 25 packages electrical material, $894. U. S. Colombia— cases electrical material, $50; 4 cases electrical machinery, $700. Venezuela—3 packages electrical material, $33. Walsall—14 packages electrical material, $559.

MR. JAMES G. BIDDLE, Stephen Girard Building, Philadelphia, has just taken a very important order covering the instrument equipment of a new laboratory about being established in New York City by the Lamp Testing Bureau, which operates under the auspices of the Association of Edison Illuminating Companies. The experts of the Lamp Testing Bureau as well as its president, Mr. John W. Lieb, Jr., gave the subject most careful attention with a view of securing apparatus of the highest quality whether manufactured in America or Europe. Price was a secondary consideration, and Mr. Biddle's bid was not the lowest one received by any means. The order comprises a large amount of apparatus manufactured by Morris E. Leeds & Co., Philadelphia. Among the more important items are an Anthony type resistance box and Wheatstone bridge, Leeds standard laboratory potentiometer with volt box and low-resistance standards, Reichsanstalt type photometer, special portable potentiometer, special resistance box of about 100,000 ohms, Leeds portable testing set, Rowland electro-dynamometer with shunt box, D'Arsonval galvanometers, etc. In addition the order comprised some Weston semi-portable laboratory standard instruments, Weston standard cells and a few foreign instruments, such as Weber portable photometer, Heffner lamp with Reichsantalt certificate, special Lummer-Brodhun photometer screen, etc. At first, it is said, the officers of the Lamp Testing Bureau were disposed to place the entire order abroad (with exception of the Weston instruments, of course), so that it is specially gratifying that instruments made here were selected in almost every case.

BROWNE & FROTHINGHAM, of New York City, who act as export representatives of certain large manufacturers, have recently been asked to furnish estimates on various improvements now being considered by one of the Japanese railroads for an addition to their shops, which it is estimated will mean an expenditure of some $25,000. When the business is finally ready to place, which it is expected will be along this fall, the orders will come through one of the several export houses in this city doing business with Japan. The machinery in question covers two 30-ton electric traveling cranes of 60-ft. span, and having a lift of 25 ft., and we understand that figures relating to the supply of such equipment are being given by request by Pawling & Harnischfeger, of Milwaukee, Wis., and the Brown Hoisting Machinery Company, of Cleveland, Ohio. Full particulars have also been furnished the same Japanese road on three 100-kw generators, 450 r. p. m., and a number of 10, 15 and 24-hp motors as made by the Milwaukee Electric Company, of Milwaukee, Wis. The switchboard proposed is to be furnished by Geo. F. Rohn, of Milwaukee. All this is additional evidence that the Japanese are becoming more and more alive to the fact that modern first-class appliances are the most economical in the long run.

MR. G. H. WALBRIDGE, of the New York electrical engineering and contracting firm of J. G. White & Co., has just returned from a two months' trip to Europe, where he went for the purpose of conferring on some important electrical matters, with the directors of J. G. White & Co., Limited, of London, which concern has recently secured some large contracts for the equipment of electric lighting and traction plants in both Australia and New Zealand. Some substantial contracts have just been awarded to American manufacturers in connection with the Kalgoorlie Tramways Company, Western Australia. The Pennsylvania Steel Company has obtained an order for 1200 tons of steel girder rails, the J. G. Brill Company is to furnish 20 cars, while the General Electric Company has been allotted the order for the requisite motor equipments. No contracts will be let for power house equipment as all the electrical energy necessary for the operation of the tramway system will be derived from the power plant now under course of construction at Kalgoorlie. That generating station was primarily intended to supply power to drive machinery in the mines located in that neighborhood.

DECORATIVE ART IN ITALY.—One of the most interesting of the exhibitions to be held in the near future is that entitled the International Exhibition of Modern Decorative Arts, which will take place in Turin, Italy, next year. The commissioner general for the United States will be General L. P. di Cesnola, the well-known director of the Metropolitan Museum of Art in New York City. The programme for the exhibition is excellent, and there are several clasess in which America should be able to distinguish itself. Reproductions are barred, and only original work will be admitted. Lighting and warming apparatus and fixtures are necessarily included, as well as lanterns, lamp-posts, standards, etc., for exteriors and for use on the streets.

UNITED STATES CARBON COMPANY.—A meeting of the directors of the United States Carbon Company will be held in the near future, when the company will probably be reorganized. At that time the capital will be increased and arrangements will be made for the expansion of the plant, which is too small to take care of the present business. W. D. Sayle, at present receiver for the company, states that there are orders enough on hand to keep the plant running full time to July 15, and there is a large amount of business in sight. The first disposition on the part of the directors and stockholders was to sell the plant, but this has been succeeded by the feeling that it will prove a profitable investment to put more money into the business.

MR. CHRIS NEILSON, of the American contracting firm of Clarkson & Co., Vladivostock, Russia, is now in this country for the purpose of purchasing considerable quantities of electrical machinery, etc. He is at present negotiating with local parties with a view to the supplying of a large electric lighting and power plant for the Russian Government docks now in course of construction at Vladivostock. The equipment will include four 150-kw generators direct connected to engines, also some 20 motors of various sizes, cranes, etc. The Jeffrey Manufacturing Company, of Columbus, Ohio, has already received a fair sized order for conveying machinery. Mr. Neilson is stopping at the Astor House.

STEAMSHIP LIGHTING.—In the new steamship "Lyra," of the Boston Tow Boat Company, the installation of electric lights is remarkably complete, including even the holds, so that darkness may not interfere with loading and discharging cargo. The dynamo and engine—forming a compact generating unit—were designed and built by the B. F. Sturtevant Company, of Boston, Mass.

WESTINGHOUSE, CHURCH, KERR & CO., of New York City has received an order for 25-hp junior automatic engine direct connected to a 15-kw Westinghouse generator, switchboard, wiring, 150 incandescent lamps, five arc lamps, etc., which will be shipped to Brazil, where the plant will be utilized for lighting a hotel at Para.

WORK RESUMED IN SPRAGUE JERSEY FACTORY.—The Sprague Electrical Works at Watsessing, N. J., have been reopened after a closure of a month on account of the machinists' strike. It is stated that 450 of the old employees returned to work, only a dozen names being missing from the roll.

ELECTRIC LIGHTING IN SPAIN.—The municipality of Rieza, Spain, will on July 9 close a concession for the establishment of a municipal electric light plant and operating the same for 20 years, at an upset price for the concession of $579 per annum.

NIAGARA DEVELOPMENT.—At 12.20 p. m., Wednesday, June 26, a great blowing of the whistles of the numerous hoisting engines and locomotives of the National Construction Company, having in charge the sinking of the wheel-pit of the Niagara Falls Power Company, announced, with all the clamor at their command, that the depth of 180 ft. below the surface had been reached, opening into the tunnel recently finished by A. C. Douglass. This completes the full depth of the northern terminus of the new wheel-pit, and the southern end, having still about 40 ft. to be excavated, will be finished before many months, and the work of excavation ended. The tunnel extension, leading from the new wheel-pit under the intake canal, and connecting with the wheel-pit of the present power-house, is extended 30 ft. or more, and the work of laying brick has been begun. Small dummy cars are being run to and fro, removing the rock as it is blasted from the tunnel. The completion of tunnel, wheel-pit, and power-house extension will bring about a doubling of the present capacity of the Niagara Falls Power Company. The work of placing the penstocks from the forebays to the inside wall of the power-house is progressing rapidly, some being already completed. In a short time the iron work will be begun. Work upon the Norton Emery Wheel plant and the Castner Alkali Works, also the Niagara Electro-Chemical Company is being pushed forward rapidly, and the upper Niagara is a scene of ceaseless activity.

ASSOCIATION FOR PROMOTING COMMERCIAL INSTRUCTION.—Under date of June 6, 1901, the United States State Department has received from the International Association for the Advancement of Commercial Instruction (Leonhardstr. 21, Brunswick) the programme and the order of exercises of the constituent meeting at Zurich, on July 11-13, of this year. The United States is requested to send as representatives members of institutions of commercial instruction. Persons interested in the matters of trade and commercial education are invited to become members of the association. The utility of an international association of this nature will be discussed at the inaugural meeting, to be held at Zurich. The universal nature of trade, it is stated, makes it possible for the question of commercial education to be internationally treated in an advantageous manner, as the bases of trade and mercantile requisites are essentially the same in all countries. It is desirable to have an annual statistical review, published in several languages, as well as a central office, to collect the educational plans of various countries and to give information to those interested.

CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY.—The annual meeting of the stockholders of the company was held June 18, and the management reported affairs in good condition, with inquiries increasing. A complete plant has been installed in South America to be used in connection with the Santa Marta Railway Company. Contracts for plants have been received from the Thomson-Houston Electric Company, of Rugby, England; the Societe Alsacienne de Constructions Mecaniques, Mulhouse (Haute Alsace), Germany, and the Semet-Solvay Company, Ensley, Ala. Immediately following the stockholders' meeting the directors met in a short session and elected the following officers and directors: Hon. E. L. Freeman, president; E. M. Prindle, vice-president; Moses E. Torrey, treasurer; F. A. Seib, secretary; John L. Putnam, acting general manager; Albert E. Farwell, Alfred S. Clark, Julius H Preston, Jeremiah W. Phillips, A. Van Wagenen, George H. Smith, William H. Herrick, directors.

ORDERS FOR ENGLAND.—Edward Bergtheil and H. Wilson Young, of the British electrical engineering and contracting concern of Bergtheil & Young, Camomile Street, London, E. C., who, it will be recalled, were recently on a visit to the United States, are understood to have left behind them some important orders for the specialties of Bullock Electric Company, Eugene Munsell & Co., and the H. W. Johns Manufacturing Company. The latter concern is said to be shipping some substantial quantities of its wire construction material to Europe. Among the many recent important domestic contracts secured by the Johns people is one for about 80 miles of No. 0000 grooved wire construction which will be utilized for high-speed interurban traction work in Pennsylvania.

MADRID TRAMWAY CONCESSION.—Tenders are invited by the Ministry of Agriculture, Industry, Commerce and Public Works at Madrid, for the concession and operation for 60 years for an electric railway from the Santuario de la Vedra to the railway station at Baeza. A provisional deposit of $1,250 will be required to qualify any tender. The contract closes July 26

FANS, ETC., FOR SPAIN.—The National Association of Manufacturers, Philadelphia, reports that Alvaro Urena, Barquillo 11 y Sauco 1, Madrid, Spain, is inquiring for prices and best discounts on electric fans and ventilators, electric motors, electric bells, storage batteries, etc.

TURBINES FOR BRAZIL.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, shipped recently on the order of Rose & Knowles, Sao Paulo, Brazil, one 18-inch improved cylinder gate Victor turbine mounted horizontally in steel penstock with quarter turn discharge. The waterwheel shaft was extended through the neck of the quarter turn and carried by ring oiling swivel bearings supported by heavy cast iron yokes. The shaft is fitted with two cast iron pulleys for belt drive. The wheel will develop 59 effective horse-power under 20 ft. working head, and will be belted to the two small dynamos for furnishing electric light in the cotton mills of Messrs. Jose Weissohn & Co., Salto de Ytie, Brazil.

MONTAUK CHANGES NAME.—The Montauk Multiphase Cable Company will be known hereafter as the Montauk Fire Detecting Wire Company. Mr. John D. Gould, president, says: "This change of name is not on account of reorganization of the company, but has been made for the purpose of more fully conveying to the public the nature of our business. We have received so many communications which indicate that wrong conclusions have been drawn as to the product we manufacture, that it was deemed advisable by the stockholders at their annual meeting May 1, 1901, to adopt the new corporate name."

POWER IN NORTH CAROLINA.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, report that a few days ago they shipped to the North Carolina Electrical Power Company, Marshall, N. C., one of their 27-inch improved cylinder gate Victor turbines on horizontal shaft in a wrought iron flume. The wheel is made entirely of bronze and under 60 ft. working head of water will develop 750 horse-power. The shipment also included 70 ft. of steel feeder pipe, three sets of head gate irons and the necessary water rack. The power of this wheel will be used for driving the plant of one of the street railways of Asheville, N. C.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Edison Illuminating Company, of Detroit, Mich., for a doubling of the capacity of their present installation of Chloride accumulators. The original installation consisted of 160 elements, and the tanks were constructed to allow the present increase, making a total normal discharge rate of 20,480 ampere-hours. Mr. Alex Dow, manager of the Edison Company, has had this enlargement under consideration for some time past.

ELECTRIC FANS IN INDIA.—According to French official reports which have reached the United States State Department through Consul-General Guenther, the demand for electric ventilators in British India exceeds the supply. American manufacturers are handicapped somewhat by the fact that the people of British India prefer fans with blades from 4½ to 6 inches long, while those of American make are only about 3 inches long. The establishment of a depot for automobiles in Bombay is also spoken of as of great promise for business.

THE RUSSIAN-AMERICAN EXPORT & IMPORT COMPANY, whose New York offices are located at 120 Liberty Street, is about to place some substantial orders for electrical apparatus, supplies, etc. Mr. J. Rich, the general manager of the company, has just returned from a seven months' tour throughout European Russia. He opened a branch establishment in Odessa, where the first permanent exhibition of American machinery in Russia is on view.

THE ELECTRIC EXPRESS SERVICE IN NEW YORK.—Under the arrangement between the Metropolitan Street Railway Company and the New York Electric Vehicle & Transportation Company express cars will be hauled at night over the Columbus Avenue and the Third Avenue lines as soon as some details are arranged. It is not expected that this express service will be extended to the Broadway line, at least for the present.

ARC LAMPS FOR CANADA.—Note was made in these pages last week of the new work of the St. Lawrence Power Company at Sheik's Island, Ont. In addition to the Bullock equipment there noted, it should be added that the General Incandescent Arc Light Company have sold to the Power Company 275 G. I. series alternating arc lamps.

THE J. G. BRILL COMPANY, of Philadelphia, will install its 21E trucks on the electric traction system now under construction at San Sebastian, one of the principal Spanish seaside resorts. The order was secured through Gustav Carde et Filo et Cie, of Paris, which concern is said to have undertaken the contract for the equipment of the major portion of the new road.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has been awarded a fair-sized contract for the electrical equipment of the Spanish Government gun works at Trubia, Spain. Shipment will be made next week of some 30-hp shunt-wound, slow-speed motors and rheostats.

THE H. W. JOHNS MANUFACTURING COMPANY has recently secured the contract for covering the cylinders, pipes and receiver at the Edison Portland Cement Company, Stewartsville, N. J., for the account of Allis Chalmers Company, successors to E. P Allis & Co., Liberty Street, New York City.

CHINA.—A German firm is announced to have secured a contract for the electric lighting of Pekin. The size of the contract or plant is not given.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The International Wireless Telephone & Telegraph Company has been incorporated here, with a capital stock of $25,000,000. The papers are from Philadelphia and are signed by W. Gehring, H. W. Shoemaker, R. Leander, W. J. Moss and Henry W. Bash.

MEDFORD, ARK.—The Arkansas River Telephone Company, recently incorporated, will build its first line from Dumas to Red Fork, via Pendleton and Medford. Extensions will afterward be carried from Pendleton to Pine Bluff, to get connection with, probably, the Southwestern system. The officers of the company are X. J. Pindall, president; J. Bernhardt, vice-president, and H. P. Buck, secretary.

SAN FRANCISCO, CAL.—Alexander McAdie, chief forecast official of the Weather Bureau in San Francisco, recently received a dispatch from Chief Clerk W. L. Moore, Washington, D. C., stating that the government authorities had decided to establish wireless telegraph stations in San Francisco and other coast points as soon as a suitable system became available.

SAN FRANCISCO, CAL.—M. Adrian King has filed a petition with the board of supervisors asking permission to establish a telephone system here. Fifty free telephones are offered to the city, a fire and police telegraph system at a cost not to exceed $12 for each telephone per year, and the agreement is offered that the company will forfeit all rights if it does not have 5000 subscribers at the end of three years.

DENVER, COL.—The Colorado Fuel & Iron Company will soon be free from alliances with the telegraph companies. Men are in the field now to construct a line over a thousand miles long connecting all branches of the company's service with headquarters in Denver.

PIERRE, S. D.—Articles of incorporation of eight companies, with $5,000,000 capital, have been filed by Philadelphia and Pierre citizens for wireless telephone and telegraph companies.

DOVER, DEL.—A certificate incorporating the Consolidated Telephone Company of Wilmington, Del., capital $10,000,000, has been filed.

WILMINGTON, DEL.—The Delaware & Atlantic Telegraph & Telephone Company has established a large number of pay stations in different parts of Wilmington.

AUGUSTA, GA.—The Mitchell & Grange Telephone Company announces connections with Grange, Ga.; Louisville, Ga.; Swainsboro and other points. The early completion of a telephone line between Gibson and Mitchell is anticipated.

PEORIA, ILL.—The farmers of French Grove are arranging for the construction of a telephone line.

CHAMPAIGN, ILL.—The Western Independent Telephone System has established an exchange in Weston, which connects about forty different houses and farmers in that vicinity.

PEKIN, ILL.—The Secretary of State has licensed the Citizens' Telephone Company of Pekin, Ill. Capital stock, $50,000. Incorporators: Jas. M. James, James W. Barrett and E. R. Periton.

CHICAGO, ILL.—Changes ordered in the outlying service of the Chicago Telephone Company involve a general reduction in rates. A new basis for charges has been established, and the old grounded lines are to be abandoned for the improved express service. Eighty towns surrounding Chicago are affected. This order for improved service was sent out by President Sabin to all the branch offices in the Chicago district and will be in full force July 1. While the reduction in rates is general, it varies. In some instances it amounts to as much as $12 a year. The new rate is based upon the monthly service, for which a charge of from $1 to $4 is made, according to the service and the number of patrons on a wire. All the old telephones are being taken out and replaced with the up-to-date copper metallic instruments.

INDIANAPOLIS, IND.—The Farmers' Mutual Telephone Company has been incorporated. Capital stock, $2,000.

INDIANAPOLIS, IND.—The Board of Works has approved the plan of the New Telephone Company for the new conduits that will be necessary by the erection of the Federal building.

INDIANAPOLIS, IND.—Severe electric storms during the past week seriously impaired the telephone service throughout the State. A number of exchanges were burned out and others were abandoned during the storms.

PERU, IND.—The Peru Home Telephone Company has filed articles of incorporation, with a capital of $30,000. The company proposes to establish an exchange and construct lines throughout the county. The directors are C. J. S. Kumler, J. M. Bergeman and Jerome Herff.

ROSSVILLE, IND.—The citizens of this city and community have arranged for a coöperative telephone system. In addition to a local coöperative system, the service is aimed to cover a radius of eight or ten miles in the country and all to be connected with long-distance 'phones.

INDIANAPOLIS, IND.—The Indiana State Board of Tax Commissioners has been called to sit in annual session. The first session will be devoted to the hearing of statements regarding the property of telegraph and telephone companies and fixing the assessment for taxation.

LOGANSPORT, IND.—There is a movement here to organize a home telephone company to compete with the Central Union, which has announced a graded schedule of rates at a substantial increase, to become effective July 1. Patrons say they will not pay the increased prices, but will order their telephones taken out. The New Telephone Company, of Indianapolis, was asked to come to the relief of Logansport, but it regarded the prevailing rates as too low. The Central Union has solicitors at work seeking subscribers to the party lines and "kitchen" service.

WHITESBURG, KY.—The citizens of this place will subscribe liberally for the building of a telephone line from Stnoega, Va., and work will be commenced on the line at once.

BALTIMORE, MD.—The Northern Neck Telephone Company will extend its lines to the towns of Kinsale and Colonial Beach, and later will establish communication between Litwalton and Warsaw and Warsaw and Village.

SAGINAW, MICH.—The Citizens' Telephone Company now has a pole gang at work from Cedar Rapids running a line east through Evans and Howard, to connect with Greenville and Ionia.

DETROIT, MICH.—The People's Telephone Company has received bids for the foundation of the building to be erected at the corner of Park and Elizabeth Streets, and the contract has been awarded.

DETROIT, MICH.—At a meeting of the stockholders of the Michigan Telephone Company directors were chosen for the ensuing year as follows: Philip Dexter, Reginald Foster and Thomas Sherwin, of Boston; J. W. Lotta, of Philadelphia; Dudley E. Waters, of Grand Rapids; E. A. Forbes, of Detroit; Charles J. Glidden, of Boston, and Hugh McMillan, of Detroit. There was no change in the list of Michigan directors, but a new list of directors was chosen for the Detroit and New State companies.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will spend something like $900,000 this season in extending and improving its systems in the Twin Cities. Of this amount $500,000 will be spent in Minneapolis. The work on the improvements has been going on for some weeks, and it will not be completed until late in the fall.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company reports a net gain of 135 subscribers in May, making a total number of 22,647 subscribers on May 31. The Erie Telephone System, of which this company is a part, reports a net gain of 3564 subscribers in May, and a net gain of 8545 since Jan. 1, making a total number of 150,144 subscribers on May 31.

MACON, MO.—Statement of increase of capital stock from $10,000 to $15,000 has been filed by the Macon Telephone Company, at Jefferson City.

JEFFERSON CITY, MO.—The Congree-Regal Telephone Company, with a capital of $1,175, has filed letters of incorporation. The incorporators are H. O. Alspaugh, J. W. Rice, C. A. Kavanaugh and others.

CRAIG, MO.—The Craig Telephone Company, which was recently organized with a capital of $1,500, contemplates some country line extensions. The company has just commenced business and uses Stromberg-Carlson apparatus.

MONROE CITY, MO.—W. H. Elliott, H. W. Wood, Frank Orr, A. C. Floyd, Lee Edy, Mark Hawkins, Samuel Wilson, James Settle and Edward Stewart, proprietors of the Hereford and Halch Telephone companies of Ralls County, met June 22 at Monroe City and consolidated on the reciprocity plan, giving them connection with all lines in Ralls, Marion, Monroe and Shelby counties.

WEST POINT, NEB.—The Nebraska Telephone Company is spending $5,000 in improving its local plant. Wires are being strung in metal tubes instead of singly, a new and improved switchboard is being put in and other improvements are under way.

ALBANY, N. Y.—The Richfield Springs Telephone Company, of Richfield Springs, has been incorporated with a capital of $5,000.

UTICA, N. Y.—The stockholders of the Interstate Telephone Company have voted to increase the capital stock of the company from $50,000 to $75,000. The additional stock will be used to equip the exchanges in St. Johnsville, Fort Plain and Canajoharie.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations on telephone franchises as follows: Troy Telephone Company, $45,000; Central New York Telegraph Company, Syracuse, $191,000; Central New York Telegraph Company, Utica, $73,000.

ALBANY, N. Y.—The Valley Telephone Company has been formed, capital $75,000, to operate a telephone system in Waverly, Tioga county, N. Y., and Sayre and Athens, Bradford county, Pa. Directors: Joel H. Fuller, Kerm F. Gill, Charles B. Stowe and Burt G. Hubbell, of Cleveland, O.; Frank Pike, of Sayre, Pa.; Fred E. Lyford, of Waverly, N. Y., and Vine Crandall, of Athens, Pa.

BUFFALO, N. Y.—A committee of the Central Council of the Business Men's Associations discussed the question of forming a municipal telephone company, with a capital of $1,000,000. Those present were: Chairman J. N. Adam, A. J. Elias, L. D. Wood, R. A. Eaton, James Fenton and Albert H. Jackson, of the corporation counsel's office. The company is to be formed to pave the road to municipal ownership, in the meantime giving cheap telephone service. The plan was referred to a sub-committee.

ALBANY, N. Y.—The Interocean Telephone & Telegraph Company has been incorporated with a capital stock of $2,000,000. The company will operate a telephone and telegraph system, connecting the following places: Cleveland, Ohio; Westfield, Buffalo, Niagara Falls, Rochester, Oswego, Ogdensburg, Whitehall, Syracuse, Rome, Utica, Schenectady, Troy, Albany, Poughkeepsie, New York City, Newburgh, Goshen, Binghamton, Cortland, Owego, Waverly, Elmira, Ithaca, Auburn, Canandaigua, Corning, Hornellsville, Genesee, Jamestown, Salamanca and other cities and villages in New York State and Jersey City, N. J. The directors are Charles H. Stewart, Joel H. H. Fuller, Chas. B. Stowe and Burt G. Hubbell, of Cleveland, O.; William T. Morris, of Penn Yan, and Harry K. Brown, of Hornellsville.

LOGAN, OHIO.—The United States Telephone Company is building a new line from this place to Nelsonville, connecting several small exchanges in Athens county.

WARREN, OHIO.—The operators of the Central Union Telephone Company at this point are on strike. Their places have been filled by girls from Ashtabula and Girard.

WASHINGTON, C. H., OHIO.—The Citizens' Telephone Company, of this place, has increased its capital stock from $50,000 to $100,000 to provide for improvements. Jerome Penn is manager.

NEWARK, OHIO.—Hon. Edward Kibler, president of the Newark Home Telephone Company, has obtained a franchise for an independent exchange at Utica, N. Y., and has made application for a franchise in Pataskala, N. Y.

PLEASANTVILLE, OHIO.—The local authorities have brought suit against the Central Union Telephone Company to restrain it from building telephone lines through this place and to oblige it to remove those in operation. It is claimed the company never secured a franchise.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Company is making rapid progress in the construction of its local exchange and it is expected that it will be in operation within a short time. Branch exchanges are being built at Williamsport and Asheville and others will be built in this county as soon as franchises are secured.

MANSFIELD, OHIO.—The linemen employed by the Central Union Telephone Company at this point are on strike. The company has acceded to their demands for $2.50 per day for city work and $40 per month and expenses for country work, but it has declined to discharge several non-union men, which are objectionable to the union men.

MARION, OHIO.—The recently organized Marion County Telephone Company has perfected its organization by electing the following officers: President, Fred E. Gunthery; Vice-President, C. H. Norris; Treasurer, O. Wollenweber; Secretary, French Crow. A franchise application is now pending, and if granted, a system will be installed in this place and throughout the county.

CLEVELAND, O.—Papers have been forwarded to Dover, Del., for the incorporation of a $12,000,000 company to be known as the Consolidated Telephone & Telegraph Company. This company will father a number of independent companies between Boston and Chicago, and will reach the more important cities between those two points.

WHITNEY, ORE.—The Blue Mountain Telephone Company, of Whitney, was recently incorporated. Directors: Burton Miller, J. M. Jones and Austin Craig. Capital stock, $5,000.

PHILADELPHIA, PA.—The Pensauken township committee passed ordinances granting franchises to the Eastern Telephone & South Jersey Gas, Electric & Traction Companies.

ERIE, PA.—The Mutual Telephone, at its annual meeting, elected these directors: W. B. Trask, Wm. Spencer, W. E. Hayes, Thos. E. Moore, T. A. Lamb. The directors chose these officers: President, W. B. Trask; Secretary and Treasurer, George Burton. The company now has in actual use 1,300 telephones. There has always been a steady increase in the number.

PITTSBURG, PA.—The Federal Telephone Company of Pennsylvania and the West Penn Telephone Company of Washington, Pa., are contending in the courts of Washington County for the right to construct a telephone line in the town of Washington. It appears that councils of that place granted telephone franchises in 1894 and 1896 to the Washington Telephone Company and the Washington County Telephone Company, but neither made any effort to construct a line or erect a plant until after the organization of the West Penn Telephone Company, an independent concern. Then the Federal people came in and began to dig holes and put up a line, claiming to have purchased the franchises of the Washington Telephone Company and the Washington County Telephone Company. In the meantime councils have repealed the ordinances of 1894 and 1896, and now the Federal Company is contending for its rights to construct its lines.

PITTSBURG, PA.—Director E. M. Bigelow, of the Department of Public Works, of this city, has renewed the contract with the Central District & Printing Telegraph Company for telephone service in the City Hall and the Department of Public Works. Former Director George W. Wilson made a contract with the Pittsburg & Allegheny Telephone Company, the competitor of the Bell Company, but, although the service has been installed, the contract was never approved by city councils. There has been a fight on for some time on account of the agreement in the franchise granted the Pittsburg & Allegheny Company, under which the company was to furnish free telephones to the city government officers. Then an ordinance was presented limiting the number of free telephones to eighteen. Neither this ordinance nor Director Wilson's contract has been approved by councils. Now, if the contract with the Central District & Printing is renewed and the Pittsburg & Allegheny Company is held to the agreement contained in its franchise, then the city will have the use of both telephones at the cost originally paid to the Central District & Printing Company.

MEMPHIS, Tenn.—The report that the Memphis Telephone Company would sell to the Cumberland Telephone Company, which has been current for some time, has been emphatically denied by General Manager Warren, of the former company.

MILAN, TENN.—Crews are now at work putting in a telephone line from Milan to Lavinia, ten miles east of here, in Carroll county. This will be under the control of the local exchange of the Cumberland Company and will prove a valuable adjunct to the local service, as the line penetrates a fine section of farming country. The line will probably be completed in thirty days.

AUSTIN, TEX.—Work has begun on the new telephone system. Poles are being erected, property purchased and other arrangements made for the installation of an independent company. This will give Austin two telephone exchanges.

AUSTIN, TEX.—The Brazoria County Telephone Company, of Columbia, has been incorporated, capital stock, $10,000, to operate a telephone line from Columbia to Rosenberg and Richmond, connecting with Angleton, Alvin, Houston, Brazoria, Velasco, Quintana, Van Vleck and Bay City. Incorporators: L. L. Smith, Jr., R. B. Loggins and J. E. Duff.

SALT LAKE CITY, UTAH.—Another application for a telephone franchise will probably be presented to the city council in the near future. It is understood that W. G. Van Horne is the local representative of Eastern capitalists, who are ready to establish a competing system in Salt Lake provided the right sort of a franchise can be secured.

PARKERSBURG, W. VA.—A movement has been started and a meeting of the interested parties already held to merge all the independent telephone lines in West Virginia into one company. It is estimated that the value of the property under the consolidation will reach $1,000,000. The new company will be capitalized for several times that amount. A committee has been appointed to inspect and report upon the various properties and the big scheme will likely be perfected within a few weeks.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company has just finished an extension to Bloomer and now has men working on an extension to Chippewa Falls. It uses the apparatus of the Standard Telephone & Electric Company, of Madison.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The Salem Light, Power and Traction Company has been incorporated, with Salem, Ore., as the principal place of business. Directors: W. H. McRae, H. H. Page and Rufus Mallory. Capital stock, $130,000.

OAKLAND, CAL.—The Suburban Electric Light Company, of Oakland, was recently incorporated. Directors: J. H. Lawrence, Wm. Angus, W. Gregg, Sr., J. L. Robinson, Alameda County; E. P. O'Brien, San Francisco. Capital stock, $500,000.

COLORADO SPRINGS, COLO.—The management of the Colorado Electric Company is now considering the extension of its lines from Canon City to Florence, a distance of eight miles, where electric power is in good demand.

TELL CITY, IND.—The Tell City Electric Light Company has been incorporated with a capital of $40,000.

INDIANAPOLIS, IND.—Mayor Taggart has vetoed the ordinance prohibiting electric arc lights on interurban cars in the city.

TIPTON, IND.—The Tipton Electric Light Company has been incorporated with a capital of $25,000, for the purpose of providing the town and citizens of Tipton with electric light and power. C. W. Ramsey heads the list of directors.

PORTLAND, IND.—Municipal electric lighting has proven a success in this city in point of good service and economy. The report for the first year ending June 1 shows a good balance after all expenses were paid. Portland used to pay $85 a year for each street light, but they cost, under municipal control, only $23.40.

INDIANAPOLIS, IND.—The General Electric Company has filed articles with the Secretary of State in compliance with the new foreign incorporation law of Indiana. The capital represented in Indiana is in the Fort Wayne Electric Works, and Secretary F. E. Hunting is named as the company's resident agent.

INDIANAPOLIS, IND.—The specifications for the new electric light contract for this city are still being much discussed, and some of the questions asked are still without answers, inasmuch as the Indianapolis Light & Power Company claims to have a perpetual franchise to furnish private lighting in this city. There is a good prospect of litigation, as outside companies desire the question settled before they bid on the specifications for public lighting. It is rumored that a movement is on foot to establish an electric lighting plant to be controlled by the municipality.

WORCESTER, MASS.—The directors of the Worcester Electric Light Company have voted to give the city an extension of ninety days on the contract for lighting streets, which expires July 1.

MACON, MO.—At the meeting of the city council bids were opened for the erection of the new power house for the city's electric light plant. The council awarded the contract to John Scott & Son, of Lancaster.

CAPE MAY, N. J.—Mayor Millet has approved the ordinance granting to the Cape May Electric Company the contract to light Cape May with arc lights for five years at the price of thirty-five cents per light per night. Supreme Court Justice Charles E. Hendrickson has granted a rule to show cause why the ordinance should not be set aside as irregular.

CHATHAM, N. Y.—It is stated that William Sheehan & Co., of New York City, are completing plans for a new municipal electric light plant, to be erected by Chatham, N. J.

SYRACUSE, N. Y.—Justice Andrews has denied the motion for the receiver of the Dolgeville Electric Light & Power Company to borrow money for the erection of a line to supply the city of Little Falls with electric light.

BUFFALO, N. Y.—Electricity is to take the place of steam as the motive power in the New York Central's Niagara B elevator. New Scotch boilers are being placed in the Buffalo dry dock yards to take the place of the four present boiler plants.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations on franchises as follows: Auburn Electric Light Company, $115,200; Watertown Electric Light Company, Watertown, $22,000; Electric Light Company, Syracuse, N. Y., $298,000.

FREEPORT, L. I.—The village trustees have been forced to go back to the old rates for electric lights and the rates for short term electric light consumers furnishing their own transformers has been reduced to twelve cents per kw-hour. Where the village furnishes the transformers, the rate for a term of six months is twenty cents.

SPRINGFIELD, O.—A new line, to cut across the country, connecting this city with Charleston, Vienna and other inland towns, is being agitated.

ALLIANCE, OHIO.—The Stark County Railway Company has purchased a site near this place for a power house for the new Alliance-Sebring line.

MARYSVILLE, OHIO.—The council has granted a franchise through this place to the Union Electric Railway, which is promoted by T. N. Kerr, of Columbus.

DAYTON, OHIO.—A petition for the dissolution of the Oakwood Street Railway Company, which operates eight miles of road in this city, has been made by the Atlas P. Stout.

COLUMBUS, O.—The Wellsville Electric Light Company, East Liverpool, has increased its capital stock from $30,000 to $100,000.

SEBRING, OHIO.—The City Light & Power Company has been incorporated, with $25,000 capital stock, to build a lighting plant.

MARION, OHIO.—The plant of the Marion Electric Light & Power Company was damaged by fire to the extent of $2,000 a few days ago.

CLEVELAND, OHIO.—Several members of the city council have declared war on the Cleveland Electric Illuminating Company and propose, if possible, to force it to arrange an equitable scale of prices.

NORTH AMHERST, OHIO.—The city has had estimates prepared for a municipal lighting plant, and it is figured that a plant with a capacity of 50 arc lamps and 500 incandescents would cost about $8,000.

NILES, OHIO.—The Wiswell-Pritchard Electric Manufacturing Company, recently incorporated, has changed its name to the Standard Electric Company. The company will manufacture incandescent lamps and other goods.

CINCINNATI, O.—The Taxpayers' Association, of this city, has addressed a communication to the Board of Public Service, asking that estimates be made of the cost of the electric lighting, per lamp, and that these estimates be taken as a basis, and all bids not coming within the figures to be rejected. This is in anticipation of the renewal of the city lighting contract.

CINCINNATI, O.—D. J. Hauss, of this city, has acqired the plants of the Georgetown (Ky.) Water Company and the Georgetown Electric Light Company. An old contract with the city of Georgetown gives Mr. Hauss the exclusive right to sell electric light and power for twenty years. Improvements to the amount of $30,000 are contemplated, about $20,000 of this is to be expended for electric light equipment.

CLEVELAND, OHIO.—The Cuyahoga County Commissioners have awarded a contract for a lighting plant for the county buildings to C. C. Bateson, his figure being $9,960. The plant is to be modern in every respect, with capacity for 3000 lights. Wiring for 2500 lights will be put in at once. The commissioners figure on saving the cost of the plant in one year, the price paid for lighting during the past year being $8,000. The plant will be so constructed that it can be removed to the proposed new courthouse with very little expense.

COLUMBUS, OHIO.—The officials of the Columbus Electric Company have made a proposition to the city to lease its west side lighting plant to the municipality for one year at $15,000, or, if the city will pay the taxes, for $13,500. This will be subject to renewal for three years. The plant has a capacity for 1,250 lights and the lighting committee has figured that it will cost about $30,000 to operate the plant. On this basis lamps would cost about $36 per year each. It is quite probable that the proposition will be accepted, as the municipal lighting plant cannot be erected by Sept. 1, when the present lighting contract expires.

BLAIR STATION, PA.—The St. Clair Furnace Company is building three large new blast furnaces, for which the Westinghouse Electric Manufacturing Company will supply the generating plant for light and power.

AMBLER, PA.—The borough council of this place has awarded the contract for lighting the streets to the Montgomery Lighting Company, which will be chartered for that purpose. The contract calls for 100 twenty-five candle-power incandescent lamps, at $20 each, for a period of five years.

ALTOONA, PA.—The Altoona Edison Electric Light Company is strengthening its line in various parts of the city by putting in new and heavier poles in the place of those which have passed their period of usefulness.

CHATTANOOGA, TENN.—The county has finished the installation of its electric lighting plant for the public building and county bridge.

SALT LAKE CITY, UTAH.—The mines and mills of Park Valley are to be provided with electrical energy. The Golden Electrical Power & Transmission Company has been organized with a capital of $50,000 by business men of this city, with a view to supplying the power and light used in that camp. The company will utilize the waters of George Creek at a point about four miles from Park Valley, and expects to be able to turn on the electric current within the next six months. Contracts for furnishing power have already been made with the Century, the Planetary, El Amigo, West Century and Golconda mining companies.

RICHMOND, VA.—J. F. Wilson has the contract for erecting the power house at Richmond Locomotive Works. The building is to cost $4,000.

THE ELECTRIC RAILWAY.

HARTFORD, CONN.—It is expected that the through trolley line from Hartford to Springfield will be operation by Sept. 1.

DES MOINES, IOWA.—The Des Moines, Nevada & Eldora Electric Railway Company has been incorporated, with a capital stock of $50,000.

CHICAGO, ILL.—Suit has been brought against the city of Chicago by Union Traction people to prevent the city from interfering with the roads and to declare the franchise good till 1960. This is a test of the ninety-nine-year franchise act.

HARTFORD CITY, IND.—The city council has voted the Ft. Wayne, Hartford City & Muncie Electric Railway Company a new franchise.

PLAINFIELD, IND.—Articles of incorporation of the Indianapolis, Plainfield & Western Traction Company have been filed. The capital of the company is fixed at $200,000.

MARION, IND.—The Richmond Traction Company has purchased the abandoned power plant of the Union Traction Company, in this city, and will remove it to Richmond, to be used in operating the Richmond line.

GOSHEN, IND.—A $20,000 subsidy was voted to the Goshen & Northern Indiana Traction Company for an electric line from here to Angolia. The majority was large in favor of the proposition and work will begin at once.

ANDERSON, IND.—George F. McCulloch, president and general manager of the Union Traction Company, is in Philadelphia in conference with Randall Morgan and other large stockholders of the company. It is the belief that the conference will result in a deal in which the Union Traction Company, recently incorporated under the laws of New Jersey for $15,000,000, will secure control of 160 miles of electric railway system centering in Anderson.

INDIANAPOLIS, IND.—Roughly estimated plans have been drawn for nearly a thousand miles of electric roads in this State. The last legislature gave the interurban road promoters a great lift by enacting a law giving them the same right of eminent domain that is enjoyed by steam roads. Thus, they are going right on surveying and condemning rights of way they could not have obtained without the law. The question whether an electric line company can condemn a right of way alongside of a steam road, taking a portion of the fifty feet allowed steam roads by law, is now in the court, and the electric promoters confidently expect a decision in their favor.

BALTIMORE, MD.—The Frostburg, Eckhart & Cumberland Electric Railway and the Lonaconing, Midland & Frostburg Railway Companies have purchased a lot of ground near Clarysville and will erect the power house for the new electric car line from Cumberland to Lonaconing.

BOSTON, MASS.—The railroad commissioners have issued an order on the petition of the Worcester Consolidated Street Railway Company for authority to issue additional capital stock to the amount of $1,675,000.

OWOSSO, MICH.—Work has finally begun on the extension of the Owosso & Corunna Electric Road.

MICHIGAN.—The Everett-Moore syndicate is negotiating for the purchase of another large system of interurban trolley line, which, when added to their thousand miles of traction, will give them a line from Port Huron, Mich., to Pittsburg, Pa. Three States will be crossed.

MINNEAPOLIS, MINN.—The Minneapolis & Anoka Railway Company has been incorporated by John J. Elliott, Arthur W. Selover, E. E. Fuller, George H. Selover and William Williamson, all of Minneapolis. The capital stock is fixed at $200,000.

ST. PAUL, MINN.—There is good reason to believe that Canadians have secured control of the Rapid Transit lines. A new electric line is to be built, connecting Minneapolis with Anoka, about 25 miles. A company has been formed for this purpose and it is believed that the line will also be extended to St. Paul. On the Twin City Rapid Transit line, which has two tracks between St. Paul and Minneapolis, traffic is often greater than the accommodations, and the advent of a new line will be welcomed. The recent heavy purchases of Twin City Rapid Transit stock by Canadians and the presence of Canadian capitalists has given rise to the rumor that the new line will be built by the latter, though the incorporators are local business men.

UTICA, N. Y.—An electric railroad, connecting the village of Clinton, is to be built this season, giving a direct line from Clinton to Utica.

CANANDAIGUA, N. Y.—The board of trustees granted a franchise to the Ontario & Wayne Traction Company, giving it the privilege of building its tracks through the village.

AMSTERDAM, N. Y.—The Amsterdam Street Railroad Company and the Schenectady Railway Company have reached an amicable adjustment regarding their differences over the proposed railway from this city to Schenectady.

ALBANY, N. Y.—A lease of the Brooklyn Union Elevated Railroad Company to the Brooklyn Heights Railroad Company, of Brooklyn, has been filed with the Secretary of State. The lease is of the date of July 1, 1901, and expires June 30, 2900.

NEW YORK, N. Y.—The War Department has granted the request of the Rapid Transit Commissioners for permission to make borings and surveys along the bed of the East River along the route of the Brooklyn tunnel, and the contract will be let in a few days.

ALBANY, N. Y.—The Canastota & Morrisville Railway Company, organized with a capital of $200,000 to operate a street surface electric road from Canastota to Morrisville, Madison county, has been incorporated. The directors are: Leander W. Burroughs, John Reidy, John A. Johnson, John H. Broad and Brownell Tompkins, of Morrisville; William H. Patten, Milton Delano and John B. Weaver, of Canastota; W. Emmett Coe, of Petersboro.

NEW YORK CITY.—The New York & Richmond Gas Company has been incorporated to manufacture and sell gas and electricity for heating and lighting purposes. Capital, $1,500,000 in shares of $100. Directors, Armitage Mathews, Robert C. McCormick, of New York; Archibald A. McGlashan, of East Bloomfield, N. Y.; George W. Sutton, of New Rochelle; H. A. Tucker, of Brooklyn.

ALBANY, N. Y.—The State Board of Tax Commissioners has placed valuations upon street railway properties as follows: United Traction Company, Cohoes, $69,500; United Traction Company, Watervliet, $71,000; Albany & Hudson Railway & Power Company, Hudson, $60,000; United Traction Company, Troy, $513,000; Troy Union Railway, $60,000; Auburn City Railway, Auburn, N. Y., $124,500; Black River Traction Company, Watertown, $28,000; Rapid Transit Railway, Syracuse, $1,200,000; Utica Belt Line, $98,000.

ROCHESTER, N. Y.—At the annual meeting of the Rochester Electric Railway Company the following officers were re-elected: President, T. J. Nicholl; treasurer, F. P. Allen; Secretary, Charles F. Pond. The directors are: T. J. Nicholl, G. G. Moorehouse, S. Stace, W. C. Barry, C. C. Woodworth, Charles S. Baker, H. P. Brewster, George W. Archer, J. Gerling, J. N. Beckley, E. H. Satterlee, Frederick Cook and C. F. Pond. It is stated that an effort is making by the new management of the Rochester Railway Company to acquire the Rochester & Charlotte Railway, which it now operates under a fifty-year lease.

NEW YORK CITY.—The underground system installed by Metropolitan on the Broadway, Lexington Avenue and Columbus Avenue lines is working

very satisfactorily and the outlook is for a largely increased volume of business and considerably decreased operating expense. The present volume of earnings all over the system is enormous. The great trouble now is to handle available business with the present facilities, which are quite inadequate. The new electric line soon to be installed on Seventh Avenue will, however, go far to relieve the strain in the belt of heaviest traffic, but business has developed so that there is no longer a possibility of accommodating all on the surface.

TROY, O.—A branch of the Dayton & Troy Traction Company will be built from Pleasant Hill to this city.

CLEVELAND, O.—The Cleveland City Railway Company's directors have voted a quarterly dividend of 1¼ per cent., payable July 5.

MASSILLON, O.—The Canton-Massillon Railway Company has applied for a franchise to extend the line from Massillon to Navarre.

MT. STERLING, OHIO.—A citizens' committee has petitioned the officials of the Columbus, Grove City & Southwestern Railway to extend its line as soon as possible to Mt. Sterling.

MARION, OHIO.—The Marion County Commissioners have granted a twenty-five-year franchise through the county to the Columbus, Delaware & Northern Traction Company.

STEUBENVILLE, OHIO.—The Steubenville & Wheeling Railway Company, which is promoted by T. K. Francis and W. B. Stringer, has applied to the county commissioners for a franchise.

DAYTON, O.—The strike of the employees of the People's Street Railway Company, declared June 21, was settled in less than an hour. Substitutes were secured and the cars were running as usual within that time.

GALION, OHIO.—The city council has granted a twenty-five-year franchise through the town to the Mansfield, Crestline & Galion Railway Company. This road is promoted by the Pomeroy-Mandelbaum syndicate, of Cleveland.

MANSFIELD, O.—The Mansfield, Cardington & Delaware Electric Railroad Company has organized as follows: President, A. A. Whitney; vice-president, R. F. Chase; C. W. Schaff, secretary, and W. A. James, treasurer.

CINCINNATI, O.—The directors of the Cincinnati, Newport & Covington Street Railway Company have rejected the proposition of the Cincinnati Traction Company for a lease of their property. They did not see a profit in a guarantee of a 5 per cent dividend in eight years.

TOLEDO, O.—The Toledo & Indiana Railway Company has been incorporated by Chas. P. Griffin, O. K. Detwiler, L. W. Brown, Q. J. Files, C. H. Masters, James Donnelly, John Rorick, L. E. Flory, John J. Banker, George G. Metzger and William P. Delaney. Capital stock, $1,000,000.

DAYTON, OHIO.—Judge Dennis Dwyer and Albert Emanuel, who were the original promoters of the Dayton & Stillwater Valley Traction Company, have transferred their holdings to the Robertson Company, of Boston, who have recently secured control of the Dayton & Xenia Traction Company.

CLEVELAND, O.—Senator Martin Dodge, promoter of the Cleveland & Warren Railway Company, has applied to the Cuyahoga county commissioners for a franchise from Newburg to Randall and Chagrin Falls. The road will extend to Warren by the way of Aurora, Mantuax and Garrettsville.

CLEVELAND, O.—The Cleveland, Pittsburg & Detroit Traction Company will be the name of the corporation that will own the trolley lines that will extend from Pittsburg to Detroit by way of this city, and which will have feeders touching every city of any size in Northern Ohio and lower Michigan.

NAPOLEON, OHIO.—A company is soon to be incorporated to build an electric railway from Woodville to Napoleon. Those interested are Capt. L. Black, Dr. J. H. Whitehead, D. B. Whipple, Dr. W. M. Tuller, Dr. F. W. Rogers, R. A. Beatty, A. E. Royce, F. W. Dunn, F. M. Young, Wesley Powell, G. W. Loomis, M. L. Case and A. Forney, all of Bowling Green.

TIFFIN, OHIO.—The Tiffin & Port Clinton Railway Company, of Fremont, has been incorporated by William H. Dore, H. C. DeRan, R. G. Kerlin, E. P. Simon and J. C. Brewer. Temporary capital stock, $20,000. This company, which heretofore has been known as the Kerlin Brothers Company, has secured right of way and done considerable grading on a road from Tiffin to Port Clinton, passing through Fremont.

CLEVELAND, OHIO.—Senator Martin Dodge, promoter of the Cleveland & Warren Railway Company, has filed the consents of property owners for the route of the line through Cuyahoga county. The road will enter Cleveland on the Miles Avenue line and will extend through Corlett, Solon, Geauga Lake, Centerville, Auburn, Mantua, Hiram, Parkham to Warren. It is also the intention to extend north from Warren to Jefferson. The road will open up a rich farming district.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company, which was recently incorporated, has effected its organization by electing the following directors: C. P. Griffin, A. K. Detwiler, L. W. Brown, C. H. Masters, Frank Yesberea, Dr. James Donnelly, Wm. P. Delaney, J. Q. Files, L. E. Florey and George G. Metzger. Officers: C. P. Griffin, president; L. W. Brown, secretary; George G. Metzger, vice-president, and C. H. Masters, consul. C. P. Griffin, A. K. Detweiler, L. W. Brown, W. P. Delaney and E. B. Smith constitute the executive committee.

YOUNGSTOWN, OHIO.—The Sharon & New Castle Railway Company has organized with the following officers: President, W. W. Whipple, of New York; Secretary, M. A. Norris, of Youngstown; Treasurer, O. W. Bright, of New York; Directors, the above, with Harry G. Hamilton, Richard Montgomery and S. D. L. Jackson. The Pennsylvania end of the company was organized shortly after at Pittsburg. Bonds to the amount of $500,000 will be sold at once. Park & Hamilton, of Youngstown, are the contractors and they are preparing to commence work at once.

CLEVELAND, OHIO.—The Everett-Moore syndicate, which is building a line from Akron to Canton and Massillon, has decided to haul coal on night runs to supply the various power houses of the systems owned by the syndicate. The various companies controlled by the syndicate operate about a dozen power houses within a radius of fifty miles of Cleveland, and by securing the output of a mine in the Massillon coal fields, a great saving could be effected. The recent decision of the Ohio Supreme Court whereby freight may be hauled through cities on electric lines, makes this possible.

COLUMBUS, O.—Members of the State Board of Public Works and the Canal Commission are considering the advisability of granting leases to traction companies for rights-of-way on canal property. The Scioto Valley Traction Company, of Columbus, and the Columbus, Winchester & Lancaster Traction Company have both filed applications for lease of right-of-way for several miles along the banks of the Ohio Canal between Groveport and Carroll. The Ft. Wayne, Dayton & Cincinnati Traction Company desires to build along the banks of the Mercer Co. reservoir near Salina. Numerous other applications are on file.

KINGSTON, ONT.—The Electric Street Railway Company has refused the demand of its employees, who are members of a union, for an increase in their wages. The company claims that the road is not a paying concern, and if the men go on strike the company will try to replace them with other men, and failing that, will run its cars into the barn and sell them and the whole plant by public auction.

GREENSBURG, PA.—This town is to have a third street railway, the application of the Coke Belt Railway Company for a franchise having been favored by the borough council. The franchise will be granted.

PHILADELPHIA, PA., has had a big town meeting against the recent free street railway franchises, rushed through the legislature, and for which Mr. Wanamaker's offer to the city of $2,500,000 was refused by the mayor.

PHILADELPHIA, PA.—A. L. Johnson's Philadelphia & Lehigh Valley Traction Company has filed a $2,500,000 mortgage to cover 55 miles of roadway to be built from Chestnut Hill through a number of towns in Philadelphia suburbs.

PHILADELPHIA, PA.—The Commissioners of Northampton County have granted permission to the Doylestown & Easton Street Railway Company to build a trolley line along the Delaware River Road between Easton and the Bucks county line.

PITTSTON, PA.—The new trolley line between Wilkesbarre and Hazleton is now an assured fact. The stock has all been subscribed for and the building of the road will be rapidly pushed. A feature of this road will be the driving of a tunnel half a mile long through the Wilkesbarre Mountains.

HARRISBURG, PA.—The West Fairview & Marysville Street Railway Company, capitalized at $30,000, has been chartered. A charter was also issued to the Altoona Belt Line Street Railway Company, with a capital of $50,000. Charles D. Baltzell, of Altoona, is president of the company.

HARRISBURG, PA.—A charter has been granted to the Bristol Street Railway Company. The concern is capitalized at $36,000 and will build a line from Bristol to Morrisville. The incorporators are G. M. Dorrance, Frank G. Edwards, Frank F. Bell, James Drury and Benjamin Johnson, of Bristol.

HARRISBURG, PA.—Four charters have been granted for surface street railway companies in Pittsburg. The incorporators include George T. Oliver, Thomas J. Crump, F. L. Roberts, John Jenkins and John Barr. The companies and the proposed routes follow: The South Atlantic Street Railway Company, two miles, capital $12,000; the Smithfield & Seventh Avenue Street Railway Company, one and one-quarter miles, capital $15,000; the Grant & Webster Street Railway Company, one and one-quarter miles, capital $15,000; the Reed Street Railway Company, one and one-quarter miles, capital $15,000.

DOYLESTOWN, PA.—William C. Ryan, representing the Doylestown & New Hope Street Railway Company, which proposes to construct a line from New Hope to this place, has filed plans for an extension of the route. The road will pass Mechanicsville through the Cuttalosa to Center Hill and thence to New Hope. The directors of the new company are A. Worthington Rich, C. S. Balderston, Albert Preston, William Watson, Florence A. Rich, William C. Ryan, Frank J. Rich and Burroughs Michener, all of this county. Burroughs Michener is president, William C. Ryan, secretary and C. S. Balderston, treasurer.

KNOXVILLE, TENN.—It is stated that an electric railway will be built by eastern capital from Johnson City to Jonesboro, a distance of seven miles.

BLUEFIELDS, W. VA.—Several miles of the Kanawha Traction Company's track were swept away by the recent disastrous flood in this region.

MANITOWOC, WIS.—The Manitowoc & Northern Traction Company has been incorporated, with a capital stock of $100,000. Thomas Higgins, of Neenah; H. C. Higgins, of Marinette, and State Senator H. I. Weed, of Oshkosh, are the incorporators.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL SUPPLY COMPANY, of Cleveland, capitalized at $500, has been incorporated by P. H. Walker, J. H. Hardwick, J. H. Smith, J. E. Mayfield and F. J. Harle.

THE NATIONAL INDICATOR COMPANY has been formed at Ottawa, Ohio, to manufacture a station or street indicator for steam or electric roads, the invention of Mayor Poe, of that town.

THE NEW YORK ESTIMATING, ENGINEERING AND CONTRACTING COMPANY, of New York, has been incorporated to do a general business in the lines indicated in the title. Capital, $10,000.

THE AMERICAN MOTIVE POWER COMPANY has been incorporated at Pierre, S. D., with a capital of $15,000,000. The incorporators are John Martyn Scobec, Lucius C. Varney and Oscar Nelson.

AUGUSTA, ME.—The Fairfield Electric Gas Machine Company has been organized at Kittery with a capital stock of $30,000. The president is William H. Mitchell, of Melrose, Mass., and the treasurer Horace Mitchell, of Kittery.

AMERICAN TYPEWRITER TELEGRAPH COMPANY, of Jersey City, has been incorporated to manufacture electrical devices; capital, $100,000. Incorporators: Spencer W. Richardson, Wm. A. Hill, Richard P. Elliott, K. K. McLaren.

THE UNITED RAILWAY LIGHT AND CHARTER COMPANY, with a capitalization of $5,000,000, was incorporated at Dover, Del. The company is authorized to purchase and acquire land and buildings for operating railways and heat, light and power plants.

LEGAL.

NEW YORK ELECTRIC VEHICLE TRANSPORTATION COMPANY has won the suit brought against it to stop an assessment of $10 on its stock. President Sanderson made a very good showing to Vice-Chancellor Pitney, of New Jersey as to business, stage lines, baggage delivery, etc. The Vice-Chancellor said that from all he could see the company was entering into highly profitable enterprises which were entirely within the range of its charter. He then denied the motion. After the hearing President Sanderson of the company announced that the company would proceed against delinquent stockholders by the advertisements of their names and holdings and by the sale of such part of them as was necessary to meet the allotment.

REFUSING TELEPHONE SERVICE.—At Indianapolis an application to transfer to the Supreme Court the case of the Rushville Coöperative Telephone Company vs. Arthur B. Irvin, which was recently reversed by the Appellate Court, was denied. The application was based on the fact that the appeal presented a new question of law, as follows: Can a telephone company arbitrarily discontinue the telephone service of one of its patrons, or refuse to grant him service after said discontinuance, on the ground that he is indebted to it for a preceding month's telephone service, and can it require him first to pay its bill for service and then resort to an action at law to recover what the company owes him? Irvin had a claim against the company for about the same amount as he owed it, and refused to pay except by giving a receipted bill, and the Appellate Court held that the company had a right to disconnect his telephone until he paid. The refusal to transfer was on the ground that the recent act providing for such transfers was not retroactive and that this appeal was decided before that act took effect.

OBITUARY.

MR. I. C. SMITH, of New York City, an inventor of steam and electrical engines, committed suicide last week in his apartments. The Northern Pacific panic in Wall Street caused a firm who were to finance one of his inventions, an electric motor, to abandon the project, it is said, and this made him despondent. He was fifty-eight years old.

MR. A. L. JOHNSON.—We regret to note the death of Mr. A. L. Johnson, from aneurism of the heart at his beautiful residence in Brooklyn, New York, on July 2. He was a brother of "Tom" Johnson, and had been closely associated with that trolley railway builder in all his enterprises, such as those in Cleveland and Brooklyn. Of late he had been interested in plans for trolley roads in England, and between New York and Philadelphia. He leaves a wife and four children.

MR. S. SIAS.—We regret to note the death of a pioneer in the field of electric lighting development, Mr. Samuel Sias, treasurer of the Boston Electric Light Company, who died last week at his home, in Cambridge, Mass., aged fifty-eight years. Mr. Sias had been treasurer of the Boston Electric Light Company since its incorporation and was a large stockholder. He was also a director of the American Pneumatic Service Company. He was a member of the Exchange and Algonquin clubs.

CAPT. JAS. D. RANDALL, president of the Southern Independent Telephone Association, died at his home, in Memphis, Tenn., on Friday morning, June 21, at 2 o'clock, after several weeks' illness. The remains were buried in Elmwood Cemetery, Memphis, on Saturday, June 22. Capt. Randall was for seventeen years a steamboat captain on the Mississippi River. For a number of years he has given his time exclusively to electrical engineering, especially in the telephone line. He was instrumental in building several telephone exchanges and was one of the telephone pioneers. About three years since he took an active part in organizing the Southern Independent Telephone Association, of which he was elected president, which position he held until his death. Capt. Randall was a man in the true meaning of the word and a true friend; a good citizen; a good husband and a Christian. Mr. Randall did more to build up the Southern Independent Telephone Association than any other member.

PERSONAL.

MR. LOUIS E. BEILSTEIN, of Cleveland, O., has been appointed general manager of the Toledo Traction Company's lines.

MR. FRANCIS W. HEISLER, purchasing agent of the American Bridge Company, has tendered his resignation, to take effect July 1.

MR. JAMES K. PUMPELLY, of Chicago, has become associated with the National Automobile & Electric Company, of Indianapolis.

MR. WARRALL WILSON has been elected president of the Detroit & Chicago Traction Company, which is building a trolley line between those cities.

MR. D. F. LEWIS and MR. W. A. BOLAND have been elected directors of the Brooklyn & Rockaway Beach Railroad Company, succeeding T. L. Frothingham and H. J. Robinson.

MR. W. S. TRUESDALE, of the Postal Telegraph service at Columbus, O., has been made assistant superintendent of the western division of the Postal system, with headquarters at Chicago.

MR. A. L. SELIG has become manager of the Redlands Electric Light & Power Company (California), in place of Mr. G. B. Ellis, who has resigned to accept a position with the California Power Company.

MR. G. R. WEBB has succeeded Mr. Nelson Perin as president of the United Railways Company, of Baltimore, and also takes his place as president of the United Electric Light & Power Company, of that city.

MR. E. J. HALL, JR., vice-president of the American Telephone & Telegraph Company, who has long had special care of the development of the "long-distance" service, has just returned from a trip to Europe.

MR. A. K. WARREN, the well-known electrical manufacturer and engineer, has lately become associated with the Brooklyn Rapid Transit System, on the staff of Mr. H. H. Williams as assistant engineer, in charge of line and equipment.

MR. F. P. FISH returned home from Europe last week and now assumes his new responsibility, the presidency of the American Telephone & Telegraph Company. The course of Bell interests under his management will be watched with the keenest interest.

JUDGE J. M. THOMAS has, it is stated, accepted the presidency of the Telephone, Telegraph & Cable Company, of America, on the condition, among other things, that a vigorous and aggressive campaign of "independent telephony" shall be inaugurated.

MR. E. R. THOMAS, son of Gen. S. Thomas, was married last week to Miss Linda Lee, daughter of Mr. W. P. Lee, treasurer of the Louisville (Ky.) Gas & Electric Light Company. Mr. Thomas was elected president of the failed Seventh National Bank last week.

PRESIDENT C. A. COFFIN, of the General Electric Company, has just returned from England, having accomplished the object of his mission—namely, securing control of the British Thomson-Houston Company, for which, it is rumored, other concerns had been quietly negotiating.

MR. ROBERT McF. DOBLE, mechanical and electrical engineer, and Lewis A. Hicks, hydraulic engineer, both well known through their connection with various Pacific coast water power transmission schemes, have formed a partnership, to be known as Doble & Hicks, and will act as consulting engineers in matters pertaining to electric power transmission, water supply, pumping, refrigeration, sewage and irrigation. Their offices will be in the Mills Building, San Francisco.

MR. J. W. ELLARD, the former general manager of the United Electric Light & Power Company, of Baltimore, Md., has become a member of the firm of J. L. Blackwell & Company. Mr. Ellard, besides being an expert on electric lighting, is also an expert on street railways, both in their financial and mechanical features. He will look after work of this sort for J. L. Blackwell & Company, whose general business is to build and finance electric light and power plants and electric street railways.

Trade Notes.

OIL FILTERS IN PORTO RICO.—The Burt Manufacturing Company, of Akron, Ohio, has recently equipped the San Juan Light & Transit Company with Cross oil filters.

SMETHURST & ALLEN, the Electrical engineers and contractors of Philadelphia, have moved their offices to the North American Building, below Chestnut Street, in that city.

MANHATTAN GENERAL CONSTRUCTION COMPANY.—The New York sales office of the Manhattan General Construction Company is changed from 11 Broadway to 120 Broadway.

THE PHELPS COMPANY, makers of the regulating "Hylo" incandescent lamp, are removing their factory to Detroit, Mich., corner of State and Rowland Streets, where they will enjoy enlarged facilities.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued neat and handsome binders in which to keep its bulletins in regard to rheostats, motor speed controllers, theatre dimmers, resistances, circuit breakers, etc.

DENTAL AND SURGICAL AIR PUMP.—In Bulletin No. 3030 of the Emerson Electric Manufacturing Company, St. Louis, Mo., is described and illustrated a dental and surgical air pump operated by direct or alternating current motor.

FALCON PANEL BOARDS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has just issued Card No. 12, giving illustrations, dimensions and price lists of its Nos. 202 and 203 all-copper straight fuse panel boards for 125 volts.

U. S. EMIGRANT STATION.—The contract for covering at the U. S. Emigrant Station, Ellis Island, New York Harbor, has been awarded to the H. W. Johns Manufacturing Company, 100 William Street, New York City. This contract amounts to $6,666.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has issued a complete catalogue of telephone and annunciator systems, in addition to its regular telephone catalogue. Contractors and telephone men who have been missed in the distribution will be supplied upon application.

BARGAIN SHEET.—The Emerson Electric Manufacturing Company, St. Louis, is offering some bargains in alternating current fan motors of the desk and ceiling types. A description of these machines is given in a bargain sheet just issued by the company, a copy of which may be had on application.

THE UNION MICA COMPANY, 56 Pine Street, New York, which has been preparing for several months to enter the electrical field is now fully equipped with one of the most modern factories in existence and is ready to fill all orders promptly. Its own mines, machinery, etc., greatly add to its facility.

THE GOULD STORAGE BATTERY COMPANY, New York, announces that, in addition to its regular product, it now manufactures high output electric vehicle batteries. A copy of the company's latest catalogue can be had by all interested on application to the company's office, at 25 West Thirty-third Street, New York.

NEW MILLING MACHINES.—The Cincinnati Milling Machine Company, Cincinnati, Ohio, has brought out some milling machines of new pattern. These machines are described and illustrated in a catalogue just issued by the

company. Examples of these machines may be seen in operation at the Pan-American Exposition.

LUNDELL MOTORS.—Bulletin No. 206 of the Sprague Electric Company covers the broad subject, "Lundell Motors." All of the different styles of this well-known type of motor are described and illustrated, and tables give the dimensions of each type. Illustrations and descriptions of the brush-holder mechanism and Lundell controllers are also included in the bulletin.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has recently closed a number of very large contracts for apparatus in the West and Southwest. It is offering for alternating current apparatus the Warren alternator and direct current Eddy generators and motors. Bulletins, descriptive matter, etc., on this material will be mailed upon application.

"THE THOROUGHFARE OF THE NATION."—In a recent article on the growth of the traffic on the New York Central, the Rochester *Herald* says: "The New York Central may well be called the thoroughfare of the nation." people living in the cities of 8,000 or more inhabitants, more than one-half live or more inhabitants, two-thirds live along the New York Central lines.

THE S. K. C. SYSTEM.—In a neat sixteen-page pamphlet the Stanley Electric Manufacturing Company, Pittsfield, Mass., gives a synopsis of its system. The pamphlet is well illustrated with small views of different types of machines and auxiliary apparatus. It also includes a description and illustration of that company's device for handling extreme potential, which was described and illustrated in these columns last week.

FAN MOTOR EFFICIENCY.—A private mailing card being sent out by the Emerson Electric Manufacturing Company, St. Louis, Mo., gives two curves plotted from actual tests, showing the comparative efficiency of alternating current desk fans, compiled from velocity of air moved and current consumption. These curves are an interesting study, and tell at once, to the eye, the results obtained under the two different conditions.

MESSRS. GARDNER & ROBINSON, 1522 Monadnock, Chicago, announce that they have recently made arrangements to furnish all kinds of heavy steel plate work, including tanks, draught stacks and blast furnace work. They are also prepared to supply ore, cinder and hot metal buggies, etc. This work will be manufactured for them by the Enterprise Boiler Company, of Youngstown, Ohio, which concern the firm represents in Chicago territory.

THE RICHMOND ELECTRIC WIRE CONDUIT COMPANY, through its main Eastern representative, Mr. W. S. Brown, 39 Cortlandt Street, tells us that its business is increasing so rapidly that, beginning with June 24, it will start in to run two shifts daily, a day shift and a night shift, making a total of 120 hands employed. It has found this to be necessary to keep up with orders, as its conduit has met with great approval throughout the entire country.

AIR COMPRESSORS.—The New York and Franklin Air Compressor companies have gotten out a handsome catalogue of their air compressors acuated by steam, belt, gearing, electricity, water power or any other form of power. The catalogue is very artistically illustrated with views of compressors of different types and various constituent parts. The descriptive text is quite complete, and tables give the dimensions of the various sizes of the different classes of compressors.

AUTOMATIC TELEPHONE METER.—The Automatic Telephone Meter Company, 620 Atlantic Avenue, Boston, Mass., gives in a card folder a brief description of its automatic meter, and points out the advantages to be derived from the use of this device. This meter can be connected to any telephone system, without interfering in any way with the existing connections. It records each outgoing call when the desired connection is obtained, but does not record incoming calls.

GENERAL ELECTRIC LITERATURE.—Woven wire and copper wire brushes constitute the subject of Bulletin No. 4249, issued recently by the General Electric Company. The publication bureau of the company has issued an index to its bulletins from No. 4200 to 4250. This will be appreciated by all having a file of General Electric bulletins. Among other recent publications of this company are catalogues and price lists of repair parts of GE—60—A railway motor for 250 and 500 volts and parts of CB—14 A and H motors. Flyer No. 2071 relates to manhole fuse boxes.

ARC LAMP SOUVENIR.—The Lea Electric Manufacturing Company, Elmwood, Ind., is distributing at its exhibit in Electricity Building, Pan-American Exposition, Buffalo, N. Y., a neat folder containing some poetry which sounds the praises of the "Northall" swinging cover enclosed arc lamp. An illustration of the lamp has the case divided vertically in two halves, each half being fixed to the card by an eyelet, thus permitting it to be swung outwardly, to illustrate the construction of the actual lamp case.

NIAGARA FALLS BRIDGE.—We have received from Mr. R. D. Lillibridge, 20 Broad Street, New York, a miniature steel engraving of the Pencoyd arch bridge spanning the Niagara Gorge, between Niagara Falls and Clifton. The engraving is on the five-cent stamp of the Pan-American series and is an excellent picture of this beautiful span, which is stated to be the largest in the world, being 840 feet. The bridge was built in 1898 by the Pencoyd Iron Works, now the Pencoyd plant of the American Bridge Company.

FIFTIETH ANNIVERSARY.—The Lane & Bodley Company, Cincinnati, O., in a circular announces the completion of half a century of its successful existence. The circular contains illustrations of the first type of engine made by the company and the latest type "The Twentieth Century Engine." The first engine made was of a small wall type, which one man could lift; the latest type weighs hundreds of tons. One of the twentieth century engines is in operation at the Pan-American Exposition in Machinery Building.

COAL HANDLING APPARATUS.—The Robins Conveying Belt Company, New York, describes its system of coal handling by means of Robins' belt conveyors, in a large, handsomely illustrated pamphlet of recent issue. The pamphlet contains twelve half-tone illustration, 6 ins. x 9 ins., of installations of the system in as many different plants, and one illustration, 6 ins. x 20½ ins., gives a view of a Canadian shipping pier, similarly equipped. Besides these illustrations, there are many other smaller one, some showing the apparatus and constructive parts.

BULLOCK COMPANY AT THE PAN-AMERICAN.—The Bullock Electric Manufacturing Company, Cincinnati, O., is sending out a handsome Pan-American souvenir, in the form of a pamphlet, to serve as a reminder of the company's line of direct current machinery. The pages contain half-tone illustrations of various types of generators and motors, also of machine tools, each illustration being accompanied by a memorandum of the points of excellence of the machine under consideration. The cover is handsomely illuminated with the coats of arms of the different countries represented at the exposition.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, calls attention to the interesting fact that while its apparatus is available and useful all the year round, it is also during the summer months that they are very highly appreciated. For instance, the soldering irons, tailor irons and laundry irons can be heated by simply connecting with the electric light socket, and thus avoid the necessity of having a hot fire to heat up the room where the irons are being used. This is a point well worth considering. The American Electrical Heater Company makes a very full line of this apparatus, and is glad to send its catalogue to any one who applies for it.

STURTEVANT.—The new plant of the B. F. Sturtevant Company at Hyde Park, Mass., sketch plans for which are now well under way, will probably provide about eight acres of floor space, fully double that existing in the old plant at Jamaica Plain. Nearly one-third of this area will be devoted to the manufacture of engines, motors and generating sets. The recent growth of this department has been almost phenomenal, and it is in this field—particularly in the application of Sturtevant motors to Sturtevant fans—that the most rapid growth is expected in the immediate future. The entire plant will be equipped with Sturtevant generating sets and motors for direct driving of line shafts and of large individual machines.

STILWELL FEED WATER HEATERS.—The following is a list of shipments of heaters made recently by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O.: Arnold Electric Power Station Company, Jenison, Mich., one size G improved heater and lime extractor; F. Hammer Paint Company, St. Louis, Mo., one No. 1 cast-iron heater; American Steel Hoop Company, Allegheny, Pa., one No. 6 cast-iron heater; Kroutil Bros. & Tyola, Geary, Okla. Ter., one size B improved heater; H. & L. P. Patton, Clarkesville, Tex., one No. 5 feed water heater; Florentine Pottery Company, Chillicothe, O., one No. 6 feed water heater; Western Tube Company, Kewanee, Ill., one No. 6 cast-iron heater; Pocahontas Collieries Company, Pocahontas, W. Va., one size H improved heater; Carter & Son, Paris, Tex., one No. 7 feed water heater; Leland Oil Works, Leland, Miss., one size E heater; Stephensville Oil Mill Works, Stephensville, Ga., one size E 2 heater; J. T. Bradley & Company, St. Louis, Mo., one E 2 feed water heater; Auld & Conger, Poultney, Vt., one size C feed water heater; H. P. Deuscher & Co., Hamilton Ohio, one size D heater; Geo. Hull, Paris, Tex., one No. 5 feed water heater. The above heaters, designated as "feed water heaters" and "improved heaters," are of the wrought-iron type.

A LARGE ELECTRICAL SUPPLY CATALOGUE.—A large catalogue is generally an indication of a large business, and it is quite safe to make this affirmation in the case of the Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, who has just issued a catalogue that it may well be proud of. The catalogue contains no less than 464 pages within the covers, and is very completely illustrated with cuts of the extensive and varied lines of electrical supplies manufactured and handled by the company. About the only electrical apparatus not listed are dynamos and street railway motors; every other line is fully covered. The supplies listed include those for electric light, telephone, telegraph, railway and the household. Electric light supplies alone take up about 150 pages; the telephone section, while not so large, is very complete and varied. Batteries, bell outfits, gongs, etc., take up many pages, and very complete lines of working tools, measuring instruments and special devices are illustrated. It would be impossible to enumerate even a small part of the contents of the catalogue in the limited space at our command. Suffice it to say that everything in the departments above mentioned, that any one is ever likely to call for, is listed.

RUBEROID IN THE ARCTIC.—Arctic explorers heretofore have had to face many perils and discomforts that do not now confront Evelyn B. Baldwin, the leader of the Baldwin-Ziegler Polar Expedition, who has just sailed for Dundee, thence to proceed to San Josephsland, whence the complete expedition starts for the Arctic regions. Everything that money can buy or experience suggest to insure safety and comfort to Leader Baldwin and his companions has been procured. The cargo of the "America" includes a large quantity of Ruberoid roofing, manufactured by the Standard Paint Company, New York and Chicago, and a large amount of galvanized wire netting. This Ruberoid is to be used as a housing or enclosure for the ship when the ice stops its further progress, and as a covering for the huts or "shelters" erected along the route for the forty men, the hundreds of dogs and other animals and the supplies. The galvanized iron wire will be used as a frame work or support for the Ruberoid, which will be laid over it. The small amount of space occupied by Ruberoid proves to be extremely desirable on Arctic expeditions. Ruberoid meets all the requirements of the situation. It is made of the strongest kind of felt, light in weight and easily laid over wire frame-work, comes in compact rolls of convenient size for easy transportation. The progress of an Arctic exploring party is necessarily slow, because only a portion of the trip can be made by water. The rivers become clogged with ice, and as the explorers proceed northward the ice closes in solidly about the ship, making further navigation impossible. The vessel is then abadoned and the remainder of the journey is made over the ice on sleds drawn by dogs. To insure the safety of the ship, however, during its long imprisonment in the ice a strong wind-proof and water-proof building is erected about and over it. During the journey over the ice the Baldwin party will erect Ruberoid huts, or "shelters," at different stations along the route, which will shield the explorers and their retinue from the biting winds and the cold. These shelters are not torn down when vacated, for they serve as storehouses for supplies and provisions, to be used on the return trip.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JUNE 25, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

676,881. SELF-LOCKING INSULATOR AND PIN; H. Etheridge, McKeesport, Pa. App. filed May 9, 1901. The insulator pin is hollow and a spring, having a hook at each end, passes through the pin and engages with the insulator at one end and the cross-arm at the other, thus locking the insulator while permitting it to rotate.

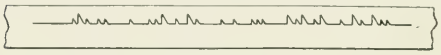
676,888. ELECTRIC RAILWAY SYSTEM; E. Frischmuth, Berlin, Germany. App. filed Feb. 12, 1900. The frame running in the conduit carries a spring-actuated arm, which bears against the conductor; by swinging the frame to one side, the arm can be withdrawn from the conductor.

676,939. TELEGRAPHIC CODE; C. G. Burke, Brooklyn, N. Y. App. filed March 29, 1900. A telegraphic code, in which the signal elements are distinguished from one another by a difference in length and by their relation to a given zero position, and in which each group or combination of elements which represents a given letter or character is made up of elements having the same relation to such zero position.

676,949. ELECTRIC HEATER; G. C. Hawkins, Boston Mass. App. filed Sept. 26, 1898. A fan is combined with an electric heater in such a way that the heated air is distributed from the heater.

676,952. ELECTRIC LAMP; C. A. Hussey, New York, N. Y. App. filed Oct. 23, 1900. One lamp globe containing a filament is formed inside of another, the structure being adapted to fit a socket provided with switching devices for throwing either filament into operation.

676,955. TELEPHONE SYSTEM; F. A. Lundquist, Chicago, Ill. App. filed Dec. 23, 1899. A series of telephones, each of which is provided with a movable switching mechanism, a central station provided with connections



676,939.—Telegraphic Code.

to said telephones, a spring-jack located at said central station, a device for covering the openings to said spring-jack, and means whereby the movements of said device to cover said openings will cause all moved mechanisms to be returned to their normal position.

676,956. CALLING DEVICE FOR TELEPHONE EXCHANGES; F. A. Lundquist, Chicago, Ill. App. filed Jan. 8, 1900. Details.

676,965. MEANS FOR RECHARGING STORAGE BATTERIES OF ELECTRIC VEHICLES; Joseph Sachs, of Hartford, Conn. App. filed Oct. 5, 1900. Provides means to recharge the battery when the vehicle is running free or is having its speed reduced with the motor shut off—the charging being regardless of the speed in either case. The motor has a supplemental field, which is thrown into the circuit when the vehicle is coasting and cut out when the motor is driving the vehicle. By this means the field strength may be increased and thereby an e. m. f. higher than the normal produced for charging the battery, even when the speed of the vehicle varies over a large range.

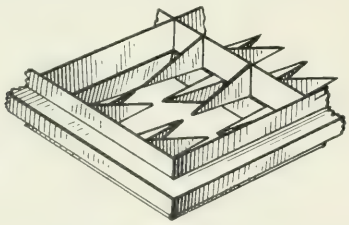
676,976. CONDUIT CAPPING OR THIMBLE; W. F. Bossert, Utica, N. Y. App. filed March 29, 1901. The thimble is provided with threads to engage the end of the conduit and with a curled edge forming an abutment for the end of the conduit, and a smooth finish.

676,985. ELECTRIC SMELTING FURNACE; H. Koller, Nuremberg, Germany. App. filed May 17, 1900. (See Current News and Notes.)

677,005. FEEDING AND REGULATING MECHANISM FOR ARC LAMPS; W. E. Waldron, Colorado Springs, Col. App. filed Feb. 6, 1901. Details of construction.

677,019. ELECTRIC ARC LAMP; F. M. Conway, New York, N. Y. App. filed July 18, 1898. Details of construction.

677,026. ELECTRIC BRAKE; F. W. Garrett, Johnstown, Pa. App. filed



677,244.—Secondary Battery.

Oct. 24, 1900. An electro-magnetic frictional brake, adapted to be energized by current furnished by the motors when connected on a short circuit to run as generators.

677,027. OPERATING MEANS FOR ELECTRIC CONTROLLERS; F. W. Garrett, Johnstown, Pa. App. filed Nov. 27, 1900. A guard plate covers the handle of the reverse switch and can be removed only by throwing the main control handle to the open position.

677,038. CONTROL OF ELECTRIC MOTORS; F. A. Merrick, Johnstown, Pa. App. filed Nov. 14, 1900. Certain new combinations in series-parallel control.

677,049. ELECTRIC LAMP CLUSTER FIXTURE; N. Weeks, New York, N. Y. App. filed Oct. 4, 1898. An electric light lamp cluster, consisting of a base having metallic receivers for a number of lamps and a separated and independent finishing cap having openings to permit the insertion of the lamps in the receivers and bushed with insulating material.

677,070. ELECTRICAL HEATING FURNACE; A. H. Eddy, Windsor, Conn. App. filed June 15, 1900. (See Current News and Notes.)

677,071. COLLECTOR FOR ELECTRIC GENERATORS AND MOTORS; A. H. Eddy, Windsor, Conn. App. filed March 27, 1901. A collecting brush composed of a cemented mixture of particles of oxide of metal and particles of pure metal.

677,145. COMBINED BRAKE AND POWER CONTROLLER; E. W. Stull, Johnstown, Pa. App. filed Sept. 28, 1900. The switch cylinder carries on one portion of its surface the necessary contacts for series-parallel control, and on another portion the necessary contacts for throwing the motors onto a closed circuit with reversed connection for generating a current to supply the brake.

677,156. SYSTEM OF CHARGING STORAGE BATTERIES; Geo. Herbert Condict, of New York. App. filed Aug. 4, 1898. Relates to a complete arrangement of electrical apparatus, circuits, switches, cut-outs and signals for charging storage batteries. There is a common source of supply, a plurality of circuits of different potential, actuating means for controlling these circuits, including signals and a single operating means for connecting the battery circuit in the circuits of different potential.

677,169. ALARM APPARATUS FOR ENGINE ROOM TELEGRAPHS OR THE LIKE; T. Bell, Liverpool, Eng. App. filed Sept. 22, 1900. Details.

677,191. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Feb. 6, 1901. A frame adapted to support the contacts and resistances in such a manner as to be readily accessible for inspection and repairs.

677,207 and 677,208. PROCESS OF PURIFYING BAUXITE; C. M. Hall, Niagara Falls, N. Y. App. filed Dec. 19, 1900, and Feb. 2, 1901. (See page 14.)

677,209. PURIFIED CRYSTALLINE ALUMINA; C. M. Hall, Niagara Falls, N. Y. App. filed Feb. 20, 1901. (See page 14.)

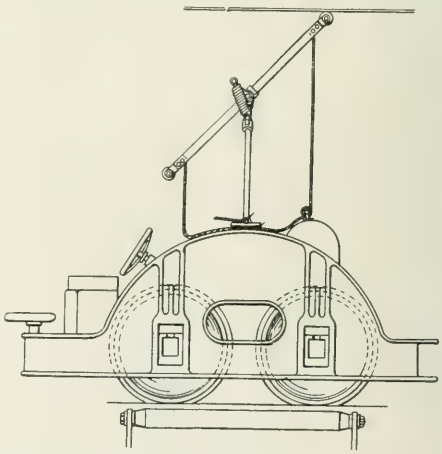
677,226. METHOD OF PRODUCING ELECTRICAL ENERGY FROM CARBONACEOUS MATERIALS; H. Jone, Chicago, Ill. App. filed July 8, 1899. (See Current News and Notes next week.)

677,238. INCANDESCENT LAMP; I. Kitsee, Philadelphia, Pa. App. filed March 2, 1900. (See Current News and Notes.)

677,244. SECONDARY BATTERY; A. F. Madden, Newark, N. J. App. filed March 19, 1901. The important feature of this invention is a grid formed by compression between dies and having openings within surrounding walls and pointed fingers projecting into the openings from the walls, the active material closing the openings and surrounding the fingers.

677,247. ELECTRICALLY OPERATED PLOW; C. Meissner, Friedrichsberg, Germany. App. filed Dec. 31, 1900. Details.

677,262. TROLLEY; A. Palmros, Columbus, Ohio. App. filed Oct. 9, 1899. A hinged and reversible frame having an elongated trolley roller at each end and means for pressing upward either end of the frame, according to the direction of movement of the car.



677,262.—Trolley.

677,269. REVERSIBLE SNAP SWITCH; G. H. Proctor, Somerville, Mass. App. filed Oct. 17, 1900. Details.

677,296. CIRCUIT TESTING AND RECORDING APPARATUS; G. A. Wall, Providence, R. I. App. filed Feb. 17, 1899. The invention is an apparatus which, when set in motion, acts automatically to complete the circuits which are to be tested and to make a record of the condition of those circuits while returning to its normal condition.

Reissue 11,916. ELECTRIC ARC LAMP; Edwin W. Rice, Jr., of Schenectady, N. Y. Original app. dated Jan. 23, 1900. App. for reissue filed May 1, 1901. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, AUGUST 3, 1901. No. 5.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1130 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 3, 1901.

CONTENTS.

PAGE
Editorial 101
Buffalo Meeting of the Institute 104
Electrical Engineers of the Day—V. H. G. Stott 104
The Toledo, Ohio-Monroe, Mich., Interurban Railway 105
Independent Telephony in Toledo 107
Exports to Central and South America 107
Wireless Telegraph Experiments Between Brussels, Malines and Antwerp, by Emile Guarini 168
The Mechanical Equivalent of Light, by C. J. Reed 170
Edison Storage Battery 170
An American Review of Telephony Abroad 171
Detailed Figures of Foreign Trade 175
The Electric Elevator in the Washington Monument, by C. M. Lewis 176
Regulations for the First Long Distance International Automobile Test in America 180
Women as Automobilists in Europe 181
Military Telephony in New York State 182
A New Higher Tariff for Germany 182
A. I. E. E. Meeting Place at Buffalo 183
Current News and Notes 183
LETTER TO THE EDITORS:
Mechanical Vibration of Wires, by Alfred G. Dell 187
Digest of Current Electrical Literature 187
New Books 191
The Westinghouse Industries at the Pan-American, by W. M. Probasco 193
P. & B. and P. A. E. 195
Lea Arc Lamps at the Pan-American 195
Holophane Exhibit at the Pan-American 196
The Reynolds Flasher 196
American Steel & Wire Company at the Pan-American 196
Enclosed Resistances 197
Slate Base for Baby Knife Switches 198
Cluster Fixtures 198
New Fuse Block 198
DEPARTMENTS:
Financial Intelligence 199
Commercial Intelligence 200
General News 202
Illustrated Record of Patents 207

TELEPHONY IN EUROPE.

The review made by Mr. U. N. Bethell in this issue of the conditions of telephony in Europe is a most interesting and valuable contribution to the literature of the art, and the discussions thereto pertaining. While it is only an abstract or excerpt of evidence given before the United States Industrial Commission, it serves to show that the commission made no mistake in asking Mr. Bethell to appear before them. The comment of a trained expert and shrewd observer on his art as he finds it practised in other countries than his own, is always highly useful, and we are confident that Mr. Bethell's views and facts will be noted with keen interest here and abroad. Many will not agree with him, but the intrinsic value of his remarks entitles them to a careful and thoughtful consideration. We may say for ourselves, for example, that we believe that, thanks to the very competition in telephony here, that Mr. Bethell condemns in some parts of Europe, the art is now being developed more rapidly than ever before; but neither he nor we can predict whether such competitive conditions are to endure forever indefinitely. It may be added, however, that if the remarkable figures of "independent" telephone growth are added to those of the Bell system, the undeniable preponderance here, in development, as compared with abroad, is even more astounding. Mr. Bethell gives as a sole reason control by other than private enterprise in the European systems. It would, at any rate, appear evident that the telephonic development of Europe has but barely begun, and should afford a large outlet for capital and production for many years to come, with great benefit not only to electrical industries but to the population of every country mentioned in Mr. Bethell's review of the situation.

THE PAN-AMERICAN EXPOSITION.

The Pan-American Exposition is now at the height of its glory so far as relates to its exhibits, although its attendance may be expected to increase as the season advances and the weather becomes less warm and more genial. It is interesting to compare this exhibition with those which have preceded it. In the first place, the Pan-American Exposition cannot properly be called an International exhibition, because only North and South America are included within the lists of exhibitors. Europe sends no exhibits; in fact, although, as the name Pan-American suggests, all American countries are represented, yet there is relatively little "pan" in the aggregation, and the great bulk of the exhibits is from the United States. Consequently, there is not the same extent or range of exhibits that would be found in a similar exhibition of international co-operation. The buildings are, on the average, decidedly smaller than those which appeared in the Chicago World's Fair. On the other hand, however, the buildings at Buffalo, if not so imposing as those of Chicago, are more beautiful in point of color. The Chicago buildings were all white with the whiteness of whitewash. These buildings have been judiciously tinted in a manner which is both harmonious and in keeping with their architectural style.

At Paris, and more particularly at Chicago, the distances in the exhibition were so considerable that intramural transport by trolley was necessary. At Buffalo the main buildings are sufficiently close to each other to make an intramural railway dispensable, and the visitors make their way either by perambulation or by perambulators. The distribution of the various buildings has been excellent, both from an architectural and from a topographical standpoint. The

only unfortunate disposition lies in regard to the Art Gallery, which is hidden away in a grove at a distance of half a mile from the main buildings. In Europe an Exposition usually devotes a large portion of space to works of art and a subsidiary space to works of machinery. In Buffalo the conditions are reversed. The Art Gallery at Buffalo is, however, particularly interesting as representing the development of American painting, drawing and sculpture, and gives a great treat to all lovers of the æsthetic. The salient feature of the Exhibition is the electric lighting, which excites universal admiration. This is almost wholly carried out by means of incandescent lamps of 8 candle-power, which have been scattered over the buildings and avenues with lavish hand. It has been the custom in previous exhibitions to limn and edge the outlines of the buildings with rows of incandescent lamps. At Buffalo, in addition to this, some of the prominent buildings are faced with large clusters of lamps which cause them to shine resplendent. The absence of arc lamps enhances the effect of uniform lustre.

In regard to the electrical exhibit it may be said to be very complete and satisfactory, doing justice to American manufacture. A prominent feature is the absence of that variety of new types in dynamos which was so marked a few years ago. It would seem that dynamos have settled into definitely marked types of structure as the result of past evolution and development. On the other hand, although the generating apparatus may have become somewhat stereotyped, the apparatus for controlling and directing electrical energy is in course of active development. Thus, high-tension switches, circuit breakers, and similar appliances exist in considerable numbers. Long-distance transmission appliances are developing insulating features that suggest the insulation of high-tension apparatus such as frictional machines, and Ruhmkorff coils. Switches and switch-mechanisms are being constructed in larger sizes and of greater power. The largest are now operated by electric motors, i. e., by electro-mechanical power intermediate between the hand and the main switch. In other words, the largest switches are becoming too heavy to work directly by hand. The contrast between the largest modern switches and those which were in use 15 years ago is very striking.

The fact that power from the Falls of Niagara, transmitted electrically, is used for nearly all the electric lighting and most of the power distribution in the Exposition, gives a special attractiveness Niagara dynamos is just on the limit of giving discomfort to the eye in connection with incandescent lamps. Under some conditions of incandescent lighting a slight unpleasant pulsation or flickering is discernible. Under other conditions it is not noticeable. The consolidation of the lighting supply of the Exposition to three 11,000-volt mains fed through a large triple-bladed switch, readily lends itself to the gradual increase in brightness at turning on the lamps that constitutes so attractive a feature. The Nernst lamp is exhibited at Buffalo for the first time as a working apparatus in useful service, being employed in lighting the interior of the Electrical Building. At no preceding exhibition have steam engines, steam boilers and smokestacks occupied so insignificant a position in comparison with the lighting effect, as at Buffalo. In electric power transmission the Niagara-Buffalo system forms in itself, at the Exposition, a notable display of modern power capabilities in this direction.

Altogether, the Exposition is well worth a long jonrney to visit, if only for the color effects of its buildings by day, and the luminous effects on its buildings by night. It will long be remembered for its attractiveness, beauty and good organization.

The Calcutta Local Section of Electrical Engineering.

In the current number of the *Journal* of the British Institution of Electrical Engineers appears the inaugural address of the chairman of the Calcutta local section. The birth of this new East Indian section appears to have been attended with due local celebration on the 15th of last March. Hindostan has for many years past been proud of a fine Government telegraph system, which has had many local difficulties to contend with. These difficulties have been in transport, in native superstition, in jungles, and in maintaining great lengths of lines passing through wild and desolate country. More recently, however, electric lighting, trolley systems, and the transmission of power have made their appearance; so that a local engineering section has not only a reason for being fostered, but also a reason for setting to work.

The Light-Flux of Arc Lamps.

In the June number of the *Bulletin* of the Société Internationale des Électriciens appears an interesting paper by M. Paporte on certain photometric measurements made upon arc lamps. With measurements of arc lamps our books are already well filled, but these measurements are particularly interesting, because they arrive at the essential results and express those results in terms of flux of light instead of in candle-power. The arc lamps to be used were placed in a lumenmeter consisting essentially of a hollow sphere with a pair of 18 deg. sectors cut out. The light emitted through these two sectors was thrown on a screen of blotting paper by a pair of suitably shaped and supported mirrors, and the illuminated blotting paper became a secondary standard of illumination, emitting a luminous intensity proportional to the total flux emitted by the arc lamp, on the supposition that the light from the two sectors was the average of all sectors; or, in other words, that the distribution of the light in azimuth around the arc was sensibly equal to the average distribution between these two sectors.

The general results obtained were that the flux of light emitted by the arc lamps increased faster than the power absorbed, that the flux for the same current strength increased steadily up to about 50 volts pressure, and then diminished. The specific flux, or flux per watt, absorbed by the lamp reached a maximum at about 41 volts, so that with these lamps a 41-volt pressure was the most economical pressure for light production. The reasons for the presence of this maximum are substantially those supplied by Mrs. Aryton in her memorable paper last year; namely, that with small pressures, and correspondingly small distances between the carbons, the flux of light is throttled or imprisoned by the lower carbon, while for greater pressures, and wide intervening distances between the carbons, the vapor of the arc is semi-opaque and absorbs much of the light. Consequently, there is a certain critical pressure and distance between the carbons at which the light per watt is a maximum. The specific flux varied in different trials and different distances separating the carbon from 5 to 14 lumens per watt, which is, on being interpreted into the vulgar, approximately from 0.9 to 2.5 watts per British spherical candle.

The special advantage of the method of measurement here recorded is the specification of the lamp in terms of its light. Thus an arc lamp may be defined as emitting from 1000 to 8000 lumens, and it is certain that a specification of a 6000-lumen lamp is far preferable to a specification of a 2000-cp lamp, the 2000 candles being a maximum value and the 6000 lumens a sum total of light emitted. The paper shows that a 450-watt lamp can have a specific flux of anywhere from 6 to 15 lumens per watt according as the pressure falls from 65 to 40 volts, but at 45 volts and 10 amperes a 450-watt

lamp would give 13.5 lumens per watt, or 6075 lumens in all. The resistivity of the carbons employed varied between 0.0057 and 0.0073 ohm centimetres. Some results were obtained with lamps 3 in series on 110 volts. It was found that with three in series each lamp gave 2800 lumens, or a total of 8400 lumens between them, while with another set of two in series, under 110 volts, 3900 lumens each, or 7800 lumens between them. The current in both cases was 8 amperes. Consequently the triple series lamps were the more efficient. The specific flux was 9.55 lumens per watt for the triple series lamps.

It is greatly to be hoped that a similar method of measuring and comparing the comparative values of arc lamps may come into general use. The maximum candle-power of a lamp is of secondary importance compared with the total quantity of flux of light which the lamp will deliver. We think it should be borne in mind, however, that although the light emitted by the arc lamp is of much more importance than its luminous intensity in a favored direction, yet the value of the arc lamp to the purchaser is not in strict proportion to its light-giving power. Any estimates which base the value of an arc lamp merely upon its light-giving powers will be commercially fallacious. The fact is that an arc light often gives more light than is really needed, and consequently the finish and appearance of an arc lamp, its convenience, its duration of carbons and a number of such little details, have often a greater influence with the purchaser than either the lumens or the candles, even if the purchaser is fully alive to the latter qualifications.

Rapid Telegraphy.

The average practical telegraph engineer has a deep-rooted distrust of rapid telegraphy, including in that class any and every system which requires the transcription of messages to fit them for automatic transmission. The old original Morse, only slightly modified for convenience, has held its own in a fashion that is little short of marvelous. Improvements have come and improvements have gone, but the hand key of half a century ago still dominates the art. Of course, in much telegraphic work the operation of transmission is greatly shortened by conventional abbreviations forming a species of code, but the process remains essentially the same. Every one admits the desirability of increased speed, enabling a single wire to do the work of half a dozen, but there is a general dread of the ensuing complications both as to apparatus and methods. Both here and abroad the Wheatstone system has come into some use on important lines, but it has by no means taken the place that at one time seemed probable. Inventors are wonted to lay the non-success of rapid systems at the door of the telegraph monopoly, declaring that its cautious conservatism has impeded the experimental adoption of various more or less promising systems. On the other hand, it is contended that the great telegraph companies of the world are not in business for their health, and that a change in the art that would afford an opportunity for increased profits would assuredly not be unwelcome. The conservative element will even admit that the apparatus of some of the rapid systems has been beautifully worked out, and is by no means forbidding in its complication, so that failure in the technical sense cannot fairly be cited as a valid reason for non-success in practical operation

---

It will not be without interest, therefore, to consider the question from the standpoint of those who view rapid telegraphy with disfavor. One of the objections offered is that such systems have a certain unwieldiness, pertaining rather to the systems as a whole than to their technical operation. In sending a telegram there is a certain amount of lost motion. The message is written upon the blank, turned in, and then passed along to the operating room, and put on the operator's hook. In due season it is sent over the wire, transscribed on a typewriter at the receiving station, and is then passed over to the delivery system. The total time taken in this process is mostly occupied with other things than the transmission itself. As a matter of practice it may take an hour, more or less, to get the message from the sender in New York to the receiver in, say, Washington. On the average, the transmission only takes a minute or so, and the remaining 59 minutes are devoted to delivery and to waiting, including the time taken to get the message to the sending office. No actual shortening of the time of transmission can save directly any material time in ordinary business messages. With the Wheatstone system the message might actually be sent in, say, two seconds, again entirely trivial from the standpoint of the public. A far greater gain can be made in the increased capacity of lines, giving a short wait prior to transmission. But on any automatic system the written message must await its turn at the perforating machine, and in systems like the Wheatstone it must also await its turn for transcription, which lessens, or even quite negatives, the advantage gained by added capacity of the lines. And a telegraph boy will not put on more pace for an automatically sent message than for any other. As a result of these conditions it is held that there can be no heavy pressure of public opinion to force the adoption of rapid telegraphy, that the real gains are in a somewhat lessened operating force and in increase in line capacity, which are felt inside the telegraph company rather than by the public; that a great increase of speed, say, to several thousand words a minute, would not affect any except a very small number of trunk lines, and would not be felt by the public at all.

From this standpoint, improvement should be looked for in the direction of automatic reception in printed form even at rather moderate speed, more than in a greatly quickened rate of transmission. This eliminates one step of the operating process entirely, and effects a material saving both in time and money. Practically, printing on a tape is objectionable, so that automatic page printing is the real desideratum. This has been successfully accomplished in more than one apparatus, and, as may be known to some of our readers, the beautifully ingenious Buckingham system has been in steady commercial use on one of the most important trunk lines in the country for many months past. The automatic delivery of messages neatly printed on regular blanks ready for distribution is a most important step, but the original transcription of the message into the form of perforated tape still remains rather a stumbling block. A perforating machine capable of being worked at any considerable speed is not a simple affair, and while it can in practice be worked much faster than a Morse key, it has been held to be an inconvenient necessity. In certain classes of work, such as press dispatches, it might be possible to prepare tape outside of the telegraph office, but the objection is made that such a process has its limitations—a rapid telegraph system being likened to a four-track railway, which needs heavy traffic to bring out its economic value. To a certain extent it may be able to build up its own traffic through increased facilities, but under the present organization of the telegraph industry there seems small chance of the tariff being put down to a point that will justify very extensive use of the service for general communication. It is admitted that possibly in the event of a postal telegraph system being established, rapid telegraphy might come into far more extensive use than seems likely under present conditions, but save for some such contingency its functions, while highly important, seem likely to be confined within rather narrow lines. As we have frankly advocated rapid telegraphy, we present the above statement of the other side of a question which is progressively assuming more importance.

Buffalo Meeting of the American Institute of Electrical Engineers.

At the meeting last week of the Council of the American Institute of Electrical Engineers a preliminary programme was adopted for the annual convention to be held in Buffalo, and for several days preceding the meeting of the convention. The Institute will meet at the house of the American Society of Mechanical Engineers at 12 West Thirty-first Street, New York, on Wednesday, Aug. 14. There will be an address of welcome to foreign guests, a collation, registration of names and distribution of badges. On Thursday visits will be made to the Crocker-Wheeler Works, the power stations of the Manhattan and Metropolitan railways, with dinner at Hotel Marlborough in the evening. On Friday, the Eighteenth Street exchange of the New York Telephone Company will be visited, and the power plant of the New York and Brooklyn Edison companies. For Saturday there are no assignments. On Sunday, Aug. 18, the party will proceed on the special steamboat "Montauk" to Albany, arriving at that place at 6 p. m. The party will be met at the wharf by special street cars and taken to the Hotel Ten Eyck, where dinner will be served and the night passed. On Monday it will leave by special train for Schenectady at 8.30 a. m., where a visit will be paid to the works of the General Electric Company. After luncheon at the works the party will proceed by special train to Buffalo, arriving there at 8 p. m. Special arrangements will be made for conveyance from the train to the Hotel Niagara, which will be the headquarters of the members during the convention. The sessions of the convention will be opened on Tuesday morning in the New York State Building on the Pan-American grounds. An address of welcome will be delivered by the Mayor of Buffalo. The afternoon and evening will be devoted to a preliminary tour of the Exposition. It is expected that only morning sessions of the convention will be held, the afternoons being utilized as may be arranged by the Buffalo local committee, including a trip to Niagara Falls, visits to electrical stations in Buffalo, etc. The fare for the trip from New York to Buffalo and return will be $16, which will include transportation on the boat with luncheon and refreshments, and transportation on the train the next morning from Albany to Buffalo. This will also include the privilege of sending heavy baggage from anywhere in New York or Brooklyn, and its delivery to a hotel room at Buffalo. A delegation of French engineers will be among the party. General topics for discussion at the convention have been selected for each day, upon which brief abstracts of papers will be presented as follows: On topics relating to Meters and Metering of Electric Energy, by Harry P. Davis, Caryl D. Haskins, Paul M. Lincoln and William Stanley. On topics relating to Electric Transmission Systems, W. S. Aldrich and H. W. Redfield, William Hand Browne, F. A. C. Perrine, E. W. Rice, Jr., Charles F. Scott, Charles P. Steinmetz, and "A Description of Niagara Falls Transmission Plant," by L. B. Stillwell. On topics relating to the Supplying of Light and Power in Large and Small Cities, L. A. Ferguson and William Lispenard Robb. "The Nernst Lamp," by Alexander Jay Wurts. On topics relating to Electric Railroading, by A. H. Armstrong, E. J. Berg and others.

Electrical Engineers of the Day—V.

H. G. STOTT.

Henry Gordon Stott, the son of the Rev. D. Stott, was born in the Orkney Islands, the extreme northern county of Scotland. He received the greater part of his early education from his father, and was sent to the Watson College School, in Edinburgh, and the following year to the College of Science and Arts at Glasgow, later consolidated with similar institutions into the Glasgow and West of Scotland Technical College. After three years' study in the engineering, electricity and chemistry classes, he started in with a small electric light company in Glasgow in October, 1884, where he became familiar with the practical part of central station work requiring more muscle than brains.

In May, 1885, through the kindness of Professor Jamieson, he was appointed assistant electrician to the Anglo-American Telegraph & Cable Company, which position he held until October, 1889, during which time he assisted in over 70 cable repair expeditions.

Much of his spare time was taken up in experimental work on the self-inductance of iron-armored submarine cables, and developing new methods for locating faults. He spent many nights in work on the duplexing of the Direct United States Cable Company's main cable, this being the longest cable ever successfully duplexed, receiving a letter of thanks from the general manager in London for his voluntary work, which was, however, interrupted by a call to the other side of the Atlantic, the work being completed by the cable company's own staff in Halifax, N. S.

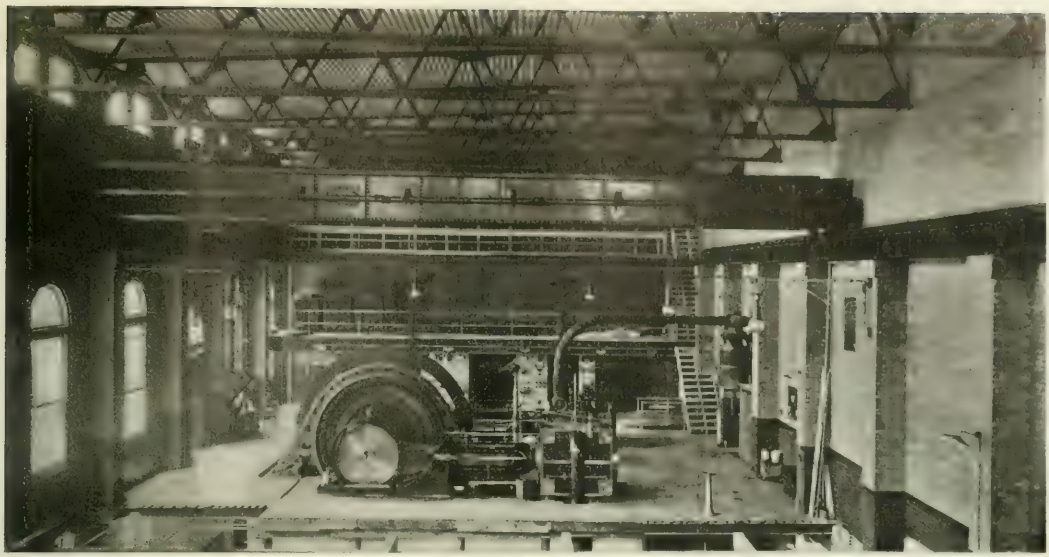
Realizing in 1889 that the future of telegraphy was a limited field compared to that of power and light, he resigned his position in London and accepted a position with the Brush Electrical Engineering Company, going to Bournemouth, England, for a year as assistant engineer in its lighting plant. After a year there he went to Madrid, Spain, and was engaged in the erection of engines, generators, underground systems, the wiring of many of the Spanish grandees' mansions and part of the Senado or Senate Chamber. From Madrid, at the expiration of the contract, he returned to the Brush Electrical Engineering Company in London, and was engaged in general engineering work on the chief engineer's staff.

In September, 1891, realizing the small opportunities for promotion in electrical work in Great Britain, he left for New York and was there immediately engaged by Mr. C. R. Huntley, of Buffalo, N. Y., to put down the first underground cables ever used in that city for lighting and power purposes. During the ensuing years he was engaged in the various kinds of installation work connected with the replacement of small generators with large, laying underground cables, installing new switchboards, in lamp and meter work, etc., two of the plants operated by the Buffalo General Electric Company

having been gutted with fire, necessitating a complete new outfit of electrical apparatus.

In 1897 the company decided to close a contract with the Niagara Falls Power Company to supply it with electric power to take the place of steam and to consolidate the two existing plants into one new one, which would be a model in efficiency, reliability and economy of operation. The design of this entire plant, together with the storage battery auxiliary, was entrusted to Mr. Stott, in addition to his other duties. The new plant at Seventh and Wilkeson Street, testifies to the fact that he carried out his instructions as to efficiency, reliability and economy of operation, for with a total of 14,000 horse-power in motors and generators, not a single shut down of any part of the service was caused by any fault in the plant itself, in two and a half years, and further, the station is operated by two men on a watch. When it is realized that this plant receives three-phase 25-cycle currents, and sends out four different kinds, namely, 60-cycle, constant-current arc, three-wire Edison and 500-volt direct-current power, with the necessary complication due to previous conditions, the record is marvelous.

In February, 1901, after nine and one-half years' service with the Buffalo General Electric Company, Mr. Stott was offered and accepted the position of superintendent of motive power of the Manhattan Railway Company, New York, to take charge of its new 70,000-hp generating plant and seven sub-stations, as well as of the entire distributing system. Mr. Stott is a member of the American Institute of Electrical Engineers, before which body he read a paper this spring on "The Distribution and Conversion of Niagara Currents at Buffalo, N. Y."



Dynamo and Engine Room, Toledo-Monroe Road.

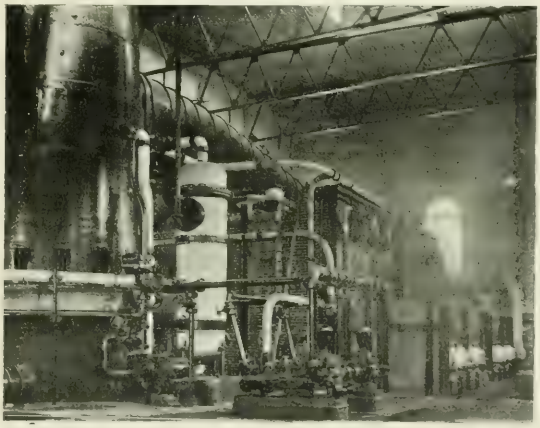
The Toledo, Ohio—Monroe, Mich., Interurban Railway.

The Toledo section of an interurban railway which is eventually to extend to Detroit, Mich., was completed several months ago, and is now running a regular hourly schedule over a distance of 18 miles. The schedule speed is 38 miles an hour, with an average number of stops of two per mile.

The accompanying illustrations show the power house, which is located in Toledo, and the upper floors of the sub-station, which is 12 miles distant from the latter city.

In the power house are two 400-hp triple-drum Babcock & Wilcox boilers, designed for 160 lbs. pressure, but at present worked at 135 lbs. Three-phase currents are generated and transformed for the railway circuits to direct current by means of rotary converters. The generator is a 400-kw, 25-cycle, revolving-field Westinghouse three-phase machine, and is driven by a compound condensing, heavy-duty Hamilton Corliss engine, the latter being rated at 600 ihp. at a speed of 100 r. p. m. For transmission to the sub-station the generated voltage of 380 volts is stepped up to 15,000 volts by means of three 135-kw Westinghouse transformers. In the power station is a Westinghouse rotary of a capacity of 200 kilowatts, which converts the three-phase current generator to direct current at about 620 volts.

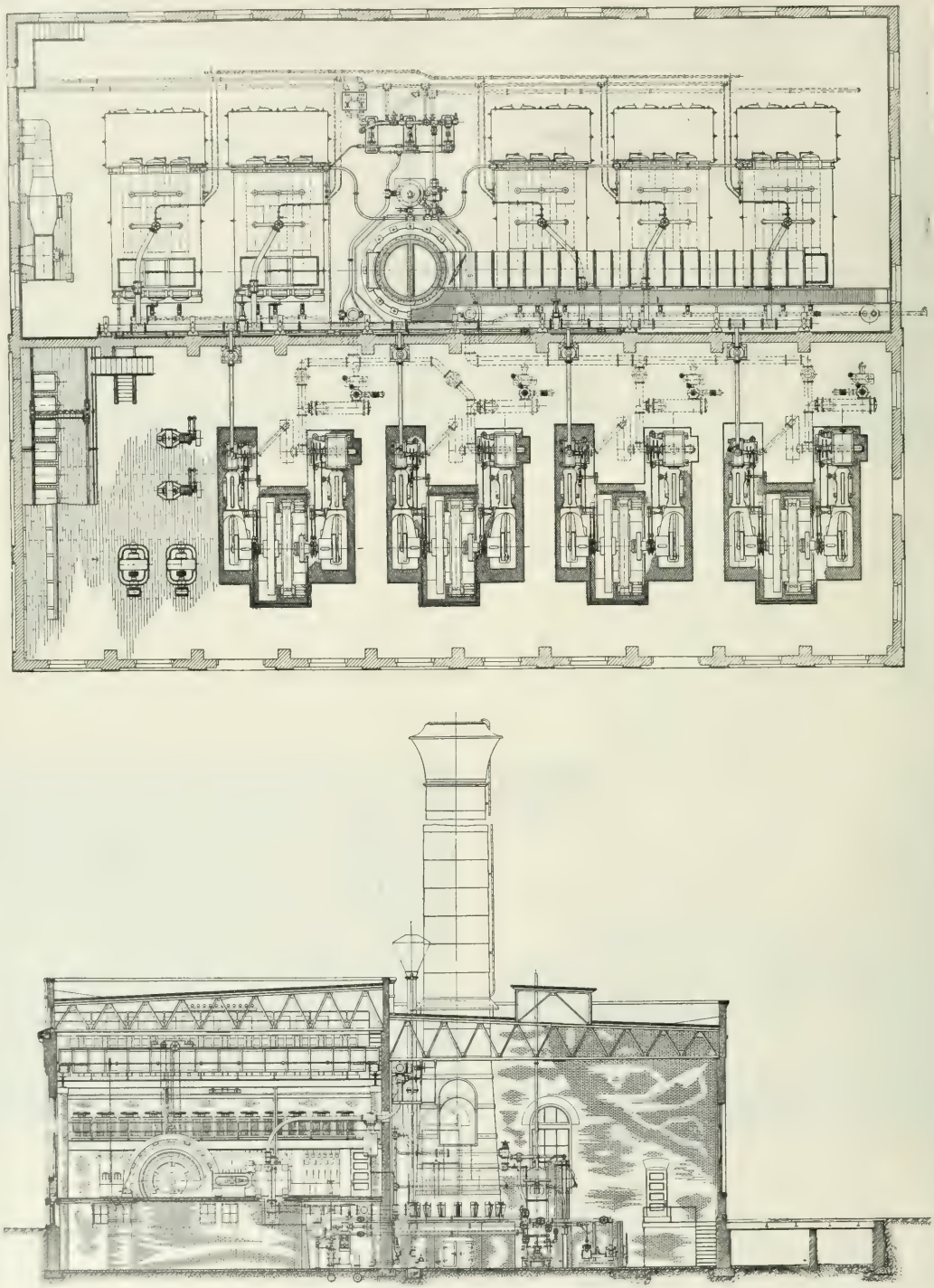
POWER HOUSE, TOLEDO-MONROE ROAD.



BOILER ROOM.

The alternating-current rotary panel of the station switchboard contains a triple-pole switch for the induction motor carried on the end of the rotary shaft, a triple-pole, single-throw, 400-ampere, spade-handle switch for the rotary itself, and a double-throw, single-pole switch which connects the field of the rotary in either short or long shunt. This last-named switch is used when the rotary is started from the direct-current end. It is first thrown to short shunt and the rotary brought up to speed as a shunt motor by gradually cutting out the resistance in a starting rheostat, which is in the main circuit. When up to speed the positive rotary switch is thrown in and the starting rheostat circuit opened. The speed can then be varied by means of the field rheostat giving a visible effect on the synchronizing lamps, and showing when to throw in the alternating-current rotary switch.

The other method of starting the rotary from the alternating-current end requires the shunt switch to be left at long shunt, as though the rotary were a direct-current generator. The speed is raised by the induction motor, and when the lamps synchronize the alternating-current switch is closed. Preventive coils are connected



ELEVATION AND PLAN, TOLEDO-MONROE INTERURBAN RAILWAY.

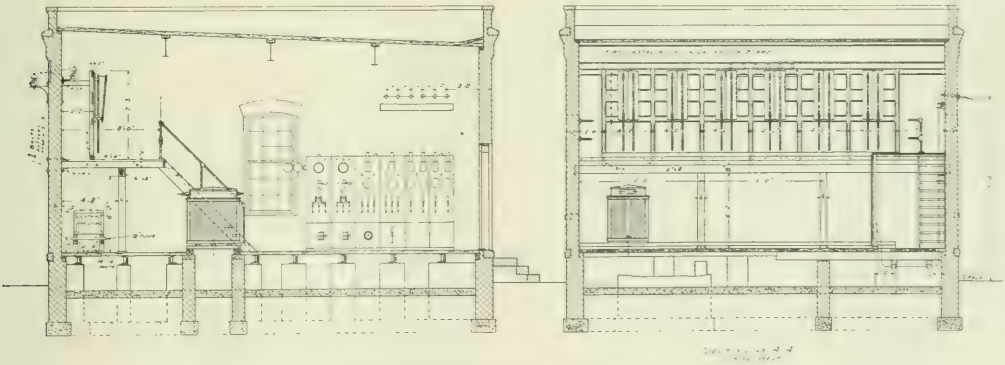
INTERIOR OF SUB-STATION.

across the shunt switch to avoid the flash discharge which would occur were the field circuit opened.

There are two sets of bus-bars, one of which is connected with a set of three auto-converters, which add 20 volts to the e. m. f. generated.

In the sub-station there are three transformers and two rotary converters of the same size as those in the power house.

The rolling stock consists of four passenger cars, one chair car, one combined passenger and baggage car and one freight car. The passenger cars are 40 ft. long, with a smoking compartment at the forward end. Electric heaters are wired under each seat. The electric equipment is of the four-motor type, 50-hp Westinghouse motors being used. The road was built by the J. G. White Company, under the direction of its engineer, Mr. Sumner W. Childs.



ELEVATION AND PLAN OF SUB-STATION.

Independent Telephony in Toledo.

The greatest victory for the independent telephone companies in Ohio, in some time, is said to be the securing by the Toledo Home Telephone Company of a franchise to build a local system. The company was promoted by Mr. Frank Graves, backed by Cleveland and Toledo people, and for some months it has been engaged in a struggle with two rival companies. Several weeks ago, after finding it impossible to gain any satisfaction from the city council, the company applied to the Probate Court which finally granted the franchise. The new company had secured over 3500 subscribers, and the Court was impelled to answer its demands. The company produced witnesses from every town in northwestern Ohio who declared they were turning their business to Cleveland and Indianapolis, because they could not secure good long-distance telephone connection with Toledo merchants. This is the last of the larger cities in Ohio to secure independent service. Toledo already has two systems, and for that reason it was extremely difficult to secure the franchise. The Bell company, it is said, has only about 1200 subscribers, while the Harrison Company, which is supposed to be controlled by the Bell company, and is not recognized by the independents, has only about 500. The Toledo exchange forms a most valuable addition to the independent interests in Ohio, as it will be a means of giving them first-class connection between the systems of Ohio and Michigan.

Exports to Central and South America.

Exports from the United States to all American countries and islands south of her boundaries show a marked increase in the fiscal year just ended, and exceed those of any other year in the history of our commerce. This statement, just announced by the Treasury Bureau of Statistics, is especially interesting in view of the various efforts being made for closer business, commercial and transportation relations between the United States and her neighbors at the South. New lines of steamers have recently been put on between the Pacific Coast of the United States and the western coast of Mexico, Central and South America. A recently published statement indicate that great financial interests of the United States have obtained control of the nearly completed transcontinental line connecting Argentina with Chile. The establishment of additional direct steamship lines between the Eastern coast of the United States and South American ports is under discussion, and the opening of an isthmian canal would give a straight line of water communication from the Eastern coast of the United States to the Western coast of South America. All of these movements in the direction of closer relations between the United States and her neighbors at the South add interest to the announcement that our exports to those countries in 1901 are larger than those of any preceding year, and to some figures just presented by the Bureau of Statistics showing the imports of each of the South American countries at the latest date and the exports from the United States to each of those countries in 1901.

The growth of exports from the United States to Central and South America has not kept pace in the past with the growth in other directions. The total exports to South America in 1900, for instance, were no more than those of 1890, being in each of those years, in round numbers, $38,000,000, while the same statement holds good with reference to Central America, the total exports from the United States to the Central American States being in 1890 and 1900 in each case in round numbers, $5,000,000. It is to Mexico and the West Indies that our exports in the decade 1890-1900 show the greatest increase, being: To the West Indies in 1890, $33,000,000, and in 1900, $47,000,000; and to Mexico in 1890, $13,000,000, and in 1900, $34,000,000. The fiscal years 1900 and 1901 show a much greater increase in our sales to our neighbors at the South than in any preceding years. The total exports to Mexico, Central and South America and the West Indies in 1899 were $103,000,000; in 1900, $127,000,000, and in 1901, $138,000,000, in round numbers. Thus the figures of 1901 are $35,000,000 greater than those of 1899, while the 1899 figures are only $1,000,000 greater than those of 1893.

Wireless Telegraph Experiments Between Brussels, Malines and Antwerp.

By Emile Guarini.

DURING the months of January, February and March, of the present year, I was enabled, with the assistance of Artillery Lieutenant Fernand Poncelet, to carry on some experiments in wireless telegraphy between the Column of Congress, Brussels, the Tower of St. Rombaut cathedral at Malines, and the Tower of Notre Dame cathedral at Antwerp, the Belgian Government having kindly placed these monuments at my disposition for the purposes of

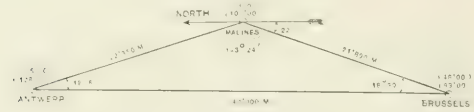


FIG. 1.

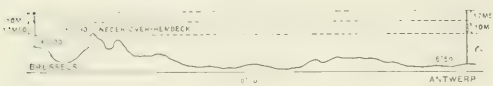


FIG. 2.

FIG. 3.

FIG. 4.

the experiments. The respective distance of these monuments from each other and their heights are indicated in Figs. 1 to 4, the heights being referred to the sea level. The general programme of the experiments was as follows:

1. The transmitter installed at Brussels and at Antwerp not to affect directly the receiver placed at Antwerp or at Brussels.

2. The transmitter installed at Brussels not to affect directly the receiver installed at Malines, and vice versa.

3. The transmitter installed at Antwerp not to affect directly a receiver placed at Malines, and vice versa.

4. A repeater was installed at Malines, and the extreme stations at Brussels and Antwerp, being provided with apparatus as stated in

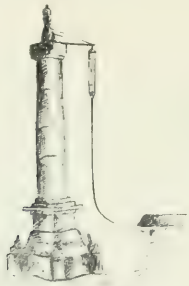


FIG. 5.

FIG. 6.

(1), Antwerp could thereby receive signals transmitted from Brussels, and vice versa.

In the first three cases I was at the first station and Lieutenant Poncelet was at the second. In the fourth case, we were both at the Malines station to observe the working of the repeater, assistants being stationed at the extreme stations. The signals were transmitted according to a programme fixed in advance in minutest detail. The watches of the observers were well regulated, and in the fourth case a Morse receiver was connected with the repeater and after each experiment its record was compared with the Morse record at the receiving station.

1.—DIRECT SIGNALING BETWEEN BRUSSELS AND ANTWERP.

Fig. 2 gives a section of the ground between the Congress Column at Brussels and the Tower of Notre Dame Cathedral. Figs. 5 and 6 show the aerial conductors attached to these monuments. In these last two figures the heights are not relative.

The aerial conductors were secured to bamboo rods securely fixed at the top of the monuments, and the portions of the conductor visible from the respective stations were run as nearly vertical as possible, the remaining portion being run obliquely to the receiving posts. At Brussels the receiving station was in a house on Rue Van der Meulen, and at Antwerp in a hotel on Place Verte. The vertical or useful part of the conductor in each case had a height of 90 ft. (27.5 meters) above the summit of each station. It consisted of a single cable of seven .9-mm wires 57 ft. (17.5 meters) long with a cylindrical portion 33 ft. (10 meters) long, consisting of 50 parallel .4-mm wires, the cross section being 50 cms. At Brussels the cylindrical portion was at the top, and at Antwerp at the bottom of the useful part of the aerial conductor.

Each station was supplied with a transmitter and a receiver, the latter apparatus included a Morse recorder. The coherers were of the metallic filing type. All the various types were tested and a Blondel receiver found to be the most sensitive. The transmitting apparatus comprised an induction coil giving a spark up to 10 inches. Current was furnished from 8 storage batteries, the strength of the current being from 6 to 9 amperes. The power of the transmitters and the sensitiveness of the receivers were carried to the maximum of which the apparatus was capable, this in the case of the transmitters corresponding to current of 9 amperes and a spark of .6 inch.

Of all the signals transmitted from Brussels in the first trial none were received at Antwerp. The same is true of the signals transmitted from the latter place, with the exception of a trial when a current of 10 amperes was used. On this trial two signals were received at Brussels. After different tests, notably one to assure that the coherer was not affected by neighboring electric tramway lines, it was concluded that the two signals came from Antwerp. At the instant when they were received, after having interrupted the grounded current of the induction coil at Antwerp, two sparks 10 inches long and lasting 30 seconds were produced. This experiment was not followed up, my aim not being to determine the maximum distance over which I could send signals without the ground connection. This result sufficed to assure us that if the transmitter and receivers were placed in the same normal conditions, using 9 amperes of current, a spark-gap of 1.5 cm, a normal earth connection and supersensitive Blondel coherers, we could not secure direct communication between Brussels and Antwerp. We reserve for future experiments with the repeater the possibility of communication with its aerial conductor discontinued, thus determining if during this interruption a signal can be exchanged between the extreme stations.

2.—DIRECT COMMUNICATION BETWEEN BRUSSELS AND MALINES.

A.—Brussels transmits and Maline receives. Fig. 3 shows a section of the ground between the two stations and Fig. 7 shows the aerial conductor at Malines attached to the summit of St. Rambaut Tower, the aerial conductor at Brussels remaining as in the first experiment.

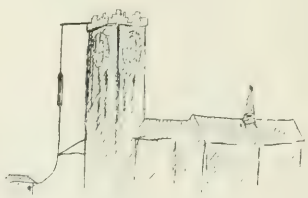


FIG. 7.

FIG. 8.

The apparatus at Brussels is the same as was used in the first experiment. That at Malines was the same as the apparatus at Antwerp, and was installed in front of the cathedral in the Breda Hotel. The experiments led to the following conclusions:

a.—The earth connection to the transmitter and receiver being

broken, all the signals transmitted were received. A current of 4 amperes and 16 to 17 volts was used.

b.—A storm having detached the aerial conductor at Malines, it was replaced in such a manner that the cylindrical portion was on a level with the roofs of houses in Brussels. Though the conductor at Malines had a height of 131 ft., communication was interrupted.

c.—The aerial conductor at Malines having been replaced by a single cable of seven 1-mm wires, starting from the height of the tower, it was found necessary to carry the current to 6 amperes in order to obtain communication.

d.—The lower part of the twisted cable at Brussels having been replaced by a cable of seven 1-mm wires in contact but not twisted, communication was established with a current of but 3 amperes. The result of these experiments and their concordance with the theory of the aerial conductor which we submitted in 1900 to the Academie des Sciences, of Paris, substantiates the principle that the aerial conductor radiates electrical energy exclusively in planes normal to its surface. The maximum effect will, therefore, be obtained with a conductor in the form of a vertical cylinder of a definite height and section, the conductors of each station being parallel and of the same height above a datum plane.

B.—Malines transmits and Brussels receives. At the beginning of this experiment a storm blew down the aerial conductor at Brussels. When it was re-established, for the cylinder of 50 wires a cone of 50 .4-mm wires of the same height was substituted, the base of the cone being at the top (Fig. 8). Thereafter to the end of the experiments the conductor at Brussels remained as shown in Fig. 8. The conductors at Malines and Antwerp were identical and consisted of a single cable of seven 1-mm wires. This set of experiments led to the following conclusions:

a.—In general, the communication was better than in the first set of experiments. At the beginning only occasional signals were received. This result was attributed at first to the form of the aerial conductor, since the parts serving principally for reception (the conical part) was less favorable; in addition, the presence of large quantities of metal which ornament the Congress Column (a bronze

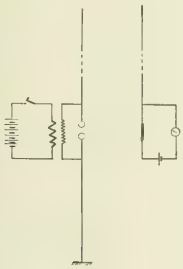


FIG. 9.

statue of Leopold I, four statues in bronze, two lions in bronze, etc.). A similar result had previously been observed in Paris during experiments between the Pantheon and Eiffel tower, in this case no message being received at the latter station while the reception was good at the Pantheon. This result was attributed to the effect of the iron in the Eiffel tower.

b.—In operating the transmitting and receiving apparatus at the maximum of their capacity and sensibility, communication could be established relatively well. The maximum number of signals were received when the vertical plane containing the two conductors was so established that it did not cut portions of the respective monuments supporting the conductors.

c.—Several experiments were made relative to earth connections. The best result was obtained in the case illustrated in Fig. 9 where the receiver earth connection was suppressed.

My conclusion from these experiments is that in wireless telegraphy the earth plays the part of the large capacity.

3.—DIRECT COMMUNICATION BETWEEN MALINES AND ANTWERP.

A.—Malines transmits and Antwerp receives.

a.—Good results were obtained with a current of from 2 to 2½ amperes.

b.—With the arrangement shown in Fig. 8 the results were not so good as with the inverse arrangement (2^c—B—c). This experiment has not changed my opinion as to the role of the earth in wireless telegraphy, for at Brussels the receiving conductor was supplied with a large capacity at its upper end, a similar cone of 50 wires not being used at Antwerp. A section of the ground between the two stations is shown in Fig. 4.

c.—An interesting experiment was made on the employment of alternating-currents in wireless telegraphy. The oscillator was suppressed at Malines, and the aerial conductor connected to earth through the secondary of the induction coil. Twenty-five per cent of the signals transmitted under these conditions were received at Antwerp.

d.—A signal was received at Antwerp when the receiver earth connection there was disconnected, alternating currents being used at Malines.

B.—Antwerp transmits, Malines receives.

a.—Less favorable results were obtained than in the inverse communication. A strong wind bent the aerial conductor at Antwerp and destroyed the parallelism between the two conductors, thus furnishing another proof of my theory as to the role of the aerial conductor.

b.—Under the same atmospheric conditions, the results attained were most favorable when alternating currents were employed.

c.—The results were still better when a capacity was added to the end of the transmitting conductor.

d.—The Marconi method of syntonizing was tried. With complete diaccord, and though the distance was more than 2½ kilometers, exchange of signals could be maintained almost as well as with complete tuning.

Apropos of recent wireless telegraph press dispatches, we learn from the newspapers that notwithstanding the precautions taken during the Marconi experiments near Nice, a dispatch transmitted from Biot to Calvie was intercepted at Ville Franche in its entirety and with perfect distinctness. This confirms the result just referred to.

4.—COMMUNICATION BETWEEN BRUSSELS AND ANTWERP, A REPEATER BEING EMPLOYED AT MALINES.

The three preliminary experiments having given the desired results, I was enabled to undertake the final experiment, which was to demonstrate the value of my automatic repeater for transmission over great distances. In my laboratory experiments this apparatus has always operated perfectly, but it was my desire to test it over long distances.

This apparatus is operated by very feeble waves, and acts as a relay to send forth waves of great energy. The experiments were crowned with pre-eminent success. On the last day of the experiments the time of sending the signals was noted at each station and subsequently

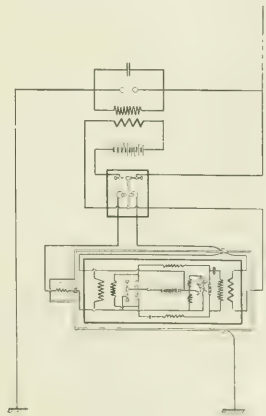


FIG. 10.

the Morse records at the two stations were compared and a perfect identity was found. All the signals transmitted from Brussels were not received at Antwerp, but this latter station received every signal which passed by Malines, which demonstrates the absolute fidelity of the repeater.

The repeater experimented with at Malines is shown schematically in Fig. 10. A single aerial conductor was employed at Malines and

connected with the secondary of an induction coil. The relay switch had for an object to maintain or interrupt communication with the receiving mechanism according as it operated as a receiving or transmitting conductor.

The result of some experiments led us to interpose a transformer with a glass core and a condenser, between the aerial conductor and the coherer. It was noted that without this precaution the atmospheric electricity gathered by the conductor at Malines, which acted, in fact, as a lightning rod, influenced the coherer at each interruption in such a manner that once set in operation by the wave transmitted from Brussels or Antwerp, it continued to function. The aerial switch had a second function, that of closing the primary of the induction coil. Its sensibility was about 1-20,000 ampere.

The coherer which gave the best results consisted of large nickel filings with traces of silver, enclosed in a 1-mm space, the tube being exhausted. To obtain perfect decoherence I used the following means: At the moment when the striker gave a shock a supplementary resistance of 2000 ohms was added to the normal resistance of 1100 ohms in the circuit of the coherer. The repeater operated automatically and in irreproachable manner, both with alternating and Hertzian waves.

The Mechanical Equivalent of Light.

By C. J. Reed.

When we speak of the "candle-power" of a source of luminosity, we mean simply the intensity of the physiological effect produced by energy in a certain condition. The candle-power is not in any sense a measure of the energy. There seems to be no more reason for assuming the existence of a definite relation between the intensity of this physiological effect and the quantity of energy producing it than for assuming that a definite relation exists between temperature and quantity of heat. The temperature produced by a given quantity of heat depends on the quantity and kind of matter through which it is distributed, not simply on the quantity of heat. No one would think of speaking of the mechanical equivalent of temperature. We may compare one temperature with another by studying the effects of heat upon matter at various intensities and also by physiological effects. But we cannot say that a temperature of 100 degs. is equivalent to 1 foot-pound per second, merely because energy must be expended at that rate to maintain this temperature in a particular body under particular conditions. The same expenditure of energy in a different body or in the same body under different conditions will maintain a different temperature, and there is not necessarily any limit to the intensity of the temperature that may be produced and maintained by 1 foot-pound per second, provided the body acted upon its small enough and suitably conditioned.

For all we now know to the contrary, the same is true of luminosity. Light is not *energy*, but merely a physiological effect produced by energy in a particular condition. The intensity of this effect, or quantity of light, does not necessarily depend on the quantity of the radient energy producing it, but on the condition of that energy, and there is not necessarily any relation between the quantity of energy and its condition. We may compare one source of luminosity with another, but we cannot measure it, either in calories or in foot-pounds, though we may measure in foot-pounds per second the power required to maintain a certain luminous intensity in a particular mass of a particular substance under particular conditions of radiation, etc. We may also measure the radiant energy given off by a source of light, but that is not a measure of the light. It is only measuring the energy dissipated in maintaining a condition in matter. We can place no finite limit to the luminosity that may be maintained by the same expenditure of energy in a different mass or under different conditions.

There is no absolute standard of either light or temperature. Both produce physiological effects, which give us qualitative knowledge of intensities. Heat affects the properties of all matter in such a way as to give us approximate, but not absolute, standards of measurement. But there is no instrument for measuring light, except the living eye. There is no known change produced in any of the properties of matter by light. We may measure the actinic power of radiant energy emanating from a given source by an arbitrarily chosen photographic plate; and the heat, by an arbitrarily calibrated thermometer, but not the luminosity. The measurements of the actinic power of the same source are not comparable when different photographic materials are used. But even if they were, we would be no better off for measuring light, as light is not actinic power.

That the maintenance of luminosity is always necessarily accompanied by the dissipation of energy, there does not seem to be any room for doubt, as is also the maintenance of temperature. But this may be only because high temperature is necessary for the production of light. It does not imply a particular quantitative relation between the energy dissipated and either the temperature or the luminosity.

The investigations for determining the mechanical equivalent of light, of which Mr. Carl Hering has given an interesting review in the Electrical World and Engineer, of March 23, 1901, have resulted in determining, at most, only the radiant energy accompanying or causing an arbitrarily defined luminosity under particular conditions. There is no evidence, however, that this energy is the luminosity, or that the relations established under these conditons would hold true under other conditions, as, for example, at higher or lower temperatures. We have, on the contrary, most positive evidence that they would not.

According to the results of Tumlirz and Thomson (which differ by about 25 per cent) the magnificent light of the Cooper-Hewitt tube would come very near the theoretical limit of possible efficiency. Increasing the temperature of the incandescent vapor in this tube a thousand-fold would not, according to this supposition, materially increase the light-giving power of a given quantity of energy. But the results obtained by Ebert indicate that there is no such fixed relation between the quantity of energy and its light-giving power—in other words, that the luminous power depends upon the *quality* or condition of the radiant energy rather than its quantity.

The luminosity of the firefly is frequently referred to as "cold light," but this is only a guess. We have no evidence that this source of light is cold. The fact that the quantity of energy required for great luminosity of this kind is so small that it cannot be easily detected is no proof that the incandescent particles are at a low temperature. The temperature of the phosphorescent particles may be greater than that of the electric arc, and yet the mass of the particles may be so small as to be unweighable and incapable of affecting perceptibly any instrument for measuring temperature. We are, therefore, not yet warranted in assuming the existence of cold light.

The great efficiency of such sources of luminosity, as are usually designated "cold," may be really due to their very high temperature.

The glass tube containing the luminous Cooper-Hewitt vapor remains comparatively cold, but we are not, on this account, warranted in assuming that the particles of incandescent mercury vapor in the tube are also cold. Nor would we be warranted in such a conclusion even if a thermometer inserted in the tube and entirely surrounded by the incandescent vapor, should fail to indicate a high temperature. The actual temperature of this vapor may be many thousand degrees, yet a thermometer entirely surrounded by it could easily radiate energy as heat of low degree faster than it could receive energy by both radiation and contact, from the minute mass of the surrounding highly heated vapor.

Edison Storage Battery.

Our French contemporary, *L'Industrie Electrique*, contains in the current issue a letter signed by Louis Krieger, which, after referring to an article in that journal in which it was stated that the zinc-nickel storage battery had been patented in 1899 by Michalowski, claims that the writer had anticipated both Edison and Michalowski, he having been granted a patent Dec. 4, 1896, on a zinc-potassium-nickel storage battery, and also on the employment of lithium and magnesium with zinc in this type of battery. This battery, which is stated to have been entirely the result of an electrochemical calculation, was made during 1896, and one which was tested in the laboratory of Professor Lippmann at the Sorbonne showed an e. m .f. of 1.82 volts, which is exactly the figure arrived at in the calculation in assuming the reduction of sesquioxide (Ni^2O^3) to protoxide (NiO). The formation of the nickel positive is stated to be very simple if certain precautions are taken. Oxidation of the nickel can even be obtained on a plate of ordinary plate nickel carrying no active material.

An American Review of Telephony Abroad.

A FEW weeks ago note was made in these pages of the evidence given before the United States Industrial Commission at Washington by Mr. U. N. Bethell, general manager New York Telephone Company, and an abstract was presented of his statements in regard to conditions in this country. During the latter part of the hearing Mr. Bethell was requested to furnish data as to the differences between telephonic conditions in the United States and in Europe, etc., and his evidence in respect to that branch of the subject was also of a most interesting and instructive nature. We are now able to present its salient points, which deserve the consideration of our numerous foreign readers not less than that of the large number engaged in telephony in this country.

In speaking of European conditions, to avoid confusion, Mr. Bethell expressed all money values in American equivalents, and in mentioning the populations of various places made his statements in even thousands. He has twice visited Europe personally for the purpose of looking into telephone conditions there, and in the fall of 1899 visited the countries of France, Belgium, Switzerland, Austria-Hungary, Germany, Holland, Denmark, Sweden and England. He then obtained from public documents and other reliable sources on the ground much of the information used in his testimony. Throughout his evidence Mr. Bethell was careful to state, in dealing with each country where there is governmental or municipal control, that what he regarded as poor service was not due to technical mismanagement, but sprang essentially from political conditions, which acted as a handicap upon the officials.

FRANCE.

As to France, he stated that a company operated the telephone industry there until 1889, and since that time it has been a Government monopoly. There has been practically no development outside of Paris. There are more telephones in New York than in the whole of France. At the beginnig of 1901 the population of Paris was 2,536,000, with 33,000 telephones, about 50 per cent of the total number in France. Only four other cities had more than 1000 stations. They compared with America as follows: Lyons, population, 466,000; telephones, 2207. Cleveland, population, 285,000; telephones, 8492. Marseilles, population, 442,000; telephones, 2151. Cincinnati, population, 325,000; telephones, 9142. Bordeaux, population, 256,000; telephones, 2009. Milwaukee, population, 285,000; telephones, 8492. Lille, population, 216,000; telephones, 1064. Louisville, population, 304,000; telephones, 5049.

There is relatively a very large development in Paris, due in a great measure to the inferiority of other means of communication. The rates are not relatively low. The Paris system is technically far behind the times. There are few modern appliances and much of the old apparatus used by the company before the Government took over the business is still in service. That the subscriber buys his own instrument, and that the Government has approved some 500 types of instruments from which the subscriber may select, gives some indication of the possible character of the service.

In Paris the company charged $120 a year. The Government has charged and now charges a flat rate, business and residence alike, of $80 a year. The rate will be reduced in 1902, in accordance with a law recently passed, to $60 a year, if the requisite plant can be provided by that time. In addition to the annual rate, the subscriber bears the cost of the instrument and a part of the cost of the line, i. e., from the underground cable in the sewer to the station, and if he is beyond the fortifications, he pays also for the line beyond that point. In towns outside of Paris, the rates range from $30 to $60. That these rates are considered high, taking into account the purchasing power of money in those places and the character of the service furnished, the figures already mentioned, showing an absolute lack of development, would seem to be sufficient proof. In Paris Government buildings are occupied by the telephone administration, and so far as the published accounts show no rents are charged for the occupancy. There are no charges for subways or rights of way, because the lines are in the sewers.

As to wages: Operators get about $6 a week; linemen and mechanics, $7.20 to $8.50, with 10 hours as a day. Separate telephone accounts are not published, so it is impossible to say whether the undertaking is self-sustaining or not. Considering the low wages and the freedom from usual charges, the Paris rate is relatively much higher than the New York rate, and considering the amount and character of the service, the annual rate plus the extra charges is also absolutely higher than the New York rate.

BELGIUM.

Belgium was next touched on by Mr. Bethell. The industry there was conducted by a company up to 1889 or 1890. Since then by the Government. At the first of this year, in all of Belgium there were 14,920 stations, or less than one-fourth the number in New York alone. In Brussels, with a population of 560,000, there were 4525 telephones; in Antwerp, population, 278,000, there were 2802 telephones. In general, the plant installed by the company before the Government took over the business in 1890, was still in use in 1899, completely out of date and almost worn out. Single wires or grounded circuits are still generally in use, although the conversion of a metallic circuit system has been commenced. In general the service, plant and methods are one with those that were abandoned in most American cities in the eighties. The company's rates for grounded circuit service have been continued in force by the Government; in Brussels and Antwerp, $50, the metallic circuit rate being $70. Elsewhere the rates range from $25 a year for grounded circuit service, and from $54 for metallic circuit service. Other things in Belgium are cheaper than telephone service. Labor is poorly paid. Operators get from $1.90 to $2.77 per week. The Government pays nothing for rights of way. The plant has been starved and is in poor condition.

SWITZERLAND.

Switzerland, Mr. Bethell said, did not properly come within the scope of his remarks, which were about large cities chiefly, but it is such an interesting country, telephonically speaking, because the Government controls the business, and it is so often referred to by writers on telephone subjects and others, that he felt it proper to say a few words about the conditions there. The population of Switzerland in 1900 was 3,300,000; of telephones at the first of this year there were 38,864. There are no cities comparable with New York as to size and general conditions. Zurich is the largest, with a population of 152,000, and only 6000 telephones. Private companies operated in some of the large towns at first, but these were bought out by the Government, and there is now a Government monopoly all over the State. The rates are uniform in all places without regard to differences in size. The subscriber pays for the first year $20, for the second year $14, and for the third and each subsequent year $8. These rates are, however, frequently quoted as if they told the whole story. These charges are only for the privilege of having telephone—the privilege of belonging to the State's telephone club, so to speak, and the subscriber must be near the central office to avoid extra line charges. Every time he uses the telephone he pays an additional charge. That additional charge is 1 cent for a local message. Four hundred at 1 cent makes $4, and that added to $20 makes $24, the annual charge during the first year for 400 local messages. Now, in many suburban towns, the New York Company has a rate of $24 for 400 messages, and gives a superior service to that given in the Swiss towns.

Mr. Bethell quoted here official statements by the director of the municipal telephone system in Amsterdam, Holland, showing that the Swiss rates usually quoted as inclusive or "flat" rates are, in fact, only minimum rates, and that the rates actually range as high as $158 a year, and possibly higher. The plant is cheap and inferior. Grounded circuits are still extensively used, and the equipment is quite out of date. Nothing is paid for rights of way except in a very few cases in one city, where the Government has not been able to break entirely away from a practice established by the private company. The Post Office collects the telephone accounts, and wages are exceedingly low. Skilled operators are paid $4; wiremen and chief operators in large central offices $7; linemen, etc., $4.20 to $6; foremen, $6.50 to $8.40 per week. The telephone accounts are separately kept and published. The national telephone receipts in 1899 were $1,007,011, the expenses $1,254,803, the deficiency $247,792. These figures will be found in the Statesman's Year Book for 1901. The expenses were practically 125 per cent of the earnings. That, continued for any time, would mean bankruptcy for a private concern.

AUSTRO-HUNGARY.

In Austria, several private companies conducted the business until 1894 or 1895. Since then the Government, after purchasing the plants of the companies, has operated the business as a government monopoly. As in France and Belgium, the chief development in Austria-Hungary has been in the principal cities—Vienna and Budapest. The Vienna plant was bought by the Government from the company

on a valuation fixed by experts, as shown by the public document covering the case, at $1,600,000. Possession was taken on Jan. 1, 1895. There were then between 7000 and 8000 stations. This is equivalent to $2000 or more per station. Either because of rapid changes in the art or because the plant taken over from the company was out of date, the Government soon after taking over the business began the construction of a new plant. They put up two very handsome buildings, laid out a comprehensive underground system and provided the offices with new equipment throughout, so that in 1899 there was very little, if any, of the company's old plant still in use. The Government up to that time had expended $1,200,000 on its new plant. The number of stations in all Austria at the beginning of this year was 31,902, of which 13,326 were in Vienna, whose population is 1,655,000. Chicago, with practically the same population, had more than twice as many stations.

The Vienna rate was $40 when the company operated the business, and that rate has been continued by the Government. Elsewhere in Austria the rate is $20 a year plus an installation charge or entrance fee, as they call it, of $40 per kilometre (⅝ of a mile) of line. The rates are thus relatively high enough to prevent development. They pay nothing for rights of way in Vienna. The wages are low. Operators receive from $1.80 to $3.40 per week; linemen, etc., about $5 per week. In the official documents relating to the transfer of the property from the company to the Government it was stated by the company that should it continue the business it would be necessary, in order to protect its stockholders and creditors, to raise the rate which was then $40. In Vienna the telephone has been a particularly unfortunate victim of Government ownership, not because of mismanagement or any misguided action respecting the telephone itself on the part of legislators. For several years there was no session of Parliament and consequently no appropriations were made for extension of telephone plant. The telephone business is peculiar in that it requires constant additions to its capital account, or it must stand still. That is exactly what happened in Vienna—growth stopped—through no fault of the telephone management or of any one in particular, but through the political troubles referred to, which had nothing to do with any telephone question. Their funds failed them, they had a large waiting list, and general dissatisfaction resulted.

There is another striking illustration of the same point—not in Europe, but in Japan. There, in Tokyo, where there is government ownership, growth was not exactly suspended, but the Government was not able to take care of the business that was offered—to furnish the facilities that the public demanded—and applications being dealt with in the order in which they were received, there arose a speculation in the rights of priority for connection, and those rights sold as high in some cases as seven times the annual subscription for the telephone.

In Hungary there is no development outside of Budapest worth speaking of. In Budapest there were at the beginning of this year 5796 telephones, with a population of 729,000. Excepting the two Russian cities of Moscow and Warsaw, Budapest has the lowest development in Europe or America among cities of from 500,000 to 1,000,000 inhabitants. Several American cities of one-half the size have more than twice the number of telephones—that is, more than four times the development.

In Budapest there is a very progressive people, but as to the telephone service their plant is antiquated, their service is inferior and their rates are the same as in Vienna. That these rates are relatively high and that the service is exceedingly poor, is fairly shown by the lack of development. The wages are even lower than in Vienna. They pay nothing for rights of way, and, as a significant example of the powers that the Government may exercise there, Mr. Bethell stated that it had licensed a private company (the Telephone Newspaper Company) to string its wires throughout the city, and to attach them to public and private buildings without any compensation whatever to the owners.

GERMANY.

Germany was next considered. Mr. Bethell said patents were never allowed for the telephone there, and the Government has monopolized the telephone business from the beginning, operating it as a part of the postal and telegraph business. There has been a very large development in Germany, especially in large cities which have been favored by the German rate policy. Until very recently they have had uniform rates throughout the Empire—that is, the same rate in a great city as in a small city. This policy was changed by law in 1899, to take effect April 1, 1900, and since the adoption of lower rates for the smaller places there has been some growth in them, but relatively the conditions have not changed much. There are 720 telephone centers in Germany, and Berlin alone has 25 per cent of the total stations. Nine large cities have 52.5 per cent of them, leaving 47.5 per cent to 711 other cities and towns. At the beginning of this year Berlin had 47,586 telephones, against 54,647 in New York, the population being approximately the same. The 1900 census figures give New York a little larger population than the latest available official figures give Berlin; but at the present time there is very little difference, if any, between the two cities in this respect.

A point that has been often overlooked when considering the Berlin service is that until Nov. 1, 1899, the service was rendered only from 7 o'clock in the morning until 10 o'clock in the evening. Since that date a night service has been rendered, but extra charges are imposed for calls made between 10 o'clock at night and 7 o'clock in the morning.

The lines are largely single wire, and a very large percentage of them are still overhead. The same policy with respect to wires has not been pursued in Berlin as in New York. That is to say, they have supplemented their overhead wires by underground wires because the former became so numerous that they could not very well add to their number; but they have not replaced in a general and comprehensive way the overhead system with an underground system.

In Berlin, too, the subscriber does a great deal of the operating; that is, he calls the central office with which he is connected, and then works his own way from that central office to the next, and so on, whereas in New York every call is so supervised that the subscriber has nothing to do but give his order, the operator taking care of it, until he is put into communication with the desired station.

The uniform rate holding throughout the Empire until April 1, 1900, was $37.50. At that time flat rates varying from $16 to $45, and minimum message rates from $20 to $30, were put in force. The rates now vary with the size of the town. The administration had many times reported to the Parliament that the Berlin system did not pay, various rate propositions were presented and considered, and finally in 1899 they enacted a law putting into force the rates mentioned. The Berlin rate was increased 20 per cent. Of the total number of subscribers throughout the Empire, 66.8 per cent (over two-thirds of them) were increased, 26.8 per cent were decreased (in the small towns), and 6.4 per cent were not changed. Thus it will be observed that the Parliament ratified the statements of the technical staff that the Berlin rate did not pay. Berlin is proverbially a cheap city. Wages, rents and almost all other items that enter into the cost of furnishing a telephone service range from two to four times as high in New York as in Berlin.

That the public patronage—the development—is less in Berlin than in New York shows that the service and the old rate were not more reasonable from the German standpoint than the New York service and rate from the standpoint of the New Yorker. Considering the character and amount of service and the purchasing power of money in the two places, the rates in New York are lower than in Berlin.

As to the responsibility for the inferior service so far as grounded circuit lines are concerned, the technical staff has frequently urged the adoption of the metallic circuit, but this was disapproved by the ministers who would not spend the money on what they considered an unprofitable industry. At last, in 1899, $1,000,000 was appropriated to begin the work of changing from the grounded circuit to the metallic circuit, and that work is now going on. A night service was not rendered until the question was considered by Parliament, and then only on the payment of extra charges. A revision of the rates was repeatedly urged. The unfairness of a uniform rate and the unprofitableness of the rate mentioned in great cities such as Berlin and Hamburg, were also frequently urged. These facts show a tardy response to the recommendations of the technical staff, of whose report Mr. Bethell read a portion.

BAVARIA.

As to Bavaria, Mr. Bethell said that it is, of course, a part of the German Empire, but its telephone system is operated separately by the Bavarian Telegraph Department. They have had the same rates and the same policy as to rates as in other parts of Germany. The general conditions are about the same. Munich has 8500 telephones. Nuremburg 3500. Seventy-one other centers have only 6000 or 7000

altogether. The technical staff has been a little more successful in having its recommendations adopted, and consequently the plant and the service in Munich are somewhat better than in Berlin.

HOLLAND

Holland is particularly interesting because of municipal ownership in its two leading cities, Amsterdam and Rotterdam. A private company conducted the industry in these cities until 1890, when the municipalities obtained franchises from the State for 25 years. Viewed superficially and narrowly, it might be said that at Amsterdam the municipality on taking over the business reduced the rate, improved the service, in three years increased the numbr of stations 50 per cent, and made a profit. They must go further with a view to ascertaining the whole truth if possible.

The reduction in rate was insignificant in amount and, moreover, it was a mere shifting of taxation. The company's rate was $47.20 per year, the municipality's $36 at residences and business places for the exclusive use of the subscriber, and $46 for hotels, restaurants and places accessible to the public, plus in each case an installation charge of $10. Taking this last item into account, it will be seen that the reduction was on the whole very slight, and that in certain cases there was an actual increase. But there is another fact that must be taken into consideration. Under its franchise the company was required to pay the city 21 per cent of its gross receipts, which going into the communal treasury operated to lessen taxes in other directions. In 1894 the last full year of the company's concession the percentage amounted to $17,125.20. In 1898, notwithstanding the large increase in the number of subscribers, the communal treasury received from the telephone industry $20,000. The slight increase it may be safely stated was more than offset by the increase in the community's general expenses due to its telephone operations, to say nothing of the use of public buildings for supporting wires and fixtures for which no charges were made. Hence the communal treasury suffered by the change; in other words, whatever reduction was made benefited telephone subscribers at the expense of the general taxpayer. Therefore, the municipality is entitled to no credit for an alleged reduction of rate.

Touching the question of reasonableness, it is very significant that at The Hague the telephone industry is conducted by private enterprise at a rate of $24 a year. In other European cities where private companies operate there are larger systems and lower rates than in Amsterdam. The service is unquestionably better now than it was under the company's administration. But the present service is not so much a superior service as the former was an inferior service. Measured by other and fairer standards the present service loses its pre-eminence. What always happens under a limited franchise happened in Amsterdam. The telephone business in a way peculiar to itself calls for constant additions to capital account, and thus far in its history has called for constant and extraordinary outlays for reconstruction and substitutions. Hoping to undertake the business itself the municipality opposed an extension of the company's franchise and was successful. Having no assurance of life the company made no extensions or improvements. It did nothing to develop the business. There was no real growth, only 1700 stations in 1896. The municipality offered for the company's plant an amount equivalent to $47 per station. This being refused the municipality built a new plant, its investment being at the end of 1898 equivalent to $182.80 per station. With its new plant and with a skillful and enterprising manager an improvement in the service was inevitable, an improvement which was particularly noticeable to those who had suffered under the previous miserable condition due largely to the obstructive tactics of the municipality. But the Amsterdam service is by no means as efficient as that rendered by private companies in the Scandinavian countries, for example, or in this country. The feature that most condemns it is its insignificant scope, its entire inadequacy for so large a city.

This brings us to the question of development. Fifty per cent in three years sounds large, but in view of the starting point it means but little. Compared with that in cities of the same rank in this country or even in Europe, where private companies operate, the Amsterdam development is absolutely insignificant. At the beginning of this year Amsterdam, with a population of 513,000, had 4462 telephone stations. There are 64 American and European cities having a population of 200,000 or more. Arranged in the order of telephone development, Amsterdam stands fifty-eighth in the list. Among the cities of its class (from 500,000 to 1,000,000), it stands at the very bottom of the list with the exception of Budapest and Brussels (both having state ownership), and the two Russian cities of Moscow and Warsaw. Amsterdam and Boston are fairly comparable. They are about the same size—Boston a little bit larger. Both are seaports; both cities of commercial importance and activity. The statistics for Amsterdam, figure out 8.7 telephones per 1000 of population. Boston, with a population of 560,000, had 23,780 telephones at the first of the year, or 42.3 per 1000 of population; that is, 42.3 against 8.7 in favor of the American city. Comparing Amsterdam with Manchester, England: Population of Manchester, 543,902; telephones, 10,647, or per thousand of population, 19.6, against Amsterdam's 8.7, while Liverpool has over 20 against Amsterdam's 8.7.

Municipal boundaries and telephone exchange boundaries are not generally co-extensive. Around every great city there are suburban places of consequence, and usually the very center of their business and social lif is in the city. The municipality can serve only within its own area or else conduct a business beyond its borders where it has no jurisdiction. Amsterdam's activity is practicaly confined within the municipal limits, and as a result of that the development in the suburbs is practically nothing, while the development in the suburban towns and cities near Boston and New York is greater even, relatively speaking, than the development in the cities themselves. This limitation upon its activities, considering the peculiarities of the telephone business, is entitled to the greatest weight in considering the question of the advisibility of municipal ownership of telephones.

GREAT BRITAIN.

Mr. Bethell then gave the Commission some data as to Great Britain. There the telephone was early held to come under the Telegraph Act of 1869, which made the telegraph a government monopoly. The Postmaster General having thus the exclusive right to operate the telephone in Great Britain, and being unwilling or unprepared to directly exploit the new and doubtful enterprise, granted licenses to various private companies, limiting the operations of each to a specified area, and providing for the payment of a royalty to the Government of 10 per cent of the gross receipts. All of these licenses were made to expire in 1911. The restriction to specified areas by preventing interurban communication proved most unsatisfactory, and in 1884 other licenses which removed all restrictions and limitations as to the area in which the licensee company could operate, were granted. These new licenses were also made to expire in 1911. As a result, trunk wires were built between the several telephone centers, and trunk line traffic grew rapidly.

For a time the Post Office endeavored to establish competing systems. They feared the telephone would make inroads on their telegraph revenues, so they started a competition, but met with little or no success, notwithstanding that they were taking 10 per cent of their rival's earnings as a royalty. The next step in the history resulted in amalgamation. It became clear soon after the change in policy in 1884, already mentioned, that to get the best results, there must be uniformity of system, similarity of method, concentration of administration and management, and complete intercommunication between all subscribers. The outcome of this was an amalgamation and the formation in 1889 of the National Telephone Company, which extended its operations over the whole of Great Britain. One of the first results of this amalgamation, although none of the amalgamated companies had been in competition with another, was a reduction in rates practically to one-half of the former figures.

In 1898 there was a telephone inquiry by a select committee, presided over by the Secretary of the Treasury. In the report of this committee the main idea seems to be that during the remaining years of the company's license (it expires in 1911), the State should endeavor to break down the company's business through competition by itself or by municipalities. In 1899 the English Parliament voted 2,000,000 pounds to enable the Government to begin its competition in London, and empowered the Postmaster General to grant licenses to municipalities. There was, however, this element of fairness in the law. It was stipulated that whenever the Postmaster General licensed a competitor that thereby the National Company's license in the same area should be extended for a like time. The Post Office is now constructing its plant, and will probably begin rendering service in London before the end of this year. Licenses have been granted to some municipalities. Glasgow has already opened an exchange, but the movement has not yet gone far enough to be a subject of more than speculation.

The service generally was exceedingly bad, chiefly for reasons stated, and although the English rates are always said to be very

low by people comparing with the United States, there was just as much dissatisfaction there, and far more, in fact, than there has ever been over here.

The competition in London will not be on equal terms. The Post Office possesses statutory powers to run its wires, which the company does not possess. It can afford postal facilities to its subscribers, and deny them to the company's subscribers, and it takes 10 per cent of its rival's receipts. Under the same conditions, as already mentioned, the private company has in several cases outstripped the Government in its previous efforts to compete, and according to announcements made by officers of the company at a recent annual meeting it seems to be going forward cheerfully. So there is to be an interesting telephone war in London. There will be a waste of capital and great public inconvenience, but the final outcome no one can now foresee. These statements Mr. Bethell based on the various committee reports referred to, and on data taken from a recent communication to the London *Times*, and other expressions of unbiased opinion in the public prints.

Considering its handicaps, Mr. Bethell thought the development in Great Britain very creditable and generally speaking, far in excess of that attained on the continent under government or municipal ownership. On Jan. 1, 1901, London, with a population of 5,633,000, had 41,111 telephones; that is, 7 per 1000; New York, with a population of 2,050,000, had 54,647; per 1000, 26. Among European cities of its class, London's development is exceeded only by that of Berlin, and there they saw how the rate policy of the Government had developed the business at the expense of other imperial revenues. The rates, generally speaking, in England are flat. The Parliamentary committee in 1898 reported in favor of message rates. The London rates are: Direct line, business, $100; residence, $60 a year, with discounts for long-term contracts. In making a comparison between London and New York one must use the rates under one year contracts in both places. The payments are required annually in advance in London; in New York monthly in advance. The National Company carries a large fund as rentals paid in advance; its statement at the close of last year showed $3,840,000 in the fund. The amount for London was not stated. Doubtless it was a considerable sum. The London *average rate* is, conservatively, a figure approximating $72. The average rate in New York is $85. The difference in the cost of rendering the service in the one item of wages, the New York wages exceeding London's on an average by 100 per cent, is more than enough to account for the difference between these average rates. Comparing what the average subscriber gets in the two cases, one might suppose that where there is a flat rate—an unlimited user—the average subscriber would get more service than where the message rate is applied; that, therefore, in London for $72 the average man gets more than he does in New York for $85. Unquestionably, imposing a charge on each message reduces the number of messages sent. That is human nature, but in the main it is the frivolous conversations that are eliminated—the office-boy's discussions of last night's episodes and the making of his appointments for to-morrow, and the like. Still some proper traffic is suppressed, because of the message rate, just as the consumption of water, gas or electricity is curtailed by the placing of meters. As between two places, one restricted and the other not, the restriction in the one place may be offset by a superiority in the scope and efficiency of its service. In New York, for instance, most important transactions of all sorts are carried on by telephone without any hesitation whatever. The service is so permanent, reliable and quick that it is very generally relied on. The London service is not so generally relied on, because of its inferiority due largely to the municipality's refusal to permit the company to put in such a plant as is absolutely necessary to render efficient service, and also because their system is smaller than that in New York, where there are 26 and in London only 7 telephones per 1000 of population. The number of talks per station is just as great in New York as in London, notwithstanding that in New York they charge for each talk, while in London the charge is the same whether the talks are many or few.

On the question of wages Mr. Forbes, president of the National Telephone Company, of England, testified before the select committee of the House of Commons, in 1895, that the wages of the company's operators varied from 5 shillings (for under studies) up to 17 shillings per week; lady superintendents, about 2 guineas per week; wiremen, 6 shillings a day. The testimony taken at the Glasgow inquiry in 1897 showed the average pay per week for the National Telephone Company's operators in that city to be 9s. 4d. The London wages may have been increased since 1895, but considering the ruling rates then and now for all classes of labor in London, it is safe to say that the increase, if any, cannot have been great. These rates of pay with a reasonable allowance for increases compared with those already mentioned for New York show that the statement that New York wages average double those in London is very conservative. Considering the extent to which labor enters into the service, and the difference in wages, as well as the differences in rents, transportation costs, etc., there should be a greater difference perhaps between the New York and London rates in favor of New York, but in fairness, London is entitled to a consideration of the facts that it pays a royalty of 10 per cent to the Government, and that the cost of the service is largely increased by the obstructive policy of the municipal government. Much that in New York they were enabled out of earnings to pay to labor in the way of wages goes in London to the government in the way of royalties, or was wasted through municipal interference.

DENMARK, SWEDEN AND NORWAY.

Turning to Sweden and Norway, Mr. Bethell said that in the Scandinavian cities they had a demonstration of what can be accomplished even on European soil by private enterprise, nothwithstanding the embarrassments of governmental and municipal interference and opposition. The situation in these cities has been greatly misunderstood by those who have not studied it very carefully. Speaking first of Copenhagen, the industry there is conducted by a private company. Copenhagen is one of the best telephoned cities in Europe. Its population is 312,859. At the beginning of this year there were 15,311 telephones, or 49 per 1000. San Francisco, with a population of 342,782, had at the same time 21,324 telephones, or 62 per 1000. The Copenhagen rates are: At residences, $27; at business places, from $32.40 to $48.60 per year; message rates, $13 per year up. Wages are exceedingly small. Skilled operators are paid from $2 to a little over $3 per week; linemen, etc., about $5.70 per week.

Until recently the lines were overhead and the system was worked on the single wire plan, but fair progress has been made in substituting metallic circuits underground. The central office equipment is somewhat out of date, but a new building and new equipments are being provided. Notwithstanding these excellent conditions obtained under private ownership, the Danish Government in 1898 assumed control of the business. It, however, issued a license to the company that had built up the business, for 20 years, reserving a power of general control and of fixing the rates every five years. In 1899 the Government fixed the rates already mentioned, which are slightly lower than those which obtained prior to that time. On the other hand, the Government relieved the company of various burdens previously borne, in the way of rights of way charges, etc., gave it protection from users of high tension electric currents, and in other ways bestowed upon it advantages that usually accrue to a European state.

By comparing these facts with those stated as to other European places, it was seen that the best conditions thus far commented on exist at Copenhagen, where until very recently the industry was left to private enterprise with but little interference. Moreover, considering the relative purchasing power of money, in the cities of even rank in this country and in Copenhagen, the rates in the Danish city are relatively as high as those in the American cities.

In Sweden the Government has no monopoly by law of either telegraphs or telephones, but has the advantage of an exclusive right of way for telegraph and telephone lines over the State's highways, and on crown property. Except in Stockholm, the industry is now conducted by the State exclusively. Stockholm has the largest development among cities of its class (of from 200,000 to 500,000 population) in Europe or America, except possibly San Francisco. In presenting American figures for cities having two systems in operation, Mr. Bethell used only the figures for one system, believing that any other figures—which would necessarily be duplicated to a large extent—would be unfair and misleading. He did the same in presenting the figures for Stockholm. On Jan. 1, 1901, with a population of 320,000 the private company operating there had 22,000 telephones, or over 69 per 1000. San Francisco has been making such rapid strides that now it is perhaps ahead of Stockholm. But at the first of the year Stockholm was in the lead.

In Stockholm there is a public system and a private system, which have been in active competition since 1890. The business is chiefly in the hands of the private company, its stations numbering at least two to the state's one. Usually the development in Stockholm is attributed to the Government, and generally popular writers, by ignor-

ing the existence of the private company and by referring only to the State, lead the public far from the truth. On visiting Stockholm one is impressed by the beauty of the city, the substantial character of its buildings, the activity of its people, and, above all, by the cheapness of things. On this matter of cheapness, Mr. Bethell quoted at some length the present American Minister at Stockholm, Mr. W. W. Thomas, who has spent the greater part of 40 years in Sweden representing our Government in various capacities, and has written a book on Sweden and the Swedes.

In the telephone company's service skilled operators are paid from $1.95 to $2.92 per week; linemen and mechanics, about $6, and foremen about $8.50 per week. The company has in its entire territory in and around Stockholm 27,247 stations, and 573 employes, i. e., one employe for 47 stations. In New York the figures work out one employe for 17 stations. These figures are very significant.

In view of various facts presented showing the conditions of living and the cheapness of things in general, one should expect under normal conditions to find telephone rates that to us would appear to be very low. But the conditions are not normal. The bitter competition between the private company and the Government has created conditions which make it quite unsafe to take any rates that we may find in Stockholm as a criterion of what should be expected elsewhere even were it possible to make due allowances for any differences that might affect the relative costs of rendering the service. On this point Mr. Bethell quoted from the official report of the director of the municipal telephone industry at Amsterdam, made in September, 1898, after a thorough investigation of the subject on the ground, and from documents before a select committee of the House of Commons, showing that the Stockholm rates were too low even for cheap Sweden.

STOCKHOLM.

There are now 7000 or more subscribers who are required to take both telephones, and the number of intercommunications amounted last year, according to the Allmanna Co.'s report, to 1,099,837. The combined rates and the extra charges, to say nothing of the great annoyance and vexation incident to the duplication of instruments, to a very large percentage of telephone users in Stockholm amount to a very considerable sum. The rates therefore under these conditions are not at all what at first glance they seem to be. Under competition, therefore, Mr. Bethell contended, as seen in this Stockholm case, there is a waste of capital and energy, the public is annoyed, in many cases overcharged, and, in a way, badly served because of a fight in which it has no interest. Thus far the company has had the best of the fight so far as victory may be measured by the amount of public patronage, having now, as already stated, about twice as many stations as the Government. According to the various data quoted by Mr. Bethell, while the Allmanna rate ranged from $27 to $10, yet in order to get full and effective service, the subscriber had absolutely to connect themselves with both the "Rikstelefon" and the Allmanna Company, and then pay at least $40.50 per year, with a minimum of $27 as entrance fee. Further, every call interchanged between the two systems cost the subscriber 2.7 cents.

GENERAL CONCLUSIONS.

Summing up this part of his evidence, Mr. Bethell said: "I have now gone over the whole of Europe touching upon the conditions in every country where there is any development worth noting. I have dealt only with the conditions that are most favorable to Europe, ignoring places where there is practically no development. Were these taken into account, American pre-eminence would only be made more prominent. We have observed that the poorest conditions obtain under Government and municipal ownership; that better conditions obtain under private ownership with Government control, and that the best conditions obtain under private ownership where there is the least Government and municipal interference. In not one of the cases where there is Govrnment or municipal ownership have we found in combination adequate facilities, efficient service, reasonable rates, and a self-sustaining system. Of cities having a population of 200,000 or more in America there are 20, in Europe 44. In the American group there were at the first of this year 21 telephones per 1000 of population; in the European group 13; almost two to one in favor of the American group. Among cities of 1,000,000 or more, New York stands at the top with twice as many telephones per capita as any city in its class except Berlin, and it is far ahead of Berlin. Among cities from 500,000 to 1,000,000 Boston stands at the top, with more than twice as many as any European city except Hamburg, and almost twice as many as Hamburg. It will be remembered that at Berlin and Hamburg the growth has been accelerated by means that have stifled growth in other parts of Germany, or that have been a charge upon other than telephone revenues. Among cities from 200,000 to 500,000 Stockholm stands at the top, but in a fair comparison, San Francisco is unquestionably entitled to the honor. In the smaller European cities and towns the development becomes insignificant when compared to that in American cities and towns of equal rank. President Hadley has said: 'There is one respect in which England and America are like one another, but sharply different from France, Germany or other European countries. It is in the way in which people in general are disposed to regard governmental interference. The English and American maxim is that whatever can be done without government should be thus done. The continental principle is that whatever can be done by government should be. It has become a commonplace saying that our Anglo-American idea of liberty is not developed in continental Europe. When a Frenchman speaks of liberty, it is not so much freedom from interference with his own movements that he seeks as the right and power to interfere with other people's movements. What he really wants is political power. A party may call itself Liberal or Republican, but when it gets into power it governs about as strictly as its predecessor. Sometimes there is a monarchy, sometimes a democracy, but there is always a bureaucracy—a government by office-holders.' England seems to have forgotten the maxim temporarily. But loss of trade and lack of progress will cause her to recall it in due time. Already there is a strong movement in that direction. Recognizing this difference in the popular idea of liberty, and observing that the telephone development in the United States under private enterprise is far ahead of that in Europe under government and municipal ownership, we may safely conclude that the best possible results will be obtained in this country by leaving the industry to private enterprise."

Detailed Figures of Foreign Trade.

The detailed figures of the foreign commerce of the United States in the year ended June 30, 1901, were completed by the Treasury Bureau of Statistics last week. They show total imports, $822,673,016; total exports, $1,487,755,557; exports of domestic products, $1,460,453,809.

The exports of domestic merchandise by great classes were as follows:

	1900.	1901.
Products of agriculture..	$835,858,123	$944,059,568
Products of manufacture.	433,851,756	410,509,173
Products of mining.....	37,843,742	39,267,647
Products of the forest....	52,218,112	54,312,830
Products of the fisheries..	6,326,620	7,743,313
Miscellaneous	4,665,218	4,561,278

Each of these great classes, except manufactures, shows a marked increase over last year. The apparent decrease in manufactures, which amounts to $23,342,583, is due chiefly to the absence of figures showing exports to Hawaii and Porto Rico, which are estimated at about $25,000,000 for the year, and largely consisted of manufactures.

In two important articles of manufacture, however, the exports of 1901 fall below those of 1900. The total exports of copper in 1901 were 252,769,328 lbs., valued at $41,260,376, against 333,340,725 lbs., valued at $55,772,166, in 1900. This decrease was chiefly due to a reduction in demand for copper in Europe.

The principal increases in exports are: To the United Kingdom, $97,000,000; British North America, $10,000,000; British Africa, $5,000,000; Germany, $3,724,363; Mexico, $1,500,389; Chile, $2,007,161; Peru, $1,464,459; Porto Rico, $2,601,025, and the Philippine Islands, $1,388, 615.

By far the largest increase was to the United Kingdom, to which the exports were $631,268,263 in 1901, against $533,819,535 in 1900, the total increase being nearly $100,000,000, of which over $50,000,000 was in cotton, about $15,000,000 in breadstuffs, and about $10,000,000 in provisions. The total exports to British territory were valued at $819,551,392, or 55.8 per cent of the total exports of the year.

The total imports of the year were $27,268,168 less than those of 1900 and $22,243,180 less than those of 1891, 10 years earlier. The total exports were $93,972,475 in excess of those of 1900, and $603,274,747 in excess of those of 1891, 10 years earlier. The excess of exports over imports was $120,540,643 greater than that of 1900 and $625,517,927 greater than that of 1891.

The Electric Elevator in the Washington Monument.

By C. M. Lewis.

THE tall white shaft, the "Sentinel of the Potomac," is again in commission, after having been closed several months for the removal of the old and obsolete steam-driven elevator and the installation of an electric elevator. Once more patriotic Americans can ascend the shaft and look out over the city, the hills of Maryland and Virginia, as 2,000,000 others have done since the monument was first opened to the public. The contract for the power plant, the motor and elevator machinery and car, was not let until spirited bidding had been indulged in, and the electrical engineers representing the interests of the Government were fully satisfied that the electric light and power plant, and elevator would meet the exacting conditions imposed.

Before taking up the description of the elevator machinery a brief description of the very excellent light and power plant is in order. The monument stands in the center of a circle about 1500 ft. in diameter, and a drive surrounds it, with other drives and walks leading from the driveway to the foot of the shaft. A few feet beyond this circular roadway, to the west of the Monument, was a small power house that formerly supplied steam to the engine in the underground engine-room on the west of the base of the shaft. This little stone building was enlarged to meet the requirements for properly housing the electric light and power plant. The boilers being already in place it was only necessary to install the engine and generator and switchboard and run the copper cables to the motor and light switchboards at the Monument. The enlarged power house has room for another generator similar to the one installed, which is an engine type, girder frame, 240-volt direct-current generator of the Crocker-Wheeler Company, which has a normal capacity of 50 kilowatts at 275 r. p. m. It is, as shown, directly connected to a duplex compound engine, built by the American Engine Company.

This engine is of the marine tandem type, in which the high-pressure cylinder is superimposed over the low-pressure cylinder. The results claimed are greater economy of floor space and a neater and more attractive looking engine. The cylinder dimensions are 9½ and 15 by 11. While the city water mains have been tapped by a 1600-ft. supply main, leading to the power house, the engines work non-condensing at 75 lbs. ihp. The builders guaranteed the efficiency of 27 lbs. of steam per ihp. per hour. In the sub-cellar there was built of concrete a very solid and substantial pier, 11½ ft. high, on

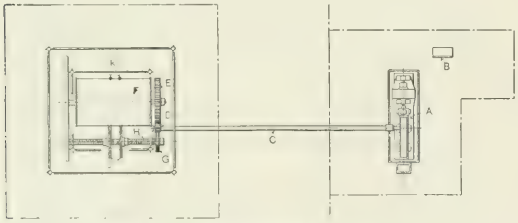


FIG. 1.—OUTLINE PLAN OF PLANT.

which the engine and generator were set. From the generator to the switchboard the current is carried by rubber-covered leaded cables in iron conduits. The cables are of 300,000 cm. area, and are suspended from the floor beams of the engine-room. The steam pipes leading from the boilers to the engine are of wrought iron, with steel flanges, and are neatly encased in magnesia covering. The switchboard consists of two panels of 2-inch pink Tennessee marble, 5 ft by 2½ ft., mounted on miniature monuments of the same material, with an additional frame of angle iron. These little highly polished monuments, it is said, are made on an exact reduced scale of the Washington Monument. There is a space 2 ft. wide between the back of the switchboard and the wall. The generator panel is equipped with Weston copper finished round pattern ammeter and voltmeter, 300-ampere Cutter I. T. E. circuit breaker; single-pole, double-throw field regulator, and a 300-ampere double-pole, double-throw switch, arranged to take current from city service in case of necessity. On the feeder panels are four 150-ampere double-pole, single-throw switches, and a Thomson recording wattmeter. Provision has been made on the switchboard panels for installing hereafter three more Thomson recording wattmeters. The conducting cables from the power and light switchboard to the motor and light switchboards at the monument were placed in position by the Government. These two separate circuits are lead through the old brick line steam pipe tunnel from the power house to the monument. The 250,000 cm and 100,000 cm lead and rubber-covered cables, the former for power and the latter for lighting, are suspended from the sides of the tunnel on Fletcher porcelain iron-banded insulator cleats, secured to 2-inch by 4-inch battens of Georgia pine. About 500 persons visit the monument each week day, and perhaps 100 of them on an average climb the long stairway. The tremendous advantages of the new system over the old may be briefly summed up as follows: With the same boilers there is now a greater power actually available, with the saving of nearly three-quarters of a ton of coal per day. The elevator now makes the trip in five minutes against ten by the old method, and at the same time carries a larger load. The change from steam to electric power has not made it necessary to increase the number of monument employes.

The new electric elevator plant which was installed by the Marine Engine & Machine Company, replaces the original steam ele-

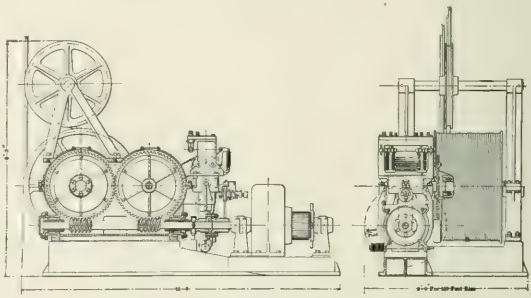


FIG. 2.—SIDE AND END ELEVATIONS OF ELEVATOR.

vator installed by Otis Brothers & Co., at the time the Monument was built to its present height of 555 ft. The old steam elevator had performed its daily work for 15 years without a single accident or any material repairs, and all its parts were in excellent condition when removed. It was a model of elevator engineering in its day, but its slow speed of about 50 ft. per minute and the great loss of transmission of the steam power to the hoisting engine from the boilers 800 ft. distant, impelled the Government to substitute a modern electric plant, which would increase the car speed as well as the efficiency of the whole plant from the coal pile to the actual work done at the car. The original elevator car with its safety devices, etc., weighed 6500 lbs., and when loaded to its normal capacity of 6000 lbs., the net load on the hoisting drum was 12,500 lbs.

The specifications issued by the government engineers for the new electric elevator called for the introduction of a counterweight system to overbalance the effect on the hoisting drum, of the car and a part of its load. The weight of the new car, together with its safety device, cage, etc., is 5670 lbs., and the weight of the drum counterbalance installed is 8040 lbs., leaving a net overbalance on the hoisting drum of 2370 lbs. when the car is empty. With the maximum load of 6000 lbs. in the car, the net load on the hoisting drum to be lifted by the machine is therefore 3630 lbs. at 100 f. p. m., equivalent to 11 horse-power in gravity work as compared with 18.9 horse-power in gravity work for the old car. The net result of the two systems compared is the same live load lifted by the new elevator at double the car speed, with 58 per cent of the energy required at the hoisting drum that was required by the old elevator to lift the same live load, viz., 6000 lbs. at 50 f. p. m., one-half of the speed of the new elevator. The consequent saving in power, together with the increased efficiency of the electric over the steam hoisting machine, enabled the government engineers to double the speed of the elevator with the same load and have power to spare to light the Monument and grounds.

The hoisting machine drives the 72-inch winding drum through the medium of a 6-inch pinion shaft about 30 ft. long, extending through a tunnel under the base of the Monument to the old engine-room. On the Monument end of this shaft there are two pinions of 13 teeth, 3-inch circular pitch by 7-inch face each, teeth staggered. These pinions mesh into similar gears that are bolted to one end of the winding drum and have 75 teeth.

An outline plan is shown of the location of the hoisting machine at the base of the Monument, in which *A* is the hoisting machine, *B* the control, *C* the 6-inch shaft, one end of which is coupled direct to one of the spiral gears and carries on the other end pinion *D* that drives the spur gear *E* that is bolted to the drum *F*. The pinion *D* also drives the spur gear *G* that is keyed to the idler screw shaft *H*. On this shaft are carried the idler sheaves *J*. These sheaves revolve on right and left-hand nuts, respectively. These nuts are held from turning by guide bars that are guided on a T-rail below the screw. The sheaves are, therefore, forced apart and drawn together as the spur gear *G* is driven in one direction or another by the pinion *D*. The drum *F*, on which the two pairs of 1½-inch diameter ropes are wound, is grooved right hand on one-half and left hand on the other half, and the spur gear *G* and pitch of the screw *H* is designed to cause the idler sheaves *J* to travel so as to follow the lead of the ropes from the drum *F*. The ropes that pass under the sheaves *J* lead to the counterweight. The other pair of ropes *K* lead to the car.

The broken lines indicate the outline of the base of the Monument and the engine-room, the floor of the engine-room being about 12-ft. below the level of the base of the Monument and the shaft *C* passing through a tunnel between the engine-room and the hoisting drum. This arrangement was obviously necessary, as there was no room inside of the base of the Monument to place the hoisting machine. It had therefore to be located outside, as shown, so as not to disturb the foundation. The drum is 72 inches in diameter, 9 ft. long, and is grooved right and left for two 1½-inch ropes. All of this apparatus being in good condition and so located as to make it impracticable to remove and replace by any other mechanism, had to be retained and the new electric hoisting machine adapted to drive this drum at 5.3 r. p. m. to give a car speed of 100 f. p. m., which speed was considered by the government engineers to be as fast as the existing conditions at the Monument would permit.

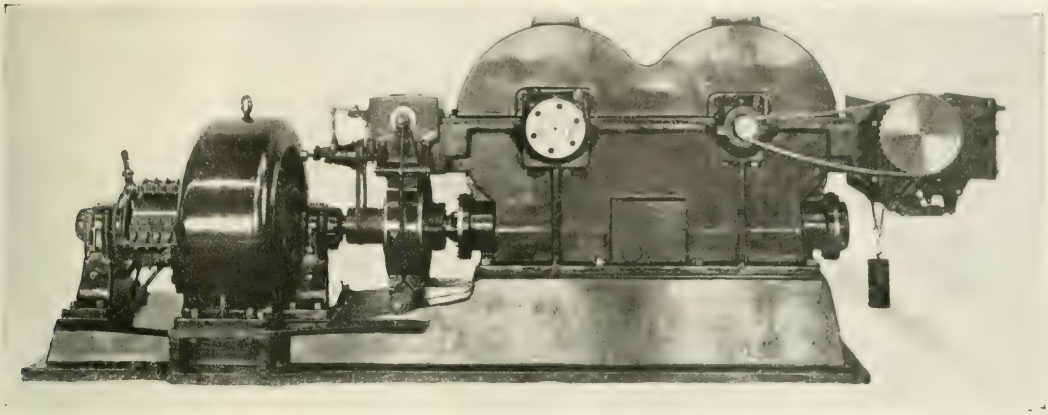
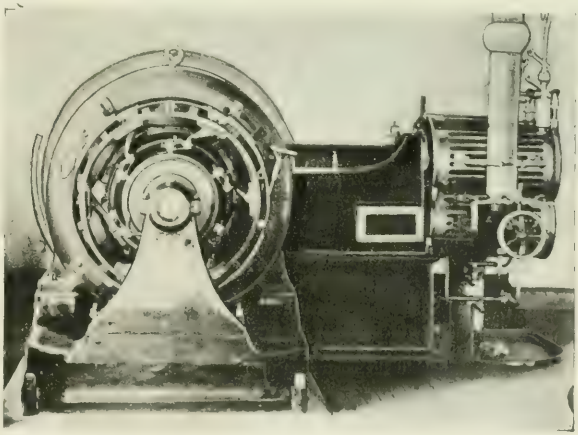


Fig. 3.—Motor and Elevator Mechanism.

The gear reduction of 13 to 75 teeth between the pinion shaft and winding drum, required the pinion shaft to run at 30.58 r. p. m., the pinion shaft to be driven by the new electric hoisting machine.

The Marine Engine & Machine Company were the only bidders who offered to couple this pinion shaft direct to their worm-gear shaft, all other bidders specifying additional spur gears for a further reduction to suit the requirements of their particular machines. The tandem spiral gears specified by this company were considered to be superior to the straight cut or to the combination of worm and spur gears.

The hoisting machine proper is of the tandem worm gear type with right and left hand worms, forged on the worm shaft, driving spiral gears which mesh together. The pitch of gears used in this particular machine and the absence of spur gears to connect the worm wheels, result in a machine of high efficiency. The worm shaft is direct connected to a 35-hp Crocker-Wheeler multipolar motor, having a special shunt field winding. The normal speed of the motor is



Figs. 4 and 5.—Views in Elevator and Engine Rooms.

628 r. p. m., which gives a car speed of 100 f. p. m. Field variation will, however, give speeds both above and below the normal if required.

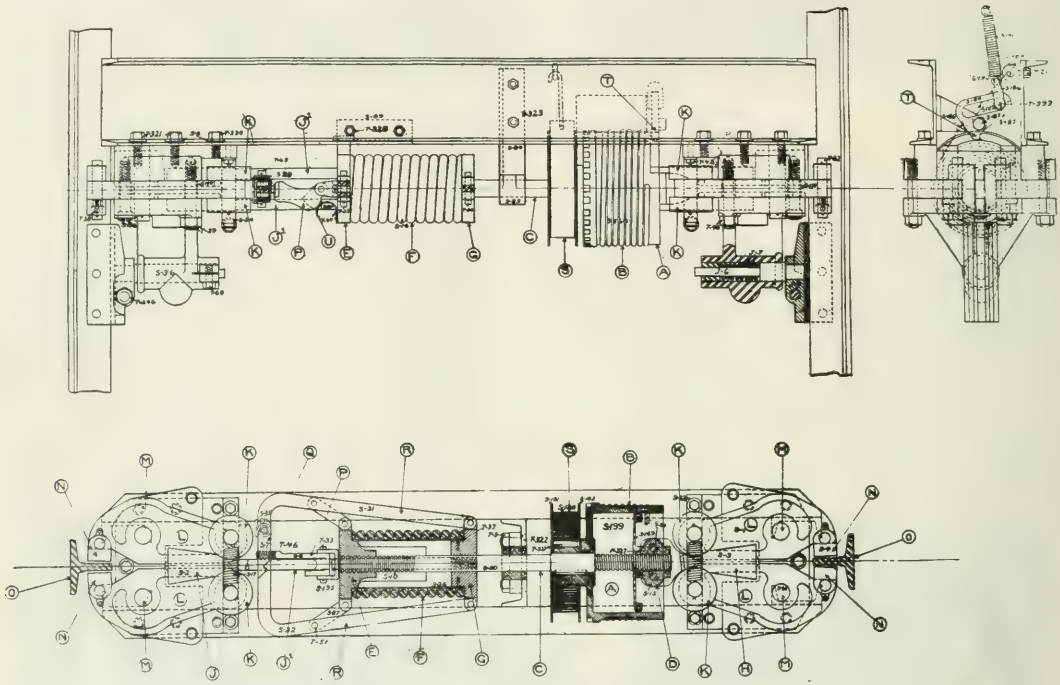
The brake consists of a pulley keyed on the worm shaft and two cast-steel brake levers holding wood shoes against the pulley. The brake is applied by a compression spring and released by an electromagnet. The upper and lower limit device is an improved type driven by the drum shaft, and utilizing the well-known "traveling nut" on a screw shaft to open the limit switches at both limits of car travel. The switches are returned to their normal positions by means of a weight instead of a spring. The centrifugal governor, driven by the worm shaft, operates at a determined speed, to cut off current supply to motor and apply brake.

The controller consists of three essential parts, viz., the two reversing switches shown on the lower panel and the resistance regulator on the upper panel. The panels are of Tennessee marble mounted on an angle iron frame.

The reversing switches are of the usual type, consisting of a solenoid core to which are attached the copper contact plates. The switches are closed by the core being drawn into the coil, and opened by gravity. Copper as well as carbon contacts of large carrying capacity are provided, all contacts being independently movable. All arcing takes place on carbon contacts, which "make" first and "break" last.

The resistance regulator consists of a contact arm traveling over the contact plates to which the resistance grids are connected. The contact arm is connected by means of the rack and gear to the core of the solenoid. At the right of the gear is a small electro-mechanical brake which will hold the contact arm in any position as long as desired. The coils of the regulator and brake magnet are connected in series when it is desired to raise the contact arm and "cut out" the resistance, thereby accelerating the motor. When it is desired to introduce the resistance into the motor circuit, the brake coil only is energized, releasing the brake and allowing the arm and core to return by gravity to the position of all resistance in circuit. By manipulation of the operator's switch the arm can be raised or lowered step by step as desired, giving variable car speeds from zero to maximum. Suitable switches, operated by the rack at both limits of travel, are provided to open the circuit of the regulator and brake coils and also to close the circuit to the "field relay" after all the starting resistance is cut out. This arrangement allows the operator to "weaken" the motor field, if he desires to increase the car speed, only under proper conditions. The "field relay" is shown in the upper left hand corner of the panel. The small relay shown in the upper right-hand corner works in conjunction with the reversing switches to introduce resistance in series with their respective coils after the switches are closed and also to automatically return the resistance regulator to its normal starting position.

The controller is also provided with an "under" and "overload" I. T. E. circuit breaker. The circuit of the underload coil runs to the elevator car where a suitable switch is provided for the operator to open this circuit if desired. This switch also opens the machine brake circuit. The operating device consists of a switch with suitable contacts for operating the reversing switches on the controller and to control the movements of the resistance regulator contact arm, and the field relay. A "slack cable switch" is also provided which operates to open the reversing switches and the I. T. E. circuit breaker, thereby stopping the motor. A switch, operated by the band brake on the winding drum and connected in series with the slack cable switch, will produce the same result at the controller, should the band brake be applied for any reason.



FIGS. 6, 7 AND 8.—DIAGRAM OF ELEVATOR "SAFETY," ETC.

The counterbalance weighs 8040 lbs. and is driven by two 1½-inch iron ropes attached to the opposite side of the drum from the hoisting ropes. The counterweight ropes lead up over a new sheave 58 inches in diameter, and thence down to and under the two traveling idler sheaves which lead the ropes to the under side of the drum. These idler sheaves are 49 inches in diameter each, and run on a threaded shaft 8¾ inches outside diameter, and 11 ft. 3½ inches between bearings. The thread is single, 13-16-inch pitch. The shaft is driven by a gear with 35 teeth, meshing into the drum pinion. The idlers revolve on a traveling nut, thereby following the exact lead of the ropes from the drum. The rope grooves on the drum had to be extended by hand cutting, to get a full turn for each counterweight rope. Counterweight ropes were not considered when the drum was originally designed, and there was just room enough to extend the grooves to the desired point. The idlers are of the largest diameter that could be installed in the space obtainable for them, and the cramped conditions existing about the winding drum, which is directly under the elevator hoistway, rendered the work of installing the necessary apparatus very difficult. New steel T-

rails and supports for them were installed, to guide the counterbalance which is 54 inches between rails and 15 ft. 6 inches over all.

The rope system is balanced by a chain counterbalance, weighing 3550 lbs., one end of the chain being attached to the car and the other to the counterweight. The effect of this load on the steel structure of the Monument had to be calculated and the supporting beams for the new counterweight sheave arranged in such a manner that the load would be distributed to the best advantage. The designs submitted by the M. E. & M. Co. were considered to present the most satisfactory solution of the problem, and the work was installed, as shown on the proposed layout submitted with their bid.

The car frame and platform is of standard corner post steel construction, with a platform 8 ft. 2 inches by 9 ft. 4 inches. The car enclosure is of ornamental grill work, finished in electro-bronze and lighted by a 6-light electrolier. The safety device was required to operate on smooth steel rails, which made it necessary to remove the cast-iron racks used in connection with the old safety device, and to install in their place standard steel T-rails. Views are shown in diagram of the safety furnished by the Marine Engine & Machine Company. Attached to the steel channels underneath the elevator car, the jaws *N* in the plan are shown set clear of the steel T guide rails. These jaws are pivoted to the outer ends of the two pairs of jaw levers *L*, which are pivoted on pins *M*. On the inner end of each of these jaws are a pair of rolls *K*, and between each pair of rolls are a pair of wedges *H* and *J*. The pair of wedges *H*, at the right hand of the safety, are bolted to a bronze nut *D* mounted on the screw shaft *C*. The wedge *J* at the left of the safety form the ends of rods *J l* that passes through the bronze nut *E* at the left hand end of the screw shaft *C* and are tapped into the spring head *G* at the right-hand end of the main spring *F*. Power to draw these two pairs of wedges together force the rolls apart and force the jaws against the guide rails, is applied as follows:

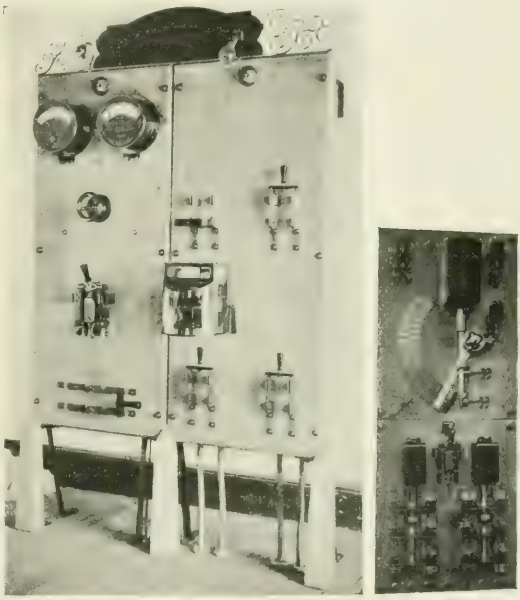
The centrifugal governor is located at the top of the hoistway, an endless wire rope passes over its driving sheave, down under a tension sheave at the bottom of the hoistway, and a branch wire rope *B* spliced into it leads to the drum *A* that is shown fastened to the screw shaft *C*.

The action of the safety is as follows: The centrifugal governor operating instantly the normal speed is exceeded, grips the endless rope and stops it, the continued travel of the car causes the drum *A* on the safety screw *C* to revolve, as the outer end of the rope *B* that is wound around it and fastened to the endless governor rope is now stopped. The safety screw *C* has now commenced to revolve, and its action upon the wedges through the medium of the main spring *F* is much more simple and effective in its operation than can well be described briefly. This screw *C* has a right-hand thread on its right-hand end, and a left-hand thread on its left-hand end, thus drawing the two nuts *E* and *D* together as it is revolved in the proper direction to do so. As it advances through the left-hand nut *E* it forces a push bar *P* against a latch *Q* that locks the toggles *R* together that hold the main spring *F* compressed. Upon the release of this latch *Q* the main spring *F* extends, forcing the left-hand pair of wedges *J* that are secured to the right-hand spring head *G*, towards the right, and forcing the right-hand wedges *H* that are secured to the left-hand spring head *E* by means of the right-hand nut *D*, screw *C*, and left-hand nut *E*, towards the left. In other words, this main spring *F* being unlatched, extends and draws the two pairs of wedges together, thus bringing the jaws *N* instantly in contact with the T guide rails *O*, with sufficient pressure to check the speed of, but not enough to stop the car. All this occurs before the car has traveled one foot after its normal speed has been exceeded. The further motion of the car continues to revolve the drum *A* and screw *C*, and draw the right and left-hand nuts together, and now occurs the action that is altogether novel in elevator safeties. The jaws *N* have instantly gripped the rails *O* as in all spring safeties, and the main spring *F* is extended to its weakest working length, the continued revolutions of the screw *C* now drawing the two nuts together compress the main spring *F* until sufficient pressure is applied to the rails to stop the car, thus bringing the lightest or the heaviest load to a perfectly gradual and easy stop, and with practically unlimited power.

Should there be any doubt as to the reliability of the main spring *F* this safety would operate without its action, as other types of safeties do, by transmitting the action of the screw *C* positively to the wedges by means of the steel tube that is inside of the main spring *F*, and acts as a stop or distance piece between the two spring heads. The release of this safety is effected simply by pulling on the governor rope from any part of the hoistway or from the car, and the flat spiral spring *S* winds up the screw *C* and automatically relatches all working parts, ready for the next operation.

The object of this safety is to overcome what are regarded as radical faults in other types of elevator car safeties. In this safety, the spring used checks the speed of the car instantly, and finally stops the car by being gradually compressed up to the point of its maximum resistance, stopping all loads at any speed with practically unlimited power and perfect safety and comfort to the passengers. This safety can be operated from the car by a simple device that grips that part of the endless governor rope that travels in the opposite direction to the car. It can also be made to stop the car when going either up or down, is so desired.

Notwithstanding the engineering difficulties experienced in surveying the plant, designing the apparatus, estimating the friction losses in the old drum gears, shafts, sheaves and ropes and the danger attending the installation of the work, the plant was completed without an accident or error. The guaranteed efficiency of the whole elevator system was 40 per cent at maximum load, 6000 lbs. at 100 f. p. m. The test made by the government engineers under the above conditions showed an efficiency of 41.09 per cent from the electrical energy delivered to the controller, to the actual work done at the car in lifting the load. In consideration of the friction losses in the heavy spur gearing at the drum, the long 6-inch pinoin shaft, the two 48-inch idler sheaves mounted on an 8¾-inch screw shaft



FIGS. 9 AND 10.—SWITCHBOARD AND ELEVATOR SWITCHES, ETC.

driven by the drum gears, and the loss due to driving two pairs of 1½ inches in diameter iron ropes over their idler and overhead sheaves, this efficiency of 41.09 per cent is high as compared with ordinary electric elevator installations. The efficiency of the elevator system as a whole is no doubt due to the high efficiency of the spiral worm gears in the hoisting machine which have the usually steep angle of 15½ degs.

The entire work at the Monument, including the new power plant, was installed under the direction of Colonel Theodore A. Bingham, Corps of Engineers, U. S. A., who represented the Government. The design of the elevator system as installed by the Marine Engine & Machine Company is the work of Mr. Charles R. Pratt, mechanical engineer of the company, and Mr. B. N. Jones, who designed the controlling system. Mr. Jones was charged with the supervision of the construction work, and he was ably assisted by Mr. C. H. Plunkett, constructing engineer in charge of the installation work for the company.

Regulations for the First Long Distance International Automobile Test in America.

We give below, as of more than usual interest and in response to many inquiries, the rules and regulations of the Automobile Club of America for the 500-mile, New York-Buffalo endurance test, to occur during the week of Sept. 9-15. A cable message received by the club on July 30 announces the entry of the famous French automobilists, Charron, with a Panhard, and Fournier, with a Mors. It will be remembered that Fournier has just won the great Paris-Berlin race:

The Automobile Club of America, recognizing the growing interest of the general public in the new industry, and desiring to promote and encourage this interest, has decided to hold a 500-mile endurance contest during the week beginning Monday morning, Sept. 9, 1901, which contest will consist of a run starting from the clubhouse, Fifth Avenue and Fifty-eighth Street, in the city of New York, and terminating at the city of Buffalo, Saturday afternoon, Sept. 15.

The route will be over roads good, bad and indifferent, representing on the whole, however, about the average condition of the country roads in the United States.

In this connection it is particularly desired to emphasize two facts: First, that this is not to be considered a speed contest; second, that it is to be an endurance contest. The principal thought of the club is to afford opportunity for the various types of motor carriages to demonstrate their reliability and enduring qualities in a practical road contest.

The undersigned committee has been charged with the duty of supervising this contest and of preparing rules and regulations governing the same, a general summary of which is herewith given.

RULES AND REGULATIONS.

1. It will be assumed that every contestant is acquainted with the rules of the contest, and by entering therein he agrees to abide by said rules. In the event of dispute concerning the interpretation of the rules, the decision of the contest committee shall be final. The committee reserves the right to alter or amend these rules from time to time as it may deem expedient.

2. The contest shall be open to all classes of self-propelled vehicles made in the United States or abroad, but no manufacturer, agent or private owner shall be allowed to enter more than three vehicles in any one class. Application blanks will be forwarded by the secretary of the club upon request.

3. *Entries.*—(a) The time for receiving entries will expire on Aug. 31, 1901. (b) All entries must be accompanied by the following information in full: Weight of the motor vehicle, including fuel, supplies and equipment; capacity of water and capacity of gasoline; number of miles, with the number of passengers, the vehicle is able to run on ordinary roads without any replenishing of fuel or water; maximum and minimum rate of speed for each vehicle; full name of manufacturer; place of manufacture; rated horse-power of the motor; number of cylinders, bore, length of stroke and normal speed of engine.

4. *Entrance Fees.*—(a) The entrance fee for all classes, motor cycles excepted, up to and including Aug. 15, 1901, shall be $50 for each vehicle; in the motor cycle class the entrance fee shall be $25 for each vehicle; after Aug. 15, 10 per cent will be added to the entrance fee for all classes. (b) The entrance fees shall be paid to the treasurer of the club at the time application for entry is made. (c) Any person making an entry agrees that in the event of the vehicle being disqualified or failing to take part in the contest, the entry fee shall be retained by the club. (d) The club shall have the right to refuse an entry without stating any reasons.

5. *Passengers.*—In classes A, B and C, each vehicle shall carry at least two persons; these may be changed and others substituted within the confines of any control, but if passengers be changed outside of control the vehicle shall be subject to disqualification.

6. *Starting of the Contest.*—All entries for the contest shall appear in person before the committee at the Automobile Club on Friday morning, Sept. 6, 1901, and after giving full information as required by Rule 3 (b), receiving their official number and being officially recorded, shall then go to a place designated by the committee and have their entry examined by the committee's representative, the carriage weighed and an official seal affixed thereto.

7. *Disqualification.*—(a) Disqualification shall mean that on notice being served on any vehicle, it shall cease to run in the contest and shall not receive a certificate of mention in the records. (b) A person on receiving notice of disqualification shall withdraw his vehicle and immediately remove the official number therefrom. (c) No notice of disqualification shall be served unless the person in charge of the vehicle has first been notified of the act which it is claimed should disqualify the vehicle. If the act be disputed, disqualification shall be postponed until the contest committee, at a meeting to which all concerned shall be invited, shall take evidence and render their decision. (d) The person so disqualified shall have no claim on the club of any kind or nature whatsoever.

8. *Protest.*—(a) Any contestant has the right of protest, but the committee may refuse to consider such protest. In the matter of protests, the contest committee or its official representative may interfere. (b) Any contestant entering a protest must do so in writing, and shall substantiate the grounds of his protest. The party protested against shall have the right of being heard in opposition. If the party protested against does not admit the accuracy of the protest, the matter shall be adjudicated by the contest committee. (c) All protests must be filed within 24 hours of the time of the commission of the act against which protest is made. (d) All parties making protests shall be required to make a deposit of $10, which shall be forfeited in the event of the protest not being sustained, the intention being to put a penalty on frivolous, immaterial or unsubstantiated protests which would consume unnecessarily the time of the committee.

9. *Class Letter and Number.*—(a) Each contesting vehicle must have securely attached to it in a conspicuous position on both front and rear, an official letter and number corresponding with the catalogue class and number. There shall be no other mark or sign on any vehicle other than the owner's initials and the manufacturer's usual name or number plate as affixed to a vehicle when sold to a customer. (b) Those having charge of vehicles will be held responsible for the plates being in conspicuous positions and clearly legible.

10. *Road Stewards.*—Stewards shall be appointed and located where it may be necessary to stop contestants or require them to drive at a limited speed, and the stewards shall see that the instructions are strictly followed.

11. *Road Regulations.* (a) All vehicles going in the same direction must pass other vehicles to the left in accordance with the rules of the road, and vehicles meeting each other must pass to the right. Vehicles must keep to the right of the center of the roadway, except when there are no approaching vehicles and the conditions are such that it is impracticable to travel on the right side of the highway. If for any reason it is necessary for vehicles to travel on the center or left side of the roadway such vehicles must cross to the right side, irrespective of the condition of the roads, as soon as signaled by an overtaking or an approaching vehicle. Vehicles must signal one another when approaching in either direction. (b) No vehicle shall be pushed or assisted by any one other than its occupants under penalty of disqualification, except that the penalty for a vehicle being towed in any period shall be disqualification for that period. (c) Contestants shall be responsible for any violation of law and for all civil and criminal penalties. (d) Contestants must comply with the traffic regulations of the local police. (e) If a contestant fails to stop his vehicle on request from the driver of a frightened horse, or in any manner shows himself inconsiderate of other users of the roadway, his vehicle shall be subject to disqualification. (f) Contestants shall inform themselves thoroughly in regard to the route and no allowance will be made for any mistakes they may make. (g) No contestant shall take any route other than that laid down in the official maps which will be furnished for each stage.

12. *Controls.*—(a) Controls are to be officially established at the beginning of each day's run, at lunching places and at the end of each day's run. The start is to be made each morning at 8 o'clock, and an hour and a half will be allowed for luncheon. Any contestant arriving at the noon control at 12 o'clock or after will be allowed but one hour for luncheon. He will be called one hour after the time of his arrival and his time will be counted from the time that he is called; but no vehicle will be allowed to leave the noon control before 1 o'clock. (b) The noon control will open at 11 a. m. and close at 3.40 p. m. (c) The night control will open at 4 p. m. and remain open until 9.20 p. m. (d) The time of arrival of each vehicle at the point of control shall be recorded by the officials at control on the record sheets, and also on the record book of those in charge of the vehicle. (e) The site of control shall be designated by a red flag with the word, prominently printed thereon in black, "Control." This flag shall be prominently displayed on both sides of the road at the point of control. There shall be notification by means of a green flag at 200

yards in advance of the control point as a warning of the approach to the control. (f) Controls are to be established in the following manner: If a green flag is displayed, the vehicle should slow down to a speed of not to exceed 8 miles per hour until a white flag is passed, when speed may be resumed as before; on coming to a red flag, the vehicle shall come to a full stop until the driver is permitted by the steward to proceed; at night, lanterns similarly colored may be used instead of flags. (g) Provision for shelter will be made at night. Vehicles may take on fuel and supplies at the noon control and at stopping places for the night, where supplies will be provided. Any vehicles requiring supplies at other points will be required to make their own arrangements for the same. (h) There shall be at each night's stopping place a storage enclosure or tent, in charge of a superintendent and assistants, for the storage of vehicles for the night. Watchmen will be on duty during the night. (i) Passes will be furnished to vehicles granting them admission to or exit from the official enclosure provided for the storage of vehicles at each night control.

13. *Hill-Climbing Contest.*—(a) Controls are also to be established on the hill-climbing contest near Little Falls, or any other place that may be chosen by the committee. (b) One-half mile from the base of the hill a yellow flag, with the letter "H" thereon in black, will be prominently displayed at each side of the road as a warning of approach to the hill. A short distance from the base of the hill a second set of flags will be placed. The vehicles will line up, in the order of their approach to the second flag, on the right side of the road, allowing 10 ft. space between vehicles. Each vehicle will be started at a given signal by the proper officials. (c) The time and manner of the performance on the hill will be officially recorded. Time will also be taken on reaching the summit of the hill. (d) This trial will be a separate contest. The time occupied from reaching the control at the base of the hill to leaving the control at the summit *will be deducted from the general running time.*

14. *Speed.*—(a) No credit for speed exceeding 15 miles an hour will be allowed. (b) Attention is called to the general State law covering speed, and all contestants will be required to conform thereto.

15. *Starts and Stops.*—(a) Vehicles will be started from the control the first morning at 8 o'clock, except in Class E, which may start earlier by arrangement. At the time of starting from each control, the vehicles shall approach the starting line and take their places one behind the other in the order of their approach to the starting line, leaving a space of at least 10 ft. between each vehicle. As each vehicle starts, the others shall move up one place. Any vehicle failing to keep its position in the line shall fall out and go to the foot. (b) Vehicles approaching control points shall follow the same rule as at starting points. (c) If it becomes necessary for a vehicle to stop, it must first be driven to the extreme right of the road as nearly as practicable.

16. *Certificates.*—(a) The committee shall post the results of each day's run as soon as practicable, and may furnish the same to the press. (b) Contestants shall not publish or communicate for publication any other times than those contained in the club certificate. (c) In the event of any subsequent alteration by the committee of the records on the certificates, owing to protest or other causes, the contestant will only publish the records as amended, on pain of disqualification. (d) The certificates will recognize no speeds in excess of 15 miles an hour, but will, for a vehicle, state as follows: Official No., Class, Maker, Entered by, Weight, Record for....day of ....1901, Number of passengers carried, Route, Distance, Average miles per hour.

17. *Stages.*—The total distance is to be divided into stages for each day on the basis of approximately 85 miles per day. Following are the stages with the approximate distance: First stage, from clubhouse to Poughkeepsie, 90 miles; second stage, from Poughkeepsie to Albany, 70 miles; third stage, from Albany to Little Falls (including a hill-climbing trial near Little Falls), 85 miles; fourth stage, from Little Falls to Syracuse, 85 miles; fifth stage, from Syracuse to Rochester, 90 miles; sixth stage, from Rochester to Buffalo, 80 miles; total distance, 500 miles.

18. *Basis of Classification.*—All vehicles, whether electric, steam, gasoline or otherwise, shall operate in the same class, which classification shall be on the basis of weight.

19. *Classification and Division.*—Vehicles shall be divided into the following classes: All four-wheeled vehicles to carry two or more persons. Three-wheeled vehicles carrying two passengers side by side and conforming in all other respects to four-wheeled vehicles, to be provided for by special arrangement in classes A or B.

Class A.—Under 1000 lbs. class; four-wheeled motor vehicles weighing 2000 lbs. or over, in commercial running and operating condition, with all tools, fuel and supplies on board.

Class B.—1000 to 2000-lb. class; four-wheeled motor vehicles weighing between 1000 and less than 2000 lbs., in commercial running and operating condition, with all tools, fuel and supplies on board.

Class C.—2000-lb. and over class; four-wheeled motor vehicles weighing 2000 lbs. or over, in commercial running and operating condition, with all tools, fuel and supplies on board.

Class D.—Motor cycle class; motor bicycles, motor tricycles and motor quadricycles.

20. *Conditions.*—The conditions of this endurance test shall be average speed for the six days, and any competitor falling below an average of 8 miles per hour (except in Class E) for any one period shall not receive any credit for that period.

21. *Awards.*—Certificates shall be awarded by the club as follows: First class certificate, average speed from 12 to 15 miles per hour; second class certificate, average speed from 10 to 12 miles per hour; third class certificate, average speed from 8 to 10 miles per hour.

22. *Public Delivery Vehicles* shall be classified as follows: *Class E.*—Light Delivery: Load not less than 500 lbs., exclusive of operators, fuel and water; 10 to 12 miles an hour for first class certificate; 8 to 10 miles an hour for second class certificate; 6 to 8 miles an hour for third class certificate. Heavy Delivery: Load to be not less than one-half rated capacity, minimum to be not less than 1500 pounds; 8 to 10 miles an hour for first class certificate; 6 to 8 miles an hour for second class certificate; 4 to 6 miles an hour for third class certificate. Trucks: Load to be not less than one-half rated capacity, minimum load to be not less than 3000 lbs.; 6½ to 8 miles per hour for first class certificate; 5 to 6½ miles per hour for second class certificate; 3½ to 5 miles per hour for third class certificate.

W. M. Power, *Chairman,*
W. E. Scarritt,
Harlan W. Whipple,
Committee on 500-Mile Contest.

S. M. Butler, *Secretary.*
753 Fifth Avenue, New York City.

Women as Automobilists in Europe.

It is noted that whatever else may be said of the great Paris-Berlin automobile contest, there is no doubt that it triumphantly demonstrated the skill and pluck of lady motorists, and at the same time convincingly proved that even a racing machine is a sufficiently docile and manageable monster to be safely guided and controlled over 750 miles by a feminine hand. Mme. du Gast was the heroine of the fast race, being the first competitor of her sex who ever entered in a contest of the kind. The Prince de Sagan traveled beside her in her blue car, called the Valkyrie, as her mechanician, but she alone drove throughout the journey. That she was by no means a tourist in disguise, but a racer in earnest, is shown by the place which she secured—nineteenth—and her time—21 hours. Her voyage was without incident, save for the inevitable punctures, and was rendered pleasant by the attentions of enthusiastic admirers.

In the tourists' section there were whole parties of ladies and families of children. Unfortunately, the car driven by Mme. Lockert and her two daughters broke down hopelessly somewhere near Gotha, so that its three venturesome occupants had to relinquish their journey. But many other ladies successfully reached Berlin. One chauffeur traveled alone with his wife, who was often to be seen on the road actively assisting him to remedy one or other of those breakdowns which must happen in the best-regulated motor cars. Another, who also was his own mechanician, used to be helped on similar occasions by his wife and their son, a boy of 10. Baron von Zuylen's party of six included ladies, while the Baroness traveled alone with her mechanician on the ill-fated Snail, which was finally smashed up by a careless servant, who was alone in the car at the time and escaped unhurt.

Electrical Draughtsmen.

It is announced that an examination of applicants for electrical draughtsmen will be held at the Brooklyn Navy Yard Aug. 7. The pay of the position is $4 per day. On the same date a similar examination will be held at the Boston Navy Yard.

Military Telephony in New York State.

At the recent encampment of the National Guard of the State of New York at the State Camp, Peekskill, during the annual practice shooting and competition of the batteries of the light field artillery the First Signal Corps had an opportunity of demonstrating an ac-

FIG. 1.—TELEPHONE STATION AND GUNS.

tion, the usefulness of the practical training it has received in the utilization of electricity in connection with military signaling. The information concerning the shooting was formerly transmitted by the agency of the old flag system, commonly known as the "wig-wag," and was found to work very slowly, requiring considerable time—more time than could be allowed for signaling to send the amount of information required. This year a telephone line three miles long was laid between the battery and the target. One telephone station was placed near the guns, as shown on Fig. 1, and the other at the end of the range near the target, where the effect of the

FIG. 2.—CROSSING A ROAD WITH TREE POLE SPLICE.

firing could be seen, by a man stationed at the telephone, who immediately reported the result. The line was a typical military one, being reeled off from the back of a wagon and thrown into the bushes by the roadside and only suspended in the air where it crossed public roads or in front of gateways. Fig. 2 illustrates the manner in which a small tree was thus spliced with a short pole for the purpose of raising the line high enough to be above the ordinary traffic of the road. The line was of the most temporary character, no effort being made with regard to permanency. The line was grounded at each end, and the insulation between the conductor and earth was very low. The line and the station was finished two hours from the time of commencing work, the whole operation being conducted as though in actual warfare, the conditions as a signaling problem being exactly similar.

The utility and success of the telephone when used in this way for military purposes depends on the rapidity of construction and perfection of instruments, which admits of no breakdown or delay. The instruments in this case were specially designed by a member of the corps to talk over a line in which the insulation between conductor and earth could be treated very nearly as a negligible quantity; and being well grounded at the end in case the circuit became interrupted, the induction telegraph which is a part of the instrument would have been brought into use. During the six days' practice the line worked perfectly, and conversation was carried on during the shooting at one time when the line had been accidentally broken. The First Signal Corps has been very successful in interesting its members in this important department of their work, everything it has undertaken in this line having been a success. Fig. 3 shows a group of its linemen who have mastered the laborious details of field construction, and are seen in the field ready and equipped for work. These men, it may be added, constituted a team which won the first military electrical trophy ever competed for, so

FIG. 3.—GROUP OF MILITARY LINEMEN ON DUTY.

far as is known, the trophy being one offered by the Military Athletic League in the tournament at Madison Square Garden.

A New Higher Tariff for Germany.

The German Government organ has just published a pamphlet of 167 pages giving a draft of the proposed new tariff, which raises many duties, some of which are quoted below: Section VIII. of the bill also provides that dutiable goods sent to Germany from countries treating German ships and German goods more unfavorably than those of other countries may be assessed at double the rates provided for under the bill, or to the full value of the goods, and that goods on the free list arriving from such countries may be assessed 50 per cent of their full value. Americans in business in Berlin regard the bill as exceedingly bad for both Germany and the United States, pointing out that the sharp agitation during the last few years against certain American products has borne fruit in the measure. They express keen disappointment at the heavy increase in the duties on machinery. The present duties, ranging from 2½ to 8 marks per hundredweight, are in many cases more than doubled. In the case of saws the duty is quadrupled. American woods are also hard hit.

The proposed duties may be quoted as follows:

Steam boilers, from 5 to 8 marks per hundredweight.

Aluminum, hammered or rolled, 12 marks; lead, rolled, 3; copper, wrought or rolled, 12; copper wire, 12 marks per hundredweight.

Steam engines, 3½ marks per hundredweight.

Machinery for wood, iron and stone working, from 20 marks on machines weighing 2½ hundredweight to 4 marks on machines weighing 10 tons. Steam thrashers and mowers, 9 marks per hundredweight.

Miscellaneous machinery, from 3 marks 50 pfennigs to 18 marks per hundredweight.

Dynamos and motors, from 9 marks per hundredweight on machines weighing 5 hundredweight or less to 6 marks on dynamos and motors weighing from 5 to 30 hundredweight.

Telephone and telegraph apparatus, 60 marks per hundredweight.

A special cable dispatch from Berlin of July 27 says: The *Post* interprets Paragraph VIII. as directed against the United States, and says: "It gives us the means to protect ourselves against the high-handed manner in which the United States interprets reciprocity. We are decidedly discriminated against under present conditions. We were weaponless against such treatment in tariff matters because Caprivi literally threw away the most favored nation treatment. This new tariff showed a determination to insure ourselves a place in the sun in tariff matters, and we expect German manufacturers to agree thereto, since many have suffered from the supercilious morality of Americans in tariff treatment."

The *National Zeitung* contends that the Government must be shown that its new tariff scheme is incompatible with the commercial and social interests of the country.

Vorwaerts says there is only one answer to the bill: "Down with it!"

The Boerse to-day took a pessimistic view of the bill, and a general fall in the prices of iron and coal shares resulted. The *Boerson Zeitung*, in its report, says: "The view prevails on all sides that the new bill will be full of danger for Germany's industry and trade."

With regard to the argument that Paragraph VIII. of the bill will be the best means of convincing foreign countries of the value of commercial treaties with Germany, the Liberal papers emphasize the fact that the bill comes at a time when German industries are already in the throes of the severest of crises, and say it can only cause new convulsions in industrial life. These papers express the fear that the United States will adopt reprisals upon German shipping, and point out that Germany's allies, Austria and Italy, must lose a large part of their German trade.

A. I. E. E. Meeting Place at Buffalo.

As has already been announced, the meeting place at the Pan-American Exposition of the American Institute of Electrical Engineers is to be the New York State Building. Through the courtesy

NEW YORK BUILDING, PAN-AMERICAN EXPOSITION.

of the State authorities and the energy of Professor G. F. Sever, the use of this handsome building has been secured, and a more handsome and comfortable place could not have been selected. A view is shown herewith of the building, which is to be a permanent edifice, and which has cost nearly $200,000. It is in design a Doric temple, exteriorly, and the material used is white marble. Within are the offices of the State Commission, and sundry rooms that answer admirably for gatherings such that of the Institute. At the close of the Exposition the structure is to be turned over to the Buffalo Historical Society, in whose care it will become a repository of relics and records connected with the development of the State and the region. It will be remembered that at the Paris Exposition last year, the meetings of the Institute were held in the United States national pavilion on the banks of the Seine.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY TESTS ON LINERS.—Tests in wireless telegraphy were made on Saturday last, July 27, in New York Harbor between the steamships Lucania, Cunard liner, and Kaiser Wilhelm der Grosse, of the North German Lloyd fleet. The former was leaving port for Liverpool. The tests were satisfactory until she had passed out of Quarantine, but after that the operators on the German liner failed to get the messages, which were received so faintly that they could not be deciphered.

NEW CHINESE CABLE LINES.—According to Consul Fowler at Che-Foo, a second cable has been laid between Che-Foo and Taku, connecting Peking with the world. This action was taken on account of the cable between these ports having been seriously interrupted. The nature of the damage is not stated by the Consul. He says he believes the Germans have had their lines from Shanghai and Tsin-Tau duplicated. There are now, says Mr. Fowler, three telegraph officers at Che-Foo—the Joint Cables, the German and the Chinese.

NEW ITALIAN SUBMARINE BOAT.—The Italian Navy Department, as a result of experiments last week, makes claim to possessing the finest submarine vessel in the world. The experiments, which were conducted at Spezzia, will have to be taken on trust, for only Italian naval officers were permitted to be present, and it is stated that the actual working crew of the submarine boat was composed for the occasion of men of commissioned rank in order better to guard the secrets. Engineer Albrizzi, however, stated that the submarine boat Delfino traversed at good speed under water the whole Bay of Spezzia, and launched a torpedo against the side of the armor-clad Verese, despite the fact that the latter had been warned to expect an attack. The Delfino is fitted with an apparatus invented by Albrizzi by which it is said the range of vision is extensive and photographs can be taken under water for a distance of 100 yards.

TROLLEY REPAIR STATIONS.—The Brooklyn Rapid Transit Company is about to put into operation a new scheme for quick repairs on its various lines. Most of the delays on the Brooklyn trolley roads are caused by either the breaking of a wire or accidents to the motors of the cars. Very often the repair wagons are a long time in reaching the scene of the accident because of the distance that must be traveled. The company now proposes to overcome this by establishing emergency stations, on the plan of the city's fire houses, in various parts of the borough. The buildings will be all of one general design, and will be built of brick, two stories in height. They will be completely equipped with all the latest appliances and appurtenances for the purposes for which they are intended, and will contain living apartments for the crews of repair men. Each crew will consist of five men. In each building the living apartments will be on the second floor. As in the fire houses, a brass sliding pole will be placed in each building to enable the men to descend quickly when a call comes in.

LONDON UNDERGROUND.—Last week we gave some details as to Mr. Yerkes' plans for the London Metropolitan and District underground roads. A dispatch from London of July 26 says: At a meeting of the stockholders of the Metropolitan Railway held this afternoon, the electric traction dispute was the principal topic of discussion. The action of the directors of the Metropolitan in opposing the proposals made by Charles T. Yerkes to fit the road with electricity was approved. The chairman of the meeting said that the expert electricians of both the Metropolitan District and Metropolitan Railways had approved the Ganz system of electric transit. The chairman said that his company was advised that the cost of the Ganz system would be from 30 to 40 per cent below that of the system advocated by Yerkes, and that when the Parliamentary Committee having the matter in charge had settled the question of a system, the Metropolitan Railway was ready to carry this system into effect. Mr. Yerkes and his associates offered to guarantee 3½ per cent on the ordinary stock, instead of the present lower rates; but the directors decided to issue fresh capital to make the installation themselves. "It is hardly fair to condemn us on account of our being an American syndicate," said Mr. Yerkes. "Americans do not condemn concerns in the United States because they happen to be British. I do not know a single great railroad in the United States which is not owned materially by Englishmen; and I think that fully one-third of the fire insurance in the United States is British."

MONO-RAIL IN ENGLAND.—The committee of the House of Commons to which the matter was referred has sanctioned the introduction of the mono-rail electric system between Liverpool and Manchester. As the Lords have already sanctioned the proposal the adoption of the scheme is practically certain.

THE MORSE TORPEDO BOAT.—A special dispatch from Paris of July 25 says: The newspapers are enthusiastic over the successful feat of the submarine torpedo boat Morse. Admiral Fournier ordered the Morse to proceed from Cherbourg to Havre and there torpedo the gunboat Cocyte. The Morse arrived at Havre after a run of 11 hours. Eight miles off the harbor she was submerged and fixed a torpedo to the gunboat without being discovered. She then returned to Cherbourg.

PNEUMATIC MAIL TUBES.—The directors of the Commercial Exchange, Philadelphia, have got up a petition signed by firms representing $200,000,000 capital and asking the President and Postmaster-General to restore the pneumatic tube service for that city. The document contains the indorsements from trust companies, banks, manufacturers, financiers, millionaires, capitalists, business men, merchants and influential property owners. There is an opportunity here for the adoption of electric methods.

ALASKAN CABLE.—With regard to the Kerite cable now being laid in Alaskan waters, a special dispatch of July 27 from Seattle, Wash., says: The party which is to lay the new cable between Juneau and Skagway will leave this city within the next two weeks. The work will be done by a cable manufacturing concern of New York City. The length of the new line is to be about 126 miles. A steamboat has been chartered and especially fitted up for the purpose, and is now on her way to this city from San Francisco.

MAXIM ON ELECTRIC TRACTION.—Sir Hiram Maxim, speaking in London on July 26 at a meeting of the Maxim Engineering Company, said that electric railways were revolutionizing American city life and property values, whereas Great Britain was deplorably behind in the matter of electric traction, which has spread out populations and mitigated some of the greatest evils of modern cities. Sir Hiram asserted that light electric roads were capable of 120 miles an hour; that their construction was perfectly practicable, and that their cost would be cheaper than that of the present steam lines.

NO FARE FOR SICK CHILDREN.—The St. Louis Transit Company issued a notice last week that caused favorable comment all over the city. The notices were put in each street car owned by the company. It read: "During this period of excessive heat and until further notice children 10 years of age or under, and one member of the family whose parents are unable to pay transportation will be permitted to ride free on Transit Company lines to Forest, O'Fallen, Tower Grove and Carondelet Parks on presentation to the conductor of a doctor's certificate certifying that in his judgment these would be benefited by an outing. This order in effect on and after July 24. St. Louis Transit Company." First Vice-President Corwin H. Spencer said on the subject: "In discussing the matter it was suggested that a physician's certificate might cost more than fare for the little ones. We do not believe, however, that any doctor would ask compensation in a case like this."

THE NEW YORK CENTRAL TUNNEL has been under investigation the past week, with a general consensus of testimony that the traffic ought to be handled by electricity. Dr. Cyrus Edson, ex-president of the New York Board of Health, in a special report, says: "There is still another source of contamination of the air in the cars, which are lighted by Pintsch lights. It is a general rule laid down by sanitarians that a 3-ft. gas burner, which is about the size of a Pintsch burner, should have 9000 cubic feet of air per hour. The gases of combustion, plainly apparent to the senses while the cars are passing through the tunnel, are mainly carbon monoxide, and dioxide and sulphur dioxide. All of these gases are very poisonous, and in sufficient quantities will destroy animal life. Carbon monoxide is the most poisonous. Five-tenths of 1 per cent of this gas will destroy animal life very quickly. Symptoms of breathing small amounts of this gas are dizziness, headaches, nausea, vomiting, debility, dry, irritating cough, and a train of symptoms similar to those of malaria." This is true of all train lighting other than by electricity.

ELECTRIC BURGLARS.—Some days ago a burglar caught a-burgling in New York was found to have on his person a small portable electric lamp of the compact cylindrical type, employing a small dry cell as a source of current. The New York sensational papers gave undue prominence to the case, owing to this new application of the electric light, but the correspondent of the London *Mail* capped the climax in the following cablegram: "Twentieth-century burglars, equipped with scientific burgling implements, have made their appearance here. The New York police to-day arrested two thieves who had been committing extensive burglaries in wealthy suburban districts. One burglar carried an electric bludgeon operated by a storage battery, and capable of shocking and stunning a person. He also had an electric saw and jimmy for opening safes. His companion carried an electric lamp instead of the old-fashioned oil lantern. The two burglars were well-dressed, and had good manners. They are said to be skilful mechanics. The police say that the electric bludgeon is one of the most dangerous weapons ever seen."

TROLLEY SUPERVISION IN CONNECTICUT.—The new law placing the electric street railways of the State under the supervision of the Board of Railroad Commissioners has become operative. The Commissioners now have exclusive jurisdiction and direction over the method of construction of street railways, and authority to designate the kind and quality of track and materials, and the method of applying the motive power. No trolley system can be opened to public travel until the Commissioners formally certify that it is in suitable and safe condition. They are required to inspect every trolley line periodically, and to recommend from time to time to its managers the adoption of such measures as the dictates of public safety and welfare sugest. They are authorized to employ an electrical engineer and as many experts as may seem desirable. Any railroad company that feels aggrieved at any ruling of the Commissioners is authorized to appeal to the Superior Court. Hitherto the electric railroads of Connecticut have been without any general State supervision, although they carry nearly 65,000,000 passengers annually.

TANDEM RAILWAY INDUCTION MOTORS.—In the tandem connection of motors for electric railway purposes, the induced member of the motor which is connected with the source of supply, supplies current to the inducing member of a second motor, the induced member of which is short-circuited on itself. When the motor equipment consists of two members connected in tandem and driving a common load, both motors will operate at one-half the speed at which they would run if both were directly connected to the source of supply. Under this condition the frequency of the currents flowing in the interconnected windings of the two motors is one-half the line frequency, or one-half the frequency of the current supplied to the first motor, and the frequency of the current flowing in the induced member of the second motor is substantially zero. The motor directly connected to the source of supply must, of course, carry the magnetizing current for both machines. In addition, since the full frequency and voltage of the source of supply are impressed upon the windings of its inducing member, the core loss in this member will be a maximum, and the core loss in the induced member half what it would be at zero speed. On the other hand, since the frequency of the currents flowing in the inducing windings of the second motor is only half that of the source of supply, the core loss in this member will be only about half as large as the core loss in the inducing member of the first motor, and the core loss in its induced member will be nearly negligible. As a consequence, the heating of the motor which is No. 1 in the tandem connection, will be very large as compared with the heating of the motor which is No. 2. Two patents issued July 23 to A. H. Armstrong relates to the equalization of the heating of the two motors of such a tandem system, which method is especially useful in connection with electric railway systems where there are heavy grades. In such systems the core loss in the No. 1 loss is often exceedingly large, and this motor may often get dangerously hot when operating on a road having heavy grades, while the second motor remains comparatively cool. One patent relates specifically to a switching system whereby one of the motors will be operated part of the time connected to the main source of supply, and for part of the time as the second motor in the tandem, the arrangement being such that the heating of the two motors during the day's run may be substantially equalized.

A CORRECTION.—In the biographical sketch of Mr. E. W. Rice, Jr., which appeared in our issue of last week, faulty proof-reading caused the given name of Mr. Rice to appear "Edwin William" instead of "Edwin Wilbur."

ELECTRO THERAPEUTICS.—The American Electro-Therapeutic Association will hold its eleventh annual convention in Buffalo, on Sept. 24, 25 and 26, 1901. Its headquarters will be at Hotel Niagara, and its place of meeting at the Armory of the Seventy-fourth Regiment.

PROFESSOR J. J. THOMSON.—The *Popular Science Monthly* for August opens with an article entitled "On Bodies Smaller than Atoms," by Professor J. J. Thomson, the successor of Lord Rayleigh and Maxwell in the chair of physics at Cambridge, who here describes for the first time in popular language the discoveries that have made him one of the leading living physicists of the world. The article is one that will be read with interest by everybody.

PAN-AMERICAN JURIES AT WORK.—The juries of awards at the Pan-American all met for the first time Monday morning, July 22, at the office of Dr. Pritchett, superintendent of awards. The different juries then separated to their various departments, and made a preliminary survey of the work. Lunch was served to all the jurors at the Stadium Restaurant by the Pan-American Exposition Company at 1 p. m., which custom will be followed as long as the jurors are at work. It is hoped to complete the work early in August.

"AUTOMOBILE HOUSE."—One of the cable dispatches from London says: What is the correct word for a private collection of automobiles equivalent to "stable" as referring to a number of horses? I have put the question to dozens of persons, and have yet to find any one with an answer ready at hand. The idea, of course, is a combination of coach and house, or, rather, motor and house, including both, and yet being neither singly. After considerable cudgeling and word twisting, among other suggestions offered have been "motorbarn," "motorome," "motorden," "motorium," "motor-shed" and "motable." One expert fell back on the French term "garage," but that, according to the general acceptance in London, is a place simply for storing and repairing automobiles, and comes no nearer filling the description of a gentleman's private collection than "livery" would describe his stable.

ARC-LAMP COMPENSATING WINDING.—After differential lamps have been in operation for a time certain changes in the "pick-up" and "feeding" voltages occur, due to the changes in the resistance of the magnet coils whereby the proper balance between them is disturbed. In a patent issued July 23 to Professor Elihu Thomson a means for overcoming this difficulty is described, which consists in providing an additional winding made of some metal having a low temperature co-efficient, such as German silver, which is connected around the series winding and in opposition therewith, at the same time assisting the shunt coil. As the resistance of the shunt and series coil increases, more current will flow through this third winding, and by proper adjustment as to length and cross section it may be made to compensate exactly for the decrease in the effect of the shunt coil. The same patent also relates to details of a carbon holder and contact device.

A MODIFIED THREE-WIRE SYSTEM.—In the usual form of the three-wire direct-current system two generators are employed, the neutral wire being connected between the generators. In a patent issued July 23 to H. E. Heath a modification of this system is shown, which consists in the employment of a third generator of double of the e. m. f. of the usual generators, which is connected to the outers, and with its two brushes also connected by equalizing wires to the outer brush, respectively, of the two main generators. All three generators are compound wound. With this arrangement of the generators a three-wire system will automatically regulate itself to the variations of current used by different series of tranlating devices, and its capacity can be increased as desired by connecting additional generators with the main wires without regard to their connection to the neutral wire, except through equalizing wires. A single generator may on this system also be connected with an ordinary three-wire system for increasing its output without disturbing the balance of the system.

MULTIPLE CIRCUIT ROTARY TRANSFORMER.—For a given frequency, as the speed of rotation of a rotary converter is reduced, the number of pole pieces must be increased, thus correspondingly increasing the number of, and crowding together, the commutator segments. In a patent issued July 24 to C. P. Steinmetz, a method is described of obviating this and some other objections due to the same cause, which consists in dividing the armature winding into distinct portions, each of which has its own commutator and set of collector rings, the latter being connected to independent transformers. By this construction the converter is made capable of delivering direct currents at different voltages, the direct-current terminals of the windings being connected in multiple for one voltage and in series for another voltage. Another advantage of this arrangement is that when connected to a three-phase circuit it gives the equivalent of a six-phase armature reaction.

PARAGUAY TELEGRAPHIC SERVICE.—A telegraph line from Asunción to Paso du Patria has been constructed, a cable being placed at the intersection of the Tebicuary River, so as to avoid the continuous interruptions by the boats navigating that stream. Another cable crosses the Paraguay River at Nueva Franca, joining the Paraguay telegraph line with that known as the Chaco line of the Argentine Republic. There is also in process of construction a telegraph line from Humaita to Curupayty, where another cable will be placed which will unite the Paraguayan line with that of the Argentine Republic at the colony of La Palma. Paraguay will then have three telegraph lines connecting the Republic with the rest of the world. Two other interior lines, one to the north and the other to the eastern part of the Republic, have been authorized by acts of Congress. The number of domestic telegrams sent in 1900 was 35,218. In that year 25,075 telegrams were received from other countries, and 23,276 telegrams dispatched to places outside of Paraguay.

SUBMARINE SIGNALING FOR BOSTON.—The Submarine Signal Company, of Boston, has obtained a special permit from the United States Government to erect a cable house on Egg Rock. The company proposes to establish its system of submarine signaling, described in these pages not long since, by which vessels bound into Boston Harbor may determine their precise position when within 10 or a dozen miles from shore, and thus escape the danger of approaching too near the dangerous shoals and ledges in the entrance to Boston Harbor. A permit has also been obtained by the company to erect a similar house on Minot's Ledge, and should the system prove as successful as the company hopes, scores of stations will be located at intervals of 10 miles or so along the entire Atlantic coast of the United States. The system is the invention of Arthur J. Mundy, a Boston electrician, and was perfected by Professor Elisha Gray, of telephone fame. Work on the Egg Rock station will start early in August. The new system will be in working order a few weeks after the station is built. The station at Minot's Ledge will be erected at the same time. A dynamo to generate current for the bell station near Nahant will be installed in the Egg Rock house, which will cost about $2,500.

LOCATING GROUNDS.—A method of locating grounds on electric circuits is the subject of a patent issued July 23 to E. M. Hewlett. Connected to the distributing mains is a differential galvanometer adjusted to a zero position under normal conditions of the line. If a leak should develop in either line the coils of the instrument are unbalanced and a corresponding indication given. When this occurs the resistances or other compensating devices are adjusted until the instrument is again brought to zero, and the amount of resistance still added is a factor from which the point at which the ground occurs may be easily determined. A switch is also provided at the distributing station by which the grounded main may be connected to a return wire, so that the resistance of the loop being tested may be easily ascertained. With a switch so placed that the two mains are connected in series relation, the two sides of the galvanometer are included in the loop, one end of which is grounded at the station through an arc machine or other source of high potential, and the other end of which is a possible ground at some point out of the system. The loop is normally open, but each sub-station is provided with means for closing it so that an attendant may insert a plug and complete the testing circuit when advised by telephone to do so. The method, therefore, relates to a distributing system provided at some point with an instrument and means for determining the resistance of each side of the circuit to any point within the range of the system.

THE TELEGRAPH IN ALASKA.—The United States telegraph system in Alaska has grown to such proportions that a large force of operators will be required. Acting Chief Signal Officer Dunwoody recently gave notice that he was prepared to enlist 20 to 30 telegraph operators to winter in Alaska.

WIRELESS IN THE NORTHWEST.—Arrangements have been practically completed, it is said, for the installation of the system on the boats of the Pere Marquette Railroad Company, as well as along the line of the road between Manitowoc and Ludington, Mich., which are about 62 miles apart, and between Milwaukee and Chicago. It is claimed that the cost of the wireless system is $150 a mile, as compared with the $3,000 of the wire system.

BROOKLYN BRIDGE.—Some of the short suspension rods and cable bands on the bridge were found broken last week, leading to a temporary interruption of traffic. The incident has caused much comment. Attempts to fix the damage on electrolysis have failed utterly. The extreme heat appears in part responsible, but the enormous development of trolley traffic is generally supposed to have at last thrown on the bridge a dead load greater than it is normally intended to carry.

INTERURBAN TROLLEYS FOR KENTUCKY.—The *Courier-Journal* says that the Louisville, Anchorage & Pewee Valley Electric Railway Company has completed arrangements with Eastern and Western capitalists to issue $18,000,000 of 40-year 5 per cent gold bonds. The purpose is to gridiron a considerable part of Kentucky with a system of interurban electric railways. The line running from Louisville to Pewee Valley is the trunk, from which branches will be run all through the Blue Grass section of the State, extending as far as Stanford and Richmond.

MUNICIPAL ELECTRICIANS.—Arrangements have just been completed whereby an electrical engineer of international reputation has agreed to prepare a paper to be read at the sixth annual convention of the "International Association of Municipal Electricians," to be held at Niagara Falls, N. Y., Sept. 2, 3, 4, 1901, on "The advisability of placing high and low potential wires or cables in the same series of conduits or through the same manholes." This is a live subject and just at present is an interesting topic in the section of the country in which we meet, particularly Rochester, N. Y. The New York party, which will number over 100 well-known electricians and dealers in electrical supplies, will leave New York on Sunday, Sept. 1, at 7.30 p. m. F. C. Mason, superintendent police telegraphs, Brooklyn, N. Y., has the matter in charge.

DINNER TO PAN-AMERICAN JURORS.—The members of the juries of awards and the directors of the Pan-American Exposition, enjoyed a banquet at the Stadium restaurant on July 26. President John G. Milburn presided. Among others at the head table were Director-General W. I. Buchanan, Treasurer George L. Williams, George P. Sawyer, Captain John Wisser, George Urban, Jr., and Mayor Diehl. The guests were seated at four long tables. The banquet began at 7.30 o'clock and the speechmaking began at 9.30 o'clock. President Milburn welcomed the guests. There were many excellent speeches. Professor Hollis, of Harvard, said that while he came from the oldest educational institution in the country, he came to the best educational institution in the world, for the time being. What impressed him was the use of engineering for beautification at the Exposition. Mr. Carl Hering spoke with particular reference to the electrical effects, and was followed by Dr. A. E. Kennelly on the same subject. "When 8.30 o'clock comes hereafter in my life I will think, 'This is the hour I saw the Buffalo Exposition grow into a crescendo of luminescence,' he said. "It is a grand poem of light."

CONSTANT CURRENT FROM CONSTANT POTENTIAL.—In 1890 Boucherot proposed an arrangement whereby with the use of an inductance and condenser in proper relation, a constant current may be obtained from constant-potential alternating-current mains, or constant-potential from a constant alternating current. In 1898 an elaboration of this system was the subject of a paper read by Boucherot before the Société Internationale des Electriciens, and at the recent Canadian Electrical Convention Professor R. B. Owens described the same arrangement in a paper which was printed in these columns. A patent issued July 23 to E. J. Berg presents a modification of the method, the object of which is to prevent such an arrangement from influencing the power factor of the main circuit with which it is connected. In one form of the Boucherot arrangement an inductance and condenser, which are so proportioned that when traversed by the same alternating current their voltages are equal in value, are placed in series across a constant-potential circuit. If now either the condenser or inductance is shunted by a circuit, a constant current will flow in this shunt circuit between wide limits as to load. In the arrangement as modified by Berg, the condenser and inductance in series are in addition shunted by another inductance (called a compensator), and one end of the constant-current circuit is connected to the middle point of this inductance or compensator. By this means the wattless currents flowing in the respective sides of the compensator equalize each other so far as the constant-potential circuit is concerned, with the consequence that the power factor of the main or constant-potential circuit is not affected. This arrangement also admits of the system being applied to a three-wire, constant-potential circuit, in which case the neutral wire is also connected to the middle point of the compensator. In a second Boucherot arrangement there are two sets of inductances and condensers in parallel. Bearing in mind the Wheatstone bridge diagram, the constant-potential circuit is connected to the two extremities of the triangle, the diagonally opposite legs of which containing condensers and inductances, respectively. The constant-current circuit is then connected to the other two angles of the triangle. In the Berg arrangement, instead of connecting the two opposite angles of the triangle directly to the line, they are connected to the extreme terminals of a transformer, the middle point of which is connected to the middle point of the constant-current circuit. Either of these arrangements, it may be remarked, can be also applied to the production of constant-potential from constant current. The second modified arrangement is claimed to have an advantage in that the wattless currents due to one set of reacting devices are compensated for to a greater or less extent by the wattless currents due to the other set, thus eliminating wattless current which would otherwise flow in the transformer windings, and thereby decreasing the waste of energy and increasing the efficiency of the transformer system. In a patent issued the same date to C. P. Steinmetz another modification of the Boucherot system is described. In this case a polyphase source of constant potential is used. Referring to the arrangement of inductance and condensers in the triangular relation above mentioned, and assuming two-phase currents, one side of the two-phase transformer is connected to opposite angles of the triangle. One end of the other side is connected at a third angle and the other end in series with the constant-current circuit, the other terminal of which is connected to the fourth or opposite triangle. It is claimed that by this means the range of regulation of the constant current system is practically doubled, and at the same time the regulation is rendered less sensitive to any higher harmonics which may appear in the e. m. f. acting in the constant-potential circuit.

LETTER TO THE EDITORS.

Mechanical Vibration of Wires.

To the Editors of Electrical World and Engineer:

Sirs.—I notice in the Digest of June 22 and July 20, 1901, an account of vibrations of wires, the latter abstract referring to the use of an influence machine as the exciter. I have frequently noticed such vibrations, and found they are caused by the nearness of two wires to each other, or if one wire only is used, to its nearness to some body; and I have frequently had to move the wires further apart from each other, or where one wire was used, have had to move it away from some body, such, for instance, as a wooden support.

The cause of the mechanical vibrations of the wires appears to be due to attraction; that is, where one wire, for instance, is used, the charges along the wire induce momentary charges of the opposite sign on some body in its neighborhood, and the wire is thereby attracted to it. The charges on the wire and opposite charges on the

near body being rapidly dissipated in space, the attraction ceases, and the wire swings back, and in virtue of its momentum, swings past its neutral position; another charge being imparted to the wire, it is again attracted to the body, and in this way it maintains a swing in time with the charges appearing on the wire.

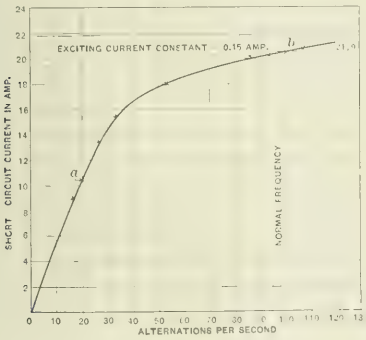
It is well known that a Geissler tube swung on such an excited wire will light up at the loops; the light appearing a maximum half way between two nodes, diminishing as a node is approached, and nearly if not entirely disappearing at a node. No mechanical vibrations, such as the writers above referred to give as a cause, would affect the light in a Geissler tube in that manner.

Baltimore, Md. Alfred G. Dell.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers.

Theory of the Short-Circuited Alternator.—Horschitz.—An illustrated theoretical article. He starts from the well-known method of determining experimentally the armature reaction of an alternator by short-circuiting the armature through an alternating-current ammeter, while the exciting current of the field is slowly increased by means of a rheostat until the ammeter in the armature circuit indicates the normal supply current. The speed is kept constant. The ampere windings, which are then used for magnetization, are nearly equal to the ampere windings corresponding to the reaction of the armature in which the normal current flows, against the m. m. f. of the pole system. He develops theoretically by graphical methods the equation of the "short-circuit curve," which is experimentally obtained by the method mentioned above. The abscissas represent the exciting current, the ordinates the current in the short-circuited armature. The speed is kept constant. As is well known, this "short-circuit curve" is generally a straight line. His theory leads to the same result. He then refers to the experimental fact that for a certain excitation the short-circuit current varies only slightly when the speed, and therefore the frequency of the machine is varied between rather wide limits. He gives the formula for the variation of the current in the short-circuited armature with varying speed (or frequency), while the exciting current is kept constant. The current in the short-circuited armature is equal to unity divided by the square root of the sum of a constant value and the quotient of a constant value and the square of the number of alternations per unit of time. The adjoining diagram shows this relation, the



SHORT-CIRCUITED ALTERNATOR CURVE.

curve having been determined experimentally. It was found to be in good agreement with the theoretical result just stated. It is worth while mentioning that when any two points of the curve in this diagram have been determined (i. e., when the current in the short-circuited armature has been determined for constant excitation at two different speeds), it is possible to calculate all numerical values of the diagram of the short-circuited alternator.—*Elek. Zeit.*, July 4.

Windings of Direct-Current Machines.—Fischer-Hinnen.—A communication referring to a recent article of Rothert who had claimed that, in order to have no sparks at the brushes, the teeth should be as saturated as possible. The present author claims that this statement does not agree with the actual practice, nor with the theory of commutation. He gives some data on machines of Krizik, which run without sparks at the brushes, although the teeth are not saturated. The eddy current losses in the teeth are 1 to 1.5 per cent, although the teeth are not saturated. He claims that with higher saturation of the teeth, as proposed by Rothert, the eddy current losses in the teeth would become very great.—*L'Eclairage Elec.*, April 27.

Rothert.—A reply to the criticism of Fischer-Hinnen. He says that his article referred to multipolar direct-current dynamos of average capacity. Fischer-Hinnen's examples are not of this kind. While Fischer-Hinnen said that the losses in the teeth are 1 to 1.5 per cent, "although" the teeth are not saturated, he would say that this is the case "because" the teeth are not saturated. When one saturates the teeth, their volume often diminishes more quickly than the losses per unity of volume increase. He claims that a theory of commutation which does not take the dimensions and the degree of saturation of the teeth into account, is insufficient, if not wrong. He gives some data about light machines which he has built.—*L'Eclairage Elec.*, May 25.

Power.

Electric Power in a Packing Plant.—An illustrated article on the electric installation of a pork-packing plant in Chicago. There are three power plants. One contains a 375-kw, 240-volt, direct-current generator, supplying a 220-volt, two-wire system for both lighting and power. The second power house supplies about 3000 incandescent lamps at 16 candle-power at 220 volts, and 35 enclosed-arc lamps. The third generating plant is old, and supplies a 110-volt source for three small motors and about 1500 incandescent and five arc lights.—*West. Elec.*, July 20.

Electric Power in Slate Quarries.—Brunswick.—The first parts of a long article on the electric power plant of a French company operating slate quarries. The power plant is near the quarries, so that a low-tension distribution at 120 volts is possible. The three-phase system is used, the frequency being 52. There are two 75-hp alternators, the power factor being 0.8.—*L'Elec.*, June 6, 15, July 13.

Traction.

Car Wheels.—Some comments on the car wheel problem. J. W. Fuller, Jr., Lehigh Car Wheel & Axle Works, states that they have continually urged their customers to increase the weight of the wheels, as many of those in common use are too light for the work. The customers, however, object to paying the additional cost. Pemberton Smith, New York Car Wheel Works, in a longer communication gives results and diagrams of the wear on steel-tired wheels; chilled wheels are often unsatisfactory because the managers will not pay sufficient price to obtain a good quality, but will pay much more than this price for steel-tired wheels. He advocates the use of first-class chilled wheels, and gives some examples of wear on this class of wheels when the best have been secured. He points out that although tram cars are approaching in weight the ordinary railroad cars of some years ago, the wheels used are much lighter, and that although the truck makers and motor makers are given all the room they require, the wheel makers are limited as to the length of the hub.—*St. R'y Jour.*, July 6, and Int. Ed., July.

The Proper Wheel Section.—Sieber.—A communication on the proper wheel section for interurban railways, referring to a former article. He points out that unless the wheels used on the same axle are of the same diameter, there will be a tendency to flange wear, and where such a difference exists it increases rapidly as the wheel of smaller diameter is slid along the track. The wheel section used by him in Nuremberg is illustrated. He gives five reasons for the cause of unequal diameter in two wheels on the same axle, viz., difference in quality of the material in the tires, difference in the quality

of material in the brake shoes, bad adjustment of the brake, narrow, one-sided curves and poor measuring appliances. Cars with wheels of unequal diameters consume as much as 15 per cent more current than where the wheels are properly mated. The writer then speaks of the successful results secured by him in following the method of current distribution proposed by Henry (Digest, Sept. 15, 1900). The line suburbs are supplied with current at 580 volts, and those in the congested district at 520 volts.—*St. R'y Jour.*, July 6, and Int. Ed., July.

Polyphase Plant for Electric Traction.—H. S. MEYER.—An article in which he criticizes some special points in Eborall's paper, abstracted recently in the Digest. He does not consider damping devices inherent to rotary converters or their generators. He says that no final conclusion regarding hunting should be drawn from engine builders' guarantees concerning speed variation of different engines, so long as it is not known how the results were arrived at, and how they will compare with actual tests. He gives a brief illustrated description of a very sensitive method, used by the Gen. Elec. Co., of this country, for measuring the variations in angular velocity. He thinks that damping devices are only necessary where the angular speed variation cannot be kept within the limit of 2 degrees or less (from mean to maximum or minimum); that is, where the flywheel to accomplish this would get unproportionally heavy. He gives a handy way of calculating the necessary flywheel effect.—Lond. *Elec. Rev.*, July 5.

EBORALL.—A reply to the criticism of H. S. Meyer, noticed above. Among other things he speaks of the use of damping coils. Whether these should be used or not with rotary converters is largely a matter of individual opinion when the phase displacement is as small as 2 degrees. Considering the insignificant cost of these coils and their great value should heating be set up, by a short circuit for instance, he always advocates their use in connection with the substation machinery with schemes of any magnitude, simply as a measure of precaution. The losses in the same are only 0.5 to 0.75 per cent. He has found in several instances that the addition of a flywheel to a synchronous converter has made hunting worse. Although he is not prepared to assert positively that such machines should always be designed to have as small a momentum as possible, still the experimental evidence available points to this conclusion as being the right one.—Lond. *Elec. Rev.*, July 12.

Railway Standardization.—An editorial referring to the fact that the negotiations with regard to electric traction on the "Inner Circle" in London drag their slow length along. The railroad is owned by two companies. One insists upon one system, the other upon another, the two systems being mutually exclusive. If the different railways of Great Britain would be equipped with different systems on its different lines, "the railway system of the United Kingdom would become a chaotic patchwork." It is claimed that the adoption of a system for suburban traffic will, in most cases, commit a railway company to that same system—as regards the line and rolling stock—for its entire network of lines. Standardization is needed. "Compulsory standardization would probably be necessary if it is to be effective. Parliament is the supreme authority in such matters, and the only authority strong enough for the task." "Not merely is it necessary to choose between rival polyphase and continuous current systems. Details need to be closely specified. The working voltage on the line, the frequency—if alternating currents are finally selected—the position of the working conductor, its height and shape and the method of protection. All these matters require to be rigidly standardized, if our railway system is to preserve its unity."—Lond. *Elec.*, July 12.

Automobile Omnibus.—An illustrated description of an Hub-motor omnibus to be used by a Chicago company. The vehicle has a seating capacity of 44 passengers. The "hub-motor" is used, the electric power being applied directly to the hubs of the four wheels supporting the vehicle, making each wheel an active driver. Charging stations are at the terminals of the line, so that the battery need not be constructed for more than a 12-mile run. With a full load of 11 tons it is estimated that the consumption of current will be about 80 watt-hours per ton mile.—*West. Elec.*, June 13.

REFERENCE.

Suspended Railway.—LUEDORF.—A very long and well illustrated detailed description of the suspended electric railway of the Langen system, between Barmen, Elberfeld and Vohwickel, Germany, which has been repeatedly mentioned in the Digest.—*Elec. Zeit.*, June 27.

WIRES, WIRING AND CONDUITS.

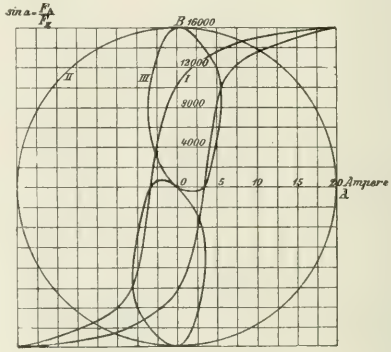
REFERENCES.

Standards for Rubber Insulated Wires.—A reprint of the standards for rubber insulated wires, proposed by the Union of German Elec. Eng.—*Elek. Zeit.*, June 27.

Overhead Construction.—THORNTON.—An illustrated paper read before the Can. Elec. Ass'n, on "Construction and protection of aerial systems."—*West. Elec.*, July 13.

ELECTRO-PHYSICS AND MAGNETISM.

Graphical Determination of the Angle of Hysteretic Advance of Phase.—JACOBSON.—A description of a simple graphical method of determining the angle of hysteretic advance of phase. The hysteresis loop is plotted on cross-section paper with the induction as ordinates and the exciting current as abscissas, with such a scale that the total length of the abscissas axle *O A* is equal to the maximum ordinate *O B*, as shown in the adjoining figure. Then the sine of the



HYSTERESIS CURVE.

angle of hysteretic advance of phase is equal to the ratio of the area of the hysteresis loop to the area of the circle with the radius *O A*. This circle may at the same time be used for plotting the current curves in polar co-ordinates (for determining the effective value), as is done in Curve III. The determination of the "equivalent sine wave" can thus be made very quickly.—*Elek. Zeit.*, June 27.

Temperature and the Photo-Electric Effect.—ZELENY.—A long illustrated paper on the influence of temperature upon the photo-electric effect. His experiments show that this influence is large. From a platinum wire the negative electricity is at first discharged more slowly as the temperature is increased; the rate of discharge reaches a minimum, however, and then increases as far as the highest temperature used, about 700 degs. C. The rate of discharge produced by the light also depends upon the immediate previous history of the wire. From an iron wire the rate of discharge also appears to diminish at first with the temperature, but after reaching a minimum it finally becomes a great many times its value at room temperature. Heating the wire does not change the inactivity of the light for discharging positive electricity, even though the wire is raised to a temperature at which, due to the heat alone, the positive electricity is being discharged. The fact that after the platinum wire has had its temperature reduced, the larger conductivity of the higher temperature persists for a time, there being a gradual recovery, shows that at least most of the variations noticed in his experiments are due to changes taking place at the metal surfaces, and not in the gas between the electrodes. A comparatively abrupt change in the effect at about 100 degs. C. may indicate some molecular alteration of the metal.—*Phys. Rev.*, June.

Energy Absorbed by Vacuum Discharges.—CARDANI.—A continuation of his researches in which he had found that the form of discharge in a gas is characteristic of its physical condition and independent of its chemical nature. He distinguishes 14 successive stages of evacuation, beginning with the ribbon-shaped spark at pressures from 650 to 320 mm. This is followed by a complete brush, a spreading brush, a luminous cathode (6 mm.), the beginning of the dark cathode space (0.7 mm.), the extension of the dark space over 8, 20, 35 and 50 mm., respectively, white brush at the anode, wandering brushes at the anode Röntgen rays and disappearance of luminosity. All these successive stages are reached at the same pressure in air,

hydrogen and carbonic acid gas. The maximum energy in proportion to the total energy is consumed at a pressure of 130 mm., just where the spark gives way to the brush discharge. The minimum is when the cathode phenomena become well marked, and the dark space is about 8 mm. long. On further exhaustion the energy rises again to near the maximum, but the appearance of Röntgen rays is not marked by any discontinuity. If cathode rays are due to a special form of ionization, it follows that the energy required for generating the electrons is always the same.—*Phys. Zeit.*, June 29; abstracted in Lond. *Elec.*, July 12.

Harmless Röntgen Rays.—Demerliac.—Röntgen rays sometimes give rise to mortifications of the skin. The present author has found that tubes worked by alternating currents of high frequency and high-tension never produce erythema, and that on the contrary, the rays so obtained possess the curative properties recognized in electro-therapeutics since the experiments of D'Arsonval, Oudin, Doumer and others. He therefore uses the Oudin resonator, which, with certain precautions, may be made to work Röntgen ray tubes. They light up on connecting them with the upper knob of the apparatus. A broad concave cathode and a small anode or an annular anode are used. The cathode is joined to the resonator, and the anode may be left free or put to earth. The discharge is most effective when it proceeds in one direction only. A cathode valve should be very useful. The tubes may be brought quite close to the skin without risk, and thus any loss of penetration power is effectually counteracted.—*Comptes Rendus*, June 24; abstracted in Lond. *Elec.*, July 12.

Europium.—Demarcay.—In his researches on electric fluorescence in a vacuum in 1885, Crookes mentioned a band which he attributed to samarium, and which, on account of its disappearance, in presence of calcium, as well as for other reasons, he called the "anomalous ray." The present author has now identified this line with the spectrum of a new element intermediate between gadolinium and samarium which he calls europium, with the symbol Eu, and an atomic weight of about 151.—*Comptes Rendus*, June 17; abstracted in Lond. *Elec.* July 12.

REFERENCES.

A Principle of Dualism in the Theory of Electricity.—Sire de Vilar.—A long mathematical article in which he shows that there is a principle of "dualism" extending over the whole theory of electricity. Ohm's law may be written in two forms, either the voltage drop is equal to the product of resistance and current, or the current is equal to the product of conductance and voltage drop. The one formula is obtained from the other by replacing voltage drop by current and resistance by conductance or vice versa. In an analogous way from any formula another corresponding formula may be deduced. This is discussed by numerous examples, the discussion being restricted to the theory of direct current phenomena.—*L'Eclairage Elec.*, May 18, 25.

Globe Lightning.—Violle.—A description of a globular lightning discharge.—*Comptes Rendus*, June 24; abstracted in Lond. *Elec.*, July 12.

Electro-Chemistry and Batteries.

Edison Battery.—De Contades.—An illustrated article on the new Edison accumulator. After an abstract of Kennelly's paper the following critical remarks are made. The Edison accumulator is said to have a capacity of 30.85 watt-hours per kilogram of electrode, for a discharge rate of 0.93 ampere per square decimeter. This is compared with the capacity of a modern Fulmen lead cell, which for a discharge rate of 1 ampere per square decimeter "has a capacity per electrode" (this probably means per kilogram of electrode) of 22.5 ampere-hours, at an average voltage of 1.9 volts, hence 42.75 watt-hours. (This comparison is very unfair. From Kennelly's paper it is evident that 30.85 watt-hours is the capacity of the Edison cell per kilogram of total cell, not per kilogram of electrode). He then gives a comparison of the Edison cell and a modern lead cell, with reference to the weight of the electrolyte and finds an advantage in favor of the lead cell. (This is evidently wrong. He says that the weight of the electrolyte in the Edison cell is 14 per cent of the weight of the electrodes, while according to Kennelly's paper it is 14 per cent of the total cell weight). He further says that the Edison cell will be expensive, and believes that it will not be durable. (One of the principal claims of Edison is that there is practically no deterioration).—*Cosmos*, July 6.

Edison Battery.—Krieger.—A communication in which he says that he has used nickel for positive accumulator plates before Michalowski and Edison. He patented a zinc-potassium hydroxide-nickel battery in 1896. The e. m. f. was experimentally found to be 1.82 volts, which corresponds exactly with the theoretical value if the chemical process at the nickel plate is assumed to be the change of the peroxide of nickel into nickel oxide.—*L'Ind. Elec.*, July 10. (See page 170.)

Diaphragms.—Le Blanc.—A German Electro-Chemical Soc'y paper on diaphragms in electrolytic cells. In the plant of the company with which he is connected, they use, for the regeneration of chromic acid, diaphragms which involve a loss of voltage of only 0.20 volt. In the meanwhile another material has been made for diaphragms which gives only half the resistance of the former. With this new mass a drop of voltage of 0.17 volt is produced by a plate of 5 mm. thickness with a current density of 300 amperes per square meter. With the older mass the voltage drop was 0.4 volt. The older mass consists of 75 per cent, SiO_2, and 25 per cent of Al_2O_3, while in the new mass about 2 per cent of the aluminum oxide are replaced by alkali. The Pukall material contains 70 to 71 per cent of SiO_2, 27 to 28 per cent of Al_2O_3, and about 1.5 per cent of alkali. He then gives an account of tests which show that plates of equal electric resistance may have a very different (mechanical) permeability for liquids and dissolved substances. He made tests with porous plates of equal electrical resistance and of equal size. He put on both sides of the plate, dilute sulphuric acid and on one side some chromic acid also. Some of these plates allowed a diffusion of 30 times as much chromic acid to the other side in the same times as other plates. It has been found that such a great permeability may be decreased without increasing the electrical resistance by placing the plate in a "solution of water glass of a certain concentration, another salt soluble in water being added." After the pores of the plate have been filled with the solution, the plate is dried and "placed in an acid." Plates with very fine pores which cannot be seen with the bare eye have a smaller (mechanical) permeability for liquids than such with larger pores, but must not necessarily have a greater electrical resistance. The electric resistance of liquids is inversely proportional to the cross section. This has been found to be correct for very thin capillary tubes. On the other hand the (mechanical) permeability is proportional to the square of the cross section. A diaphragm may be regarded as a system of capillary tubes. With equal total cross-section of all the pores and equal electrical resistance, that diaphragm which has the finer pores, has the smaller (mechanical) permeability. An ideal diaphragm is theoretically possible with extremely fine pores, combining a small electrical resistance and a very small (mechanical) permeability.—*Zeit. f. Elektrochemie*, May 30.

Sulphide Ore Treatment.—Ashcroft.—A long illustrated abstract of a paper read before the Brit. Inst. of Mining and Metallurgy; also some editorial notes on it. The paper deals with the treatment of sulphide ores, and is a description of the modified Phœnix process for extracting the silver, lead and zinc by a combiantion of metallurgical, chemical and electrolytic reactions. The modified process has been worked out by Swinburne and Ashcroft, after an earlier process of Swinburne had not proved satisfactory. The principle of this earlier process consisted in feeding the crushed but unroasted ore into a bath of molten zinc chloride and in electrolyzing the semi-molten mass thus obtained with a molten lead cathode and carbon anode. The lead was to be removed first by electrolysis, and then the zinc, while the sulphur was to be separated and recovered at the anode. The new modified process differs from the old one in the following points: The removal of the sulphur by substitution of chlorine, the removal of lead by substitution of zinc, and the removal of iron, manganese and gangue by settling. In other words, a comparatively pure fused mass of zinc chloride is submitted to electrolysis in place of the mixture of sulphides and chlorides, used in the earlier process. Editorially it is remarked that although the inventors appear to have surmounted in some cases the metallurgical and mechanical difficulties of the earlier process, it is yet too early to assert that the modified Phœnix process has successfully solved the sulphide ore problem.—Lond. *Elec.*, July 12.

Commercial Aluminum Zinc Alloys.—J. W. Richards.—No alloys containing more zinc than aluminum have any specially valuable mechanical properties, nor even the alloy of equal parts of both. The alloy "Al-2, Zn-1" reaches a tensile strength of 40,000 lbs. per square inch, melts at 425 degs. C., does not easily oxidize, and takes a fine finish. It closely resembles a high carbon steel in character, and is the hardest and strongest of the Al-Zn series. Its specific gravity is 3.8. A contraction of 17 per cent takes place during alloying. The alloy "Al-3, Zn-1" is the most generally useful of the

series. It is softer than the last tensile strength, 35,000. It is not malleable, but yet not brittle, bending before breaking. Hence castings may be straightened out. Specific gravity, 3.4; contraction, 14 per cent; good castings are yielded. When made from pure metals, it is equal to finest brass in the lathe and under the drill and file. Its color is equal to that of aluminum. Below 25 per cent zinc the strengths of the alloys decrease rapidly. The 15 per cent alloy can be rolled and drawn; tensile strength, 22,330 lbs. per square inch.—*The Alum. World,* May; abstracted in *The Elec. Chem. and Met.,* June.

Electrolytic Production of Metallic Chromium.—Neumann.—A German Electrochem. Soc'y paper in which he gives an account of experiments made to determine the proper conditions in which metallic chromium can be obtained by electrolysis. The experiments were made with a double-fluid cell. The cathode side contained a solution of chloride or sulphate or acetate of chromium, while the anode side contained mineral acids or salt solutions. As cathode carbon was used, as anode lead or platinum or carbon. To get good deposits the liquid at the cathode must be thoroughly stirred. Only at certain limits of concentration, current density and temperature it is possible to get good deposits of metallic chromium.—*Zeit. f. Elektrochemie,* May 30.

Galvanic Coppering of Aluminum.—Gianoli.—The metal is cleaned of all fatty substances by means of a 10 per cent sodium hydroxide solution, washed with warm water, then dipped into a 5 per cent hydrofluoric acid solution, and again washed. In order to cover the metal with a thin layer of copper it is dipped into a 10 per cent alcoholic solution of copper chloride until it has assumed a uniform color. It is then brought as cathode into an electrolytic bath of the following formula: Cyanide of copper, 300 grammes; potassium cyanide, 450 grammes; barium phosphate, 450 grammes; water, 500 grammes. The best voltage to use varies between 1.7 and 2 volts. He also gives formulas for silvering and nickeling.—*L'Elettrictita,* 1901, v. 20, p. 107; abstracted in *The Elec. Chem. and Met.,* June.

Pyrogenetic Reactions by Means of the Electric Current.—Loeb.—A preliminary account of some experiments in which he studied the effect of the carbon arc, using alternating current of 110 volts with 11 ohms series resistance on various liquids or vapors. In the cases in which a complete destruction of the substance occurred—especially with aromatic bodies with deposition of carbon, a metal wire which was heated by passing a current through it to a glowing condition, was used instead of the arc. Under the influence of the arc, water gave a gas consisting of about 50 per cent hydrogen, 40 per cent CO, 7 per cent CO_2, and 0.8 per cent unsaturated and 2 per cent saturated hydrocarbons. He also investigated methyl alcohol, glacial acetic acid, benzene, naphthaline, aniline and nitrobenzene.—*Ber. der Deutsch. Chem. Ges.,* 1901, v. 34, p. 915; abstracted in *The Elec. Chem. and Met.,* June.

White Lead.—Cowper-Coles.—An illustrated article on "Some electrolytic processes for the manufacture of white lead." The following processes are described: Gardner, Browne and Chaplin, Browne, Woltereck, Lucknow, Tibbit, Bottome, Lukon, Bailey, Cox and Hay, Bredig and Faber. He concludes that the chief difficulty with electrolytic processes has been the trouble experienced in getting the white lead free from metallic lead and obtaining a product that is of the right composition. The lead anodes are also likely to give rise to difficulties, through getting coated in such a way that their action is retarded, or, on the other hand, the lead disintegrates and particles of metallic lead are found in the final product. An ideal white lead should be composed of about two molecules of lead carbonate and one molecule of lead hydroxide. The analysis of a good white lead is about 69 of carbonate and 31 of hydroxide. As one ton of metallic lead produces about 1.25 tons of white lead, it is calculated that a fair profit can be made when the price of white lead is about equal to that of sheet lead.—*The Elec. Chem. and Met.,* June.

Solubility.—Rothmund.—A German Electro-Chemical Soc'y paper. In many cases the solubility of a non-electrolyte in water is changed, and generally diminished by the addition of a salt. This represents a difficulty to the theory of electrolytic dissociation, and shows that "the ions cannot be considered under all circumstances like other kinds of molecules." From the principles of thermodynamics he draws the conclusion that when the solubility of a non-electrolyte in water is diminished by the addition of a salt, then the solubility of this salt in water must be greater than in the solution of the non-electrolyte. He also develops the mathematical formulas. They were found to be in good agreement with measurements made by Wilmsmore.—*Zeit. f. Elegtrochemie,* May 30.

Formation Energy of Water and an Electrode Sensitive to Light.—Bose.—A German Electro-Chemical Soc'y paper, giving an account of experiments by which he found the free formation of water to be 52,654 calories, with a possible error of 693 calories, more or less. He also describes experiments with a gold anode which is covered by a film of gold hydroxide, which prove to be sensitive to light.—*Zeit. f. Elektrochemie,* May 30.

REFERENCES.

Storage Batteries.—Illustrated descriptions, taken from patent specifications, of the following new batteries: Edison, Renaud, Cheval-Lindeman, Brault, Gladstone and Beckett, McCartney and Majert.—*L'Eclairage Elec.,* June 8. A continuation of this serial, in which the following batteries are described: Skwirsky, Placet, Collins, Porter, Muhle, Hewitt, Boese, Ricks.—*L'Eclairage Elec.,* July 6.

Nickel Ammonium-Sulphate.—Pfanhauser.—A German Electro-Chemical Soc'y paper, giving an account of a theoretical and experimental investigation on "The electro-chemical behavior of nickel-ammonium-sulphate." This complex double salt is formed when ammonium-sulphate is added to a solution of nickel sulphate, the specific conductivity of the electrolyte being increased.—*Zeit. f. Elektrochemie,* June 13.

Velocities of Ions.—Steele.—An illustrated description of a mechanical appliance for demonstrating in the lecture-room the traveling of ions and measurements of transport numbers.—*Zeit. f. Elektrochemie,* June 27.

Aluminum.—Ohly.—An article on "Modern production of alum and aluminum." He gives a history of the methods of producing aluminum and discusses especially the process of treating bauxite. He refers to the uses of aluminum for electric conductors and for the reduction of refractory oxides.—*Min. and Met.,* July 15.

Units, Measurements and Instruments.

REFERENCES.

Pyrometers.—Rosenhain.—The first part of an illustrated article on electric pyrometers. After some general remarks on resistance pyrometers and thermo-electric pyrometers and on the methods of placing the pyrometer directly in the furnace or exposing it only to the heat radiation, he describes the Siemens platinum resistance pyrometer, the Griffith-Callender platinum resistance pyrometer and the Callender recorder.—*The Elec. Chem. and Met.,* June.

Electric Dynamometer.—Deroude.—An illustrated description of a new transmission dynamometer, devised by him.—*L'Ind. Elec.,* June 10.

Localizing High-Resistance Breaks on Cables.—Rymer-Jones.—A communication in which he gives the results of some actual tests with his method, noticed recently in the Digest. They show that his method is correct in principle and simple in application.—Lond. *Elec. Rev.,* July 5.

Telegraphy, Telephony and Signals.

Artificial Submarine Cable.—Trowbridge.—For demonstration purposes he uses the following arrangement. A number of resistances are connected in series between one pole of a galvanometer and a double key. The other pole of the galvanometer is earthed. The double key enables one to connect the line either to earth or to one pole of a battery, the other pole of which is earthed. Each junction of two resistances is connected to one plate of a condenser, while the other plate is connected to earth. The condensers he uses are short lengths of glass tubing about 1 cm in diameter, with a platinum wire as an electrode sealed in one end. The tube is filled nearly full of distilled water and the other electrode, which is a piece of platinum foil about 3 mm. wide, is corked in so as to dip about 5 mm. into the water.—*Phys. Rev.,* June.

Telephone Cable.—Baechtold.—An article on a new telephone cable in the St. Gotthard Tunnel, Switzerland. The total length is 16.6 kilometers. The construction of the cable is shown in the adjoining figure, which shows its cross-section in actual size. The cable consists of seven double wires of copper of 1.8 mm. diameter, with paper and air insulation. They are twisted together and covered with paper tape, the diameter being 7 mm. Around this is a three-fold layer of cotton tape; a mantle of lead, containing tin, and a second mantle of lead protect the cable against gases and water. Around the lead mantle there is an insulating compound layer.

Around this an armor consisting of 28 steel wires, and finally a cover of jute, impregnated with a compound. The external diameter is 44 mm. The electric properties were specified as follows:

NEW TYPE OF CABLE.

Copper resistance, 6.4 ohms per kilometer at 15 degs. C.; insulation resistance at least 1000 megohms per kilometer at 15 degs. C.; maximum charge, 0.06 microfarad per kilometer.—*Elek. Zeit.*, June 27.

REFERENCES.

Currents and Potentials on Submarine Cables.—Crehore.—An illustrated paper in which he develops an approximate method for calculating the currents and potentials on submarine cables, produced by sine-wave e. m. f.'s. The method only applies to the transmitting end of the cable. The receiving end is perhaps the more important, for the signals must be received in legible shape, if the transmitter has any commercial value, but the transmitting end is also important, for it is there that the cable experiences the greatest potentials, and the insulating material the greatest strain. He applies his calculations to the example of an actual Atlantic cable. The results are given in a series of diagrams.—*Phys. Rev.*, June.

Wireless Telegraphy.—A long illustrated serial on the experiments in wireless telegraphy made between Brussels, Mechlin and Antwerp with the Guarini automatic repeater.—Lond. *Elec. Rev.*, May 24, June 7, 28; July 12. Another article on the same experiments by Poncelot, who participated in these experiments, is begun in Lond. *Elec. Eng.*, July 12. An article by M. Guarini appears elsewhere in this issue on the same subject.

Telautograph.—Letheule.—An illustrated description of the Ritchie telautograph for transmitting written characters or drawings over a two-wire telephone line.—*L'Eclairage Elec.*, June 1.

MISCELLANEOUS.

Electric Resistance of the Human Body.—Hooper.—An account of experiments in which the hand-to-hand resistance of the human body was measured at all practicable voltages. Brass rods of about three-quarters of an inch in diameter were selected for electrodes, and the resistances were masured first with a Wheatstone bridge and a single Leclanche cell, and then with milliammeter and voltmeter and storage battery, varying from a few volts to 75 or 100, and sometimes to 125 volts. With the Wheatstone bridge and cell the resistances were always high, usually from 20,000 to 40,000 ohms; with the milliammeter and voltmeter and storage cells the resistances were always lower, decreasing along an apparently hyperbolic curve until with 100 to 125 volts the results obtained were usually between 1000 and 2000 ohms. He thinks that the diminished resistance might be partly due to increased flow of blood to the parts under the stimulus of the relatively large currents at high voltages. He made experiments with a special apparatus, and found that the resistance of the body during the first one or two-hundredths of a second after being subjected to potentials of from 50 to 100 volts is much higher than that found after the current has acted for several seconds. There are, however, probably also other effects of relatively large currents much more instantaneous in their action, but tending also to reduce the body's resistance.—*Elec. Rev.*, June 29.

REFERENCES.

Raoult.—An account by Abegg of the life and work of the late chemist and electro-chemist, Francois Marie Raoult.—*Zeit. f. Elektrochemie*, June 13.

Treating Lupus.—A long illustrated article on the method of treating lupus by means of the electric arc light, devised by Professor Finsen, of Copenhagen.—Lond. *Elec. Rev.*, July 12.

British Engineers in Germany.—Illustrated articles on the recent visit of the (Brit.) Institution of Electrical Engineers to Germany, especially to Hanover, Berlin and Dresden.—Lond. *Elec., Elec. Rev., Elec. Eng.*, June 28, July 5, 12; *Lightning*, June 27, July 4, 11.

Paris Exposition.—Reyval.—An illustrated description of a 800-kw, 500-volt direct-current dynamo of Decanville.—*L'Eclairage Elec.*, June 1. Illustrated descriptions of 7-kw, 30-kw, 225-kw direct-current dynamos and a 176.5-kilovolt ampere, three-phase alternator of Alioth & Co., also of polyphase-direct current converters of the same company.—*L'Eclairage Elec.*, June 8. Illustrated descriptions of machines of the Comp. Internat. d' Elec. de Liege; two direct-current dynamos of 135 kilowatts and 45 kilowatts, respectively; an 80-kilovolt ampere, three-phase alternator, and 20-kw three-phase transformers; a 100-kw motor-generator for transforming three-phase currents into direct current.—*L'Eclairage Elec.*, June 15.

New Books.

Practical Electro-Chemistry. By Bertram Blount. New York: Macmillan Company. 374 pages, 47 illustrations. Price, $3.25.

In laying aside this book the reviewer has great pleasure in stating that he enjoyed its perusal. True, he probably would have stated certain facts differently, and introduced other material here and there had he attempted the preparation of a volume upon the same subject, but the fact remains that Mr. Blount has given the chemical public a readable and most acceptable volume. It will prove particularly valuable to chemists whose knowledge of electro-chemistry is very limited, and indeed it will reveal to them and to chemical manufacturers generally a new world. This new domain of chemistry, opened up through the "subtile agent" of Faraday, will cause chemists to pause, and probably will lead many to attempt the wider application of the electric current in chemical work.

Within the compass of seven sections or chapters the author covers admirably the most salient points in practical electro-chemistry. The introduction discusses the nature of electrolysis, constitution of electrolytes, theory of solution, ionic theory, etc., in a clear, comprehensive and attractive way. The busy practical man receives here in 32 pages the substance of some of the most important theoretical deductions of modern times, and the bearing of the same upon industrial work. The winning and refining of metals by electrolytic means in aqueous solution, in igneous solution, their alloys obtained in the electric furnace (carbides, borides and silicides), electro-deposition, the production of alkali, chlorine and their products, the manufacture of organic compounds and fine chemicals, and finally the power, are treated understandingly in their respective chapters. Forty-seven illustrations appear. They represent the more important forms of apparatus used in electrolytic processes.

The book cannot fail to prove a valuable addition to the library of all persons who are "interested in one of the youngest and most promising of modern industries."

A Treatise on Electromagnetic Phenomena. By Commander T. A Lyons, U. S. N. New York: John Wiley & Sons. 556 pages, 385 figures and plates. Price, $6.

This volume has an introduction of nine pages in the place of the usual preface. Part I. occupies the whole of the volume; the other five parts of the complete work are to appear in another volume. The work can in no sense be accepted as authoritative, being frankly a compilation. The author says in his introduction that a complete list of the works consulted, read, or studied in the preparation of the book will be printed in a succeeding volume.

The subject matter of the parts is as follows: Part I., Electromagnetic Phenomena; Part II., The Compass; Part III., The Ship a Magnet; Part IV., The Mathematical Theory of the Deviations; Part V., Swinging Ship and Compensation of the Deviations; Part VI., Various Matters Bearing on the Main Subject.

The arrangement of the subject matter is unusual, the title of the first chapter being "A Medium Necessary to the Production of Magnetic Phenomena." The author therefore starts where some authors leave off. The next four chapters are a continuation of the wave theory. Chapter VI. is entitled "A General View of Electrical and Magnetical Phenomena," in which the elementary theory of magnetism and so much of electricity as is necessary are taken up.

The book then branches off again to discuss terrestrial magnetism in the next chapter. Chapter VIII. gives a pretty full description

of instruments used in the observation of terrestrial magnetism. Chapter IX. treats of sun-spots, auroras, etc., then at Chapter X. the book returns to the subject dropped with Chapter VI. Chapter X. is entitled "The Magnetic Condition in Bodies of Restricted Size; Field Around Them; Laws of Action; Effect of Heat on Magnetism." Chapter XI. entitled "Theories of Magnetism-Molecular and Terrestrial," comes next. In a book arranged in the ordinary manner, the subject matter of Chapters VI., X. and XI., would come in the first part of the book, while the discussion of the wave theory—and much more, cosmic magnetic phenomena—would come later. The author may have had some particular object in view when he arranged the contents in this manner, but if so he has not made it clear to the reader.

Chapter XII., the last, treats of the magnetic theory of light; the treatment is semi-popular, which may be said generally of the treatment of the other subjects also. In this chapter the method of juggling with dimensional formulæ, developed by Professor Rücker and his followers, is exploited. Both Professor Rücker and Professor W. Williams are quoted. The logic of this method was discussed in the columns of the *Electrical World* in the year 1897, and for the benefit of those who have never read anything on the subject it may be stated that the whole method is founded upon—or at least implicitly contains—the fallacious assumption that the dimensions of a physical unit depend upon the ultimate nature of the physical quantity of which the unit is the measure.

The chief criticism of the book is that it is disconnected. However, most of the material is obtained from reliable sources, and the book will probably prove of value to a certain class of readers.

EXPERIMENTAL PHYSICS. By Eugene Lommel. Translated from the German by G. W. Myers. Philadelphia: J. B. Lippincott Company. 664 pages, 430 illustrations. Price, $3.75.

This is a work upon elementary physics, and is excellently adapted to the use of elementary students. So far as electricity and magnetism are concerned the treatment is very much behind the times, many of the illustrations being archaic and some of the subject matter out of date. For example, the treatment of magnetism is wholly on the basis of poles and polarity. Nothing seems to be said concerning either magnetic flux or the magnetic circuit. It is hard to imagine how any adequate treatment of magnetism can at the present time be conveyed without treating of these subjects and from the standpoint of those subjects. In electricity the apparatus described is very ancient.

The chapter on light is excellent, and is the longest in the book. The book is well worthy study, if only for the sake of this one chapter, which presents more logical and clearer notions concerning abstruse optical phenomena than are perhaps to be found in any other text-book of the same character.

Although as a text-book the statements are generally accurate, yet there are errors of oversight which might have been avoided. For example, it is stated that "one kilogramme-metre is equivalent to 98,100,000 ergs." Of course, the author in making this statement had in mind the localities where the gravitational constant was 981, but the students would have been aided if the limitation had been distinctly expressed. There are some other errors attributable to translation which should have been avoided. For example, it is stated that the horse-power "is equivalent to the work of 75 kilogramme-metres." What should have been stated is that it is equivalent in Germany to the activity of 75 kilogramme-metres per second. The watt is also stated as being the 1-736th part of a horse-power, which was an acceptable proposition at the hands of the author in Germany, but is not an acceptable unqualified statement when the book is translated into English for English-speaking students.

ANNUAIRE POUR L' AN 1901. Publié par le Bureau des Longitudes. Avec des Notices Scientifiques. Paris: Gauthier-Villars. 936 pages. Price, 1 franc, 50 centimes.

This little volume, which has already passed through more than 100 republications, is a very valuable and interesting combination of ephemerides and statistics. It is a sort of scientific almanac published under the auspices of the French Government. It is wonderful how much useful information in physics, chemistry and astronomy it contains, mingled with a good deal of matter of especial interest to Frenchmen. Thus, there are 38 pages devoted to an enumeration of the various departments and townships in France with their several populations and their magnetic elements. Then follows an interesting series of French population tables from which it appears, among other things, that in all France about 9 per cent of the births are illegitimate, and in Paris 29 per cent; that there is one divorce to approximately 40 marriages; that among still-born children the ratio of males to females is 1.34; in legitimate births, 1.05, and in illegitimate births 1.02, there being 21 births living to 1 still-born. Moreover, in the year 1898, the births exceeded the deaths by approximately 34,000 or less than 1-10th of one per cent of the total population of France, showing that this population, while certainly not retrograde, is almost stationary in numbers.

While all scientists and nearly all progressive persons recognize that the French system of weights and measures ought to be universally adopted, and that the English-speaking countries are more conservative than progressive, in adhering to their existing barbarous systems of weights and measures, yet it is a pity that France officially adopts the meridian of Paris as its standard of longitude, in place of the meridian of Greenwich. The Greenwich meridian sets time for all the world except France, Russia and Portugal, which adopt the local meridians of Paris, St. Petersburg and Lisbon, respectively. The difference of longitude between Greenwich and Paris is 9 minutes 21 seconds. Let us hope that when the English-speaking peoples adopt the metric system of weights and measures France will consent to adopt the Greenwich meridian.

A very full chapter is devoted to the magnetic elements of France, which may be roughly stated as 14½ degs. W. declination, 64 degs. dip, and ⅕ gauss horizontal intensity. A very useful series of physical and chemical tables follows. There are two electrical papers by M. Cornu, one on electric units and the other on the electric transmission of power. Both subjects are treated from the theoretical rather than from the practical standpoint.

TELEPHONE LINES AND THEIR PROPERTIES. By William J. Hopkins. Revised and enlarged. New York and London: Longmans, Green & Co. 307 pages, illustrated. Price, $1.50.

This sixth edition of a book which first appeared in 1893, has had several of its chapters rewritten and has had a chapter on composite working and wireless telephony added. A number of half-tone pages have also been inserted. The subjects of its 15 chapters are as follows: Design and Construction of City Lines, Underground Work, Long-Distance Lines, Wire, Insulators, Exchanges, Switchboards, Propagation of Energy, Telephone Current, Measurement, Properties of City Lines, Interferences from Outside Sources, Properties of Metallic Circuits, Cables, and Composite Working and Wireless Telephony. There are also two appendices—one on oscillations and the other being based upon Carty's paper before the Institute on inductive disturbances in telephone circuits. The style of the book is semi-popular, and in construction has more the appearance of a compilation than a connected treatise. It would form a good basis for a course of lectures to those who wish to get a general idea of the subject. Those looking for a thorough discussion of the subject will have to look elsewhere. Of the new matter that of most importance is an abstract of the introductory non-mathematical portion of Pupin's paper before the Institute at its Philadelphia meeting.

INSTRUCTIONS FOR THE USE OF TELEPHONES. United States Signal Corps, United States Army. Prepared under the direction of General A. W. Greeley, Chief Signal Officer, United States Army, by Captain Samuel Reber, Signal Corps. Washington: Government Printing Office. 34 pages, 20 plates. Price, 75 cents.

By order of the United States War Department officers and men of the Signal Corps are obliged to familiarize themselves not only with the ordinary methods of operating telephone lines, whether the instruments are bridged or in series, but also with the various types of telephones as described in this volume. It is expected that every officer and non-commissioned officer of the Signal Corps shall be able to readily locate and remedy faults, whether they are in the instrument, in the battery, or on the line. After a brief and clear presentation of the principles of speech and of electromagnetic induction a general description of the functions and principles of action of the different elements of a telephone system is given. This is followed by a detailed description of the construction and operation of various commercial types of receivers, transmitters, magnetos, subscribers' sets and switchboards. The book is illustrated with 20 plates, reproduced directly from drawings which evidently were made expressly for the book. A very much better result would have been produced if the engravings had been made by the wax process, the cost of which would have been but a small part of that for finished drawings for direct reproduction.

The Westinghouse Industries at the Pan-American Exposition.

By W. M. Probasco.

It is altogether fitting and proper that Buffalo, situated by the great waters of the North, should invite the peoples of all countries to an exhibition representing the material growth of America. To celebrate the achievements of a century of progress in the Western world is said to be the aim and purpose of the Pan-American Exposition, and although there may have been one or two expositions exceeding it in extent, it is heralded as the most effective ever attempted. The point of greatest significance in any exposition is the thought that countries, like individuals, become provincial unless they exchange their resources, industries, products, inventions, arts and ideas. By increasing the countless articles needed by man, the machinery of the world has brought prosperity, wealth and leisure which in turn have given birth to the beautiful in art. It is, therefore, of the greatest importance that the electrical and mechanical inventions be brought together.

Worthy of the exposition as a whole are the exhibits of the Westinghouse Companies. It was in a broad and liberal spirit that these companies decided to make an exhibit at the Pan-American, for in the city of Buffalo and vicinity the Westinghouse Electric & Manufacturing Company alone has over 150,000 horse-power of electrical machinery in operation, including the ten 5000-hp generators which this pioneer electric company installed at Niagara Falls, at a time when the largest electrical machine built was about 2000 horse-power in capacity. It is this installation that has made possible the most brilliantly lighted of expositions and contributed so successfully to its operation. To the visitor at the Pan-American Exposition the numerous industrial enterprises associated with the name Westinghouse are in the main familiar. Almost every traveler by rail knows that his safety and comfort are in a large measure due to the Westinghouse air brake, which for 30 years has been the standard appliance for arresting the motion of trains. One million two hundred and fifty thousand of these brakes are now in service throughout the world. Those familiar with engineering affairs are acquainted with the very extended use of the steam and gas engines built by the Westinghouse Machine Company. Those who use electrical machinery, whether for lighting, power or traction, know the apparatus built by the Westinghouse Electric & Manufacturing Company. Equally well known are Westinghouse, Church, Kerr & Co., whose work practically covers the entire field of engineering as applied to power systems and their application to transportation, lighting and industry. The Union Switch & Signal Company, manufacturers of every known variety of automatic and semi-automatic railroad signals—makers of frogs and switches and of mechanical, pneumatic and electrical interlocking mechanisms of all kinds; the Sawyer-Man Electric Company, makers of incandescent lamps, whose product has been on the market for over 20 years. These are the Westinghouse Companies that have joined in a common exhibit.

Fig. 1 Main Westinghouse Exhibit in Electricity Building.

Beneath the central dome of the Electricity Building and to the right and left of the main entrance to the Railway Exhibits Building occupying in all over 6500 square feet of space and truly representing the progressive spirit of this century the exhibits of these companies have been placed. The dome of the Electricity Building is tastefully draped with hanging green and lavender bunting, making a background upon which numerous strings of Nernst lamps festoon off from a large 2000-cp lamp placed in the center. There are over a hundred 400-cp Nernst lamps that contribute to this illumination, which is the first public exhibition of the Nernst lamp in America and a notable introduction of one of the greatest developments that has been made in electric lighting.

The operation of two gas engine-generating sets is one of the features of greatest interest in the Electricity Building. The large unit consists of a 300-hp, 3-cylinder, 4-cycle gas engine, direct coupled to a 2200-volt, two-phase, revolving field alternator. The smaller unit is a 3-cylinder, 4-cycle gas engine, direct connected to a 125-volt, direct-current generator. The power furnished by the

large unit is employed partly in supplying current to 130 Nernst lamps at 220 volts, and partly in operating numerous Westinghouse induction motors applied to stationary service. The small gas engine-generating set is used for exciting the large alternating-current generator, for lighting the switchboard, and for charging the storage sparking outfits for both gas engines. It is used also for operating the motor-generator outfit and for lighting four large electric signs, two of which are placed over the main entrances of the Electricity Building. The switchboard for controlling these generators is equipped with the latest type of measuring instruments, switches, circuit breakers and auxiliary apparatus. Other standard switchboards for lighting and power service are in place. A 375-kw alternator, revolving field type, 7200 alternations, is of particular interest.

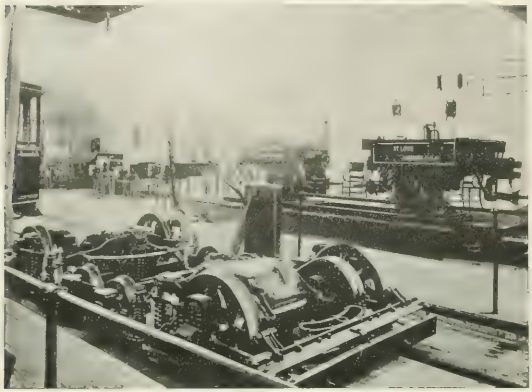


FIG. 2.—MOTOR TRUCK AND MAGNETIC BRAKE.

Of transformers there are to be seen a complete set of the company's O. D. transformers from ¼ to 50 kilowatts, two sizes of manhole-type transformers, and two 100-kw self-cooling, oil-insulated transformers. The latter are used to lower the voltage of the 180-kw machine from 2200 to 110 volts, at which potential they supply the four incandescent signs. These transformers present no radical departure from the excellent type which the Westinghouse Company has standardized.

One of the most novel attractions in the Electricity Building is a high-voltage sign. It consists of two large glass plates covered on the back with metal foil, with the name "Westinghouse" in its center. An alternating pressure having a maximum of 40,000 volts is applied between the foil on the back and the metal letters on the front. As the potential is raised a fringe of violet light appears about the letters which, gradually increasing in intensity, culminates in a myriad branched lightning discharge that plays continuously over the surface of the plate, and is accompanied by a continuous crash not unlike thunder.

Among the railway motors included in the railway exhibit are a Westinghouse 56 motor for heavy suburban and interurban service, a 50-C for heavy railway service, and a 69 motor for city and suburban service. These motors are split horizontally with their suspension on the lower half of the field. The pole faces are smooth and unbroken, and the armature possesses a ventilated winding. The 50-C motor is provided with a special cradle suspension from the car axle, thus removing the not inconsiderable weight of the motors from the car truck. This arrangement minimizes the wear of the rails, increases the life of the wheels and, what is most important, makes an easy riding car. There is also a large number of induction motors adaptable where constant speed is required, and of variable speed motors. These latter are provided with collector rings which serve to carry the induced currents of the secondary to an adjustable external resistance whose operation controls the speed of the motor. The company also exhibits a complete line of detail apparatus, including motors, lightning arresters, fuse blocks, switches, circuit breakers, etc. Included in this comprehensive and interesting exhibit are two large revolving photograph stands containing a great number of pictures which illustrate engineering work of importance, as well as various electrical and mechanical installations of the several companies.

Passing now to the Railway Exhibits Building, which is properly defined as containing all flanged wheel exhibits, we find in the southeast section of this building the exhibit of the Westinghouse Air Brake Comapny. A rack representing a six-car train, including the locomotive, is equipped with the high-speed brake. The air is supplied by four motor-driven duplex air compressors, which are also part of this exhibit. These compressors are especially adapted to supply compressed air for air brakes on electric motor vehicles as well as various other industrial uses. A complete equipment of both the straight air and the storage system of air brakes for electric cars is so arranged on the platform as to show their application to the car.

The necessity of using some sort of power brake to control railway cars operating in urban and interurban service, suggested itself immediately that electric traction became impracticable. The Westinghouse electric brake and car-heating apparatus shown in full operation at the exhibit, more nearly approximates, I believe, the ideal brake for electric cars than any other appliance heretofore invented. The apparatus consists of two elements, a brake and a car heater. The brake may be installed and used independently of the heater, but the operation of the heater is dependent upon the use of the brake, the produced heat being derived from energy that would otherwise be wasted. This combination of a magnetic track brake with a wheel brake of maximum power produces a braking effect greatly in excess of any heretofore attained. Moreover, cars equipped with the complete apparatus are heated without using the line current and therefore without cost for the electrical energy employed in heating.

This system is shown in operation in two exhibits. First, a standard single truck electric car is in constant service on a track extending from the main exhibit in the Railway Exhibits Building to a point east of the building some 250 ft. This car is equipped with the electric brake and car heater complete, and is in charge of a regular street car motorman, who is in readiness at any time to demonstrate the operation of the system to those interested. When in action powerful magnets force the brake friction shoes upon the rails and set up a strong magnetic attraction between the shoes and the rails, while at the same time the drag or back action of these magnet shoes throws in action a system of levers that apply to the wheels brake shoes of the regular type. The current for exciting the magnets is supplied by the motor which, through the proper wiring of the controllers, is at this time operated as a generator. With this electric brake system it is impossible to skid the wheels, and any degree of braking power is secured from the slightest effect up to a braking effect exceeding the weight of the equipment. Second, a double truck of the maximum traction type equipped with two 40-hp motors and with the electric brake, is operated on a short section of track by a stationary controller. This equipment shows the enormous braking power of the apparatus and the absolute freedom from skidding of the wheels. The smooth action of this brake is one of its chief features, there being no shock or sudden jolts during its application.

FIG. 3.—TROLLEY CAR EXHIBIT.

The space occupied by the Union Switch & Signal Company is located just west of the Westinghouse Air Brake Company's ex-

hibit. It contains three of the most important signaling systems owned and manufactured by them—the Westinghouse electro-pneumatic interlocking and signaling system, the "wireless" system of automatic electric block signaling, and the high-speed electric train staff system. The electro-pneumatic exhibit is located at the west end of the space and consists of a two-lever section of the latest pattern, electro-pneumatic interlocking machine, a double-arm iron post signal, a dwarf signal, and a switch-and-lock movement operating a single switch point complete with detector bar, rocker shaft, electric switch, valve cylinder, etc. These appliances are connected and working. They represent a part of the signaling required for a

FIG. 4.—EXHIBIT OF RAILWAY SIGNALS AND SWITCHES.

single track main line turn out. Sections of some of the principal parts are also displayed.

The working of the "wireless" system of automatic electric block signaling is shown on a model track 50 ft. long, divided into two blocks and representing one line of a double-track railway with a side track connected at both ends for returning the model engine or car without running against traffic. The switch at the west end is also equipped with a switch instrument and indicators to illustrate the protection provided against misplaced switches, or trains from sidings entering on or fouling the main track.

Two of the Union Switch & Signal Company's latest type of electric semaphore signals—a single and double arm—are operated automatically from the model track and the complete exhibit shows plainly the working of automatic home and distant block signals under the "wireless" systems. Several of the separate appliances used in this and other systems are on view, including semaphore mechanisms and motors, battery chutes, relay boxes, cranks, wheels, jars, etc. Two of the high-speed electric train staff instruments connected and working show the practicability of operating trains on single track railroads by means of this system and without the use of train orders. Photographs and drawings of various appliances and plants built and installed by the Union Switch & Signal Company, together with a view of their new and greatly enlarged works at Swissvale, Pa., are also a part of the exhibit.

Altogether it may be said that under various names, but deriving their initial impetus and origin from one source, the industries to which I have directed attention, constitute one of the most impressive and interesting features of the beautiful Pan-American.

P. & B. and P. A. E.

The friends of the Standard Paint Company, manufacturers of the P. & B. goods, New York and Chicago, are receiving a cordial invitation not only to visit the P. & B. pavilion at the Pan-American Exposition, but to make it their headquarters. The invitation which is a handsome engraved steel plate card, reads as follows: "During your stay at the Pan-American Exposition in Buffalo, we cordially invite you to make your headquarters at our pavilion, which is located near the East Amherst Gate, directly south of the Canadian Building, where you can keep appointments or have your mail sent in our care. The Standard Paint Company."

The convenient location of the P. & B. pavilion near one of the gates of the Exposition and the unique character not alone of the exhibit itself, but of the handsome building in which it is placed, is attracting many visitors, curious to see it. The pavilion is a very interesting affair, being constructed entirely inside and outside, walls, ceilings and floors of the Ruberoid Roofing made by the Standard Paint Company. Ruberoid enjoys the distinction of occupying one of the seven or eight individual exhibition buildings at the Pan-American. The P. & B. pavilion is well lighted. The Ruberoid of which it is built is handsomely painted both inside and outside with oil colors. The exterior color scheme is white and gold, with the dome-shaped roof in blue. The interior is ornamented with designs of various kinds in appropriate colors.

The pavilion is the one which attracted so much attention at the Paris Exposition. Inside of it are shown samples of all the P. & B. goods, such as the Ruberoid roofing and flooring, insulating, building and lining papers, preservative paints and electrical compounds. Representatives of the Standard Paint Company are in constant attendance at the exhibit.

Lea Arc Lamps at the Pan-American.

The Lea Electric Manufacturing Company, of Elwood, Ind., has an attractive display of arc lamps at the Pan-American Exposition. One distinctive feature of all these lamps is the split cover on hinges which permits of easy access to the mechanism. The miniature lamp, which is one of the strongest features, burns on 2½ amperes on 110-volt circuit, or 1¼ amperes on 220-volt circuit, giving 75

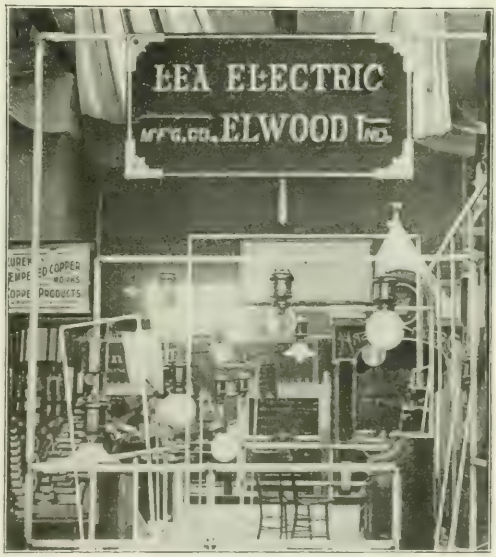


EXHIBIT OF ARC LAMPS.

hours' life with 9-16-inch carbon. The regular alternating lamp takes 5 amperes at 90 volts on either 60 or 120 cycles. Regular direct-current lamps of similar size, for all voltages up to 500 are, of course, exhibited. Street railway men are interested in the Northall headlight, which is made to burn either direct on 500 volts or in series with incandescent lamps in the car, thereby doing away with wasteful resistance.

Electric Roads for Russia.

A St. Petersburg dispatch says that M. de Witte, Minister of Finance, will shortly go to Berlin to negotiate with German financiers in regard to electric tramways and other municipal enterprises in Russia. While in Berlin M. de Witte will probably confer with Count von Bulow, the Imperial Chancellor. Afterward he will visit London.

Holophane Exhibit at the Pan-American.

The Holophane Glass Company has hit upon a very simple and effective way of illustrating the quality of its wares to the general public at its Pan-American exhibit. In the rear of its very handsome booth, the exterior of which is shown in the accompanying illustration, is a dark room for photometric purposes. In this is a regular photometer with which the engineer can make tests. But that does not appeal to the great light-using public. Something less technical and more easily tried is necessary for the layman. One end of the room is partitioned off into two alcoves, the interior of

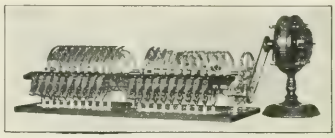
GLASS GLOBE EXHIBIT AT THE PAN-AMERICAN.

both of which can be seen from the other end of the room. The difference in illumination and diffusion between the lights covered with Holophane globes in one room, and those without in the other room can be seen at a glance, and is convincing to the veriest layman.

The Reynolds Flasher.

The "Original Reynolds Flasher" (current controller) is an automatic rotary jack-knife switch for controlling the current of incandescent lamps, transferring or switching the current from one or a cluster of lamps in any manner desired, giving what is called the flashing or changeable effect to incandescent lamps. The flasher is mounted on a slate base. The wheels or disks constituting the drum are revolved on a steel shaft by means of a gearing at the end of the shaft, which is driven by a small electric motor, usually a 12-inch fan motor. The wheels or disks have segments or lugs attached to the rim by clamps of various lengths, from 1-16 to about 8 inches long, these segments being adjustable so that an unlimited number of combinations may be made with them. On the front of the flasher is a slate shelf on which are fastened the blade holders or hangers, and the blades with fibre blocks are riveted to the ends. On the base is fastened a brass casting with improved flexible forks made of spring brass. As the drum revolves the segments on the wheels bear down on the fibre tips of the blades, the blades being driven into forks to close the contact. The service mains are connected to a brass bar on the base. The lead wires from sign to cluster of lamps are fastened to the blade hangers, thus the drum is only mechanical, no part of the flasher being charged with electric current excepting from the blade hanger to the bar holding the forks. The flasher is used in various ways for electric signs, show window decorations, electric flags and designs for out-door electrical displays. When attached to an electric sign the effectiveness and attractiveness of the sign is increased a hundred-fold by flashing on and off single letters or entire words. For electric flags it produces the waving effect. The combined points of economy, cutting down the cost of electric current, and its advertising power are a great incentive for business firms to use this flasher.

The "Original Reynolds Flasher" has been used for years, and it is made of few simple parts, resulting in a compact, well-built device that meets all demands. It is approved of by the National

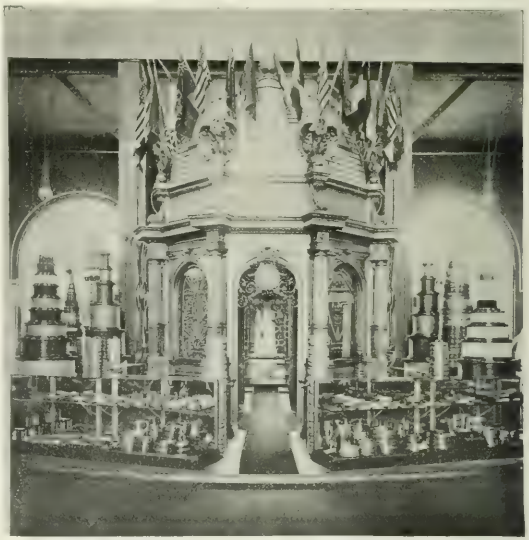


LAMP FLASHING MECHANISM.

Board of Fire Underwriters, and is being largely used by enterprising business houses. It is manufactured by Reynolds Electric Company, of Chicago.

American Steel and Wire Company at the Pan-American.

The American Steel & Wire Company in the Machinery and Transportation Building at the Pan-American Exposition has one of the most comprehensive exhibits in that line ever made in the industry. Every kind of wire or cable commercially manufactured is shown. Electrical men will be most interested in the display of copper and aluminum wires and cables of "Crown" brand, and also



WIRE EXHIBIT AT THE PAN-AMERICAN.

in the exhibit of rail bonds which is somewhat evolutionary in character. It begins with the "Chicago" rail bond, which was invented by H. R. Keithley, of the Chicago City Railway, in 1893, and which filled such a need at the time. This bond is a solid bond with thimbles swaged on the ends. The "Crown" bond, which is a heavy cable, flexible bond made to go under the fish plates, is the latest type of bond shown. Wires for every conceivable electrical purpose are shown. N. H. Van Sicklen, of the Chicago office, is in charge.

Enclosed Resistances.

The construction of the type of resistances shown in the accompanying illustrations, consists briefly in employing a metal shell or casing, within which the resistance is contained in a thin layer of vitreous insulation completely surrounding and hermetically sealing the resistance, which insulation is also held in intimate contact with the inner walls of the metal casing. With this construction an apparatus is provided in which the resistance is not only sealed in a high insulating material, but is also so disposed with reference to the metallic casing as to provide rapid conduction or flux of heat to the metal casing, the outside of which is the dissipating surface.

In perfecting the details of this apparatus one object has been to work out carefully in every detail a construction which will make a resistance good for a number of years, if not too greatly abused. An illustration is the method in fastening the terminal points to the resistance. In the case of each terminal an iron or copper screw is employed to bring the current from the resistance within the iron casing to the terminal point without, which copper or iron screw is securely brazed to the resistance conductor, the brazed joint being sealed within the vitreous insualtion.

A comparatively heavy shell of iron is employed, not only for mechanical strength, but also to provide considerable cross section for the rapid conduction of heat from one part of the plate to the other, so as to keep the temperature quite uniform throughout the surface of the plate, regardless of the steps in circuit.

These plates are made in four sizes, namely, 4 by 8 inches, 5 by 12 inches, 7 by 14 inches and 7 by 21 inches, and are substantially as shown in Fig. 4. When banked together they appear as shown in Figs. 2 and 3, and provide a construction which is comparatively compact, and which admits of free ventilation. When the plates are so banked together for convenience, the terminals are all brought out to a common iron strap on one edge of the plate, where a terminal connector bored for a proper size cable is provided for each terminal of the resistance. This makes the apparatus very easy to wire up where the controller is furnished separate from the resistance. This type of resistance is not only suitable for continuous regulation, but is equally suitable for intermittent and starting service. It is particularly suitable for use in damp locations, such as mines, or where the apparatus is likely to be exposed to the weather, as there is nothing to be affected by dampness, since the only materials which enter into the construction are metal, glass and resistance material combined in one solid mass.

To meet the cases where self-contained switches are desirable, a complete line of these have been devised for different kinds of service in the manufacture of rheostats. Round button contacts have

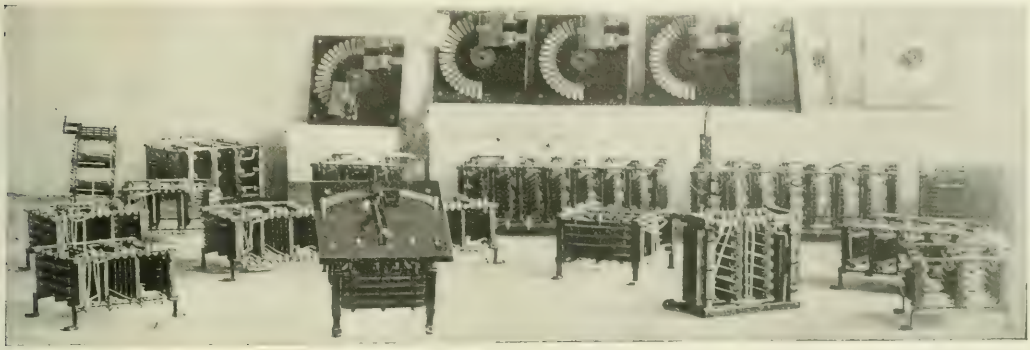
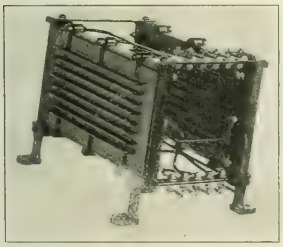
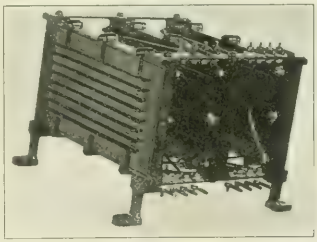


Fig. 1.—Group of Enclosed Resistances.





Figs. 2 and 3.—Banks of Enclosed Resistances.

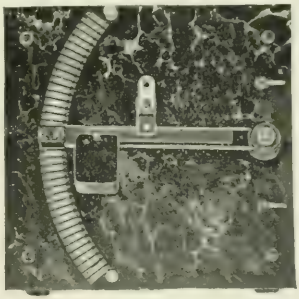


Fig. 5.—Organ Motor Regulator.

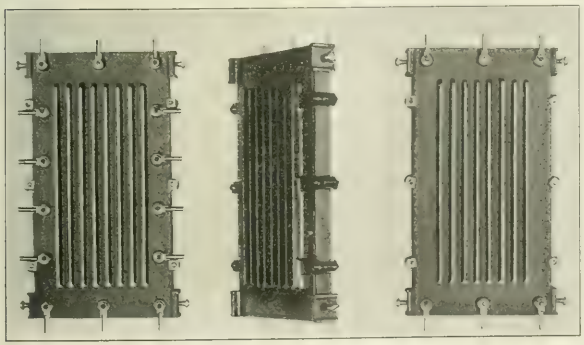


Fig. 4.—Enclosed Resistance Plates.

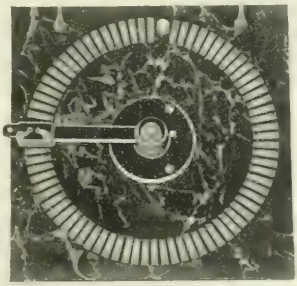


Fig. 6.—Field Controller.

not been employed in the construction of these switches, except for very small current, but sector-shaped pieces employed, such as shown in Figs. 10 and 16.

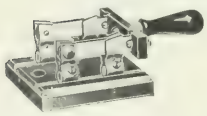
In combination with the sector-shaped pieces, multiple contact fingers are used, not less than two in number, their number depending upon the current capacity of the switch. These multiple contact fingers each consist of a copper block pressed down upon the switch block by steel springs and driven by steel pins, the current being carried from the switch arm to the contact fingers by a small flexible cable. These contact fingers are all standard parts made by special machinery, as well as the steel pins, springs and other parts which work in combination with them, so as to be easily and cheaply replaced in case of accident. By this design the contact can be made very effective between the switch arm and the contact blocks without the friction commonly incident to switches of considerable current capacity.

Fig. 5 shows a switch of an organ-motor regulator. In this apparatus the weight and also the swivel attachment for the cord are adjustable by a set screw entirely independent of each other, and almost the entire length of the switch arm. This in connection with the multiple contact fingers of the construction above described, together with the sector-shaped contact pieces, gives the perfect freedom of movement, which is so essential in an apparatus of this character which has to work automatically.

Fig. 6 shows a switch forming part of a field controller arranged for the back of a board, with 75 steps or divisions of the resistances, and is the type of switch designed for back of board field controllers, as well as other similar apparatus. Fig. 1 is a view of a number of different instruments. The large switches in the background are for mounting on the back of a switchboard controlled by a hand wheel on the front. These switches are used for starting large rotary transformers with about 100 amperes starting torque, and 700 amperes continuous capacity on the short circuit position when the knife blade switches are engaged. Some of the resistances to be used in connection with these switches are shown in the cut. An organ-motor regulator is also shown in the foreground.

The apparatus above described is manufactured by the Carpenter Enclosed Resistance Company, 79 East 130th Street, New York. Mr. C. E. Carpenter, its vice-president, is prominently known in the department of rheostats and resistances, and was, it is believed, the first person to form a company specially devoted to their manufacture, organizing it in the spring of 1892. From that time on, he has devoted himself almost exclusively to the production of rheostats of all descriptions, being thus not only a pioneer inventor, but a steady worker in the line of producing enamel rheostats now used so universally for controlling the fields of dynamos and the speed of small motors.

Slate Base for Baby Knife Switches.



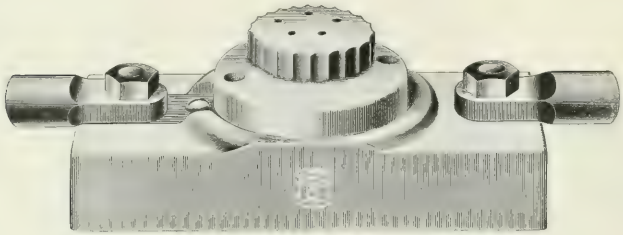
We illustrate herewith a small knife switch generally designated as a "Baby Knife Switch," but which is a radical departure from any construction heretofore used in devices for this purpose. Other small switches have been confined to a porcelain base, and owing to the necessary irregularity of this material, there has been much difficulty in getting the parts uniform and in adjustment. The base of this switch is Monson slate. The holes are drilled in steel templates. The metal contacts are exactly alike, being formed of a bushing of thick metal, one-half of which is fitted exactly to the V-groove in the base, the other half being cylindrical. Around this bushing is formed and riveted the contact proper, and through the two pieces of metal are tapped the thread for the holding-on screw and the wire-binding screw. The hinge joint contact is made secure by having the metal on the contact so formed, as to bring a continuous tension onto the switch blade. All parts are made by automatic machinery, which insures absolute uniformity. The switches are being manufactured and put on the market by the Marshall-Sanders Company, of Boston.

Cluster Fixtures.

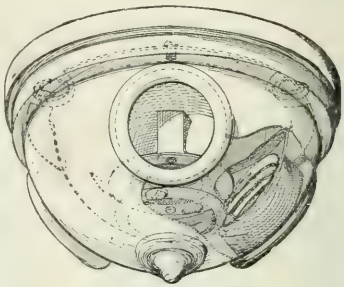
We illustrate herewith a cluster fixture being placed on the market by the Benjamin Electric Manufacturing Company, of 1992 West Van Buren Street, Chicago, with the object of complying with the requirements of the National Board of Fire Underwriters. The clusters consist primarily of a porcelain base upon which are mounted two contact plates each provided with a binding screw and serving like terminals on all the lamps in the cluster. A removable casing (brass or aluminum) insulated from the contacts by porcelain bushings, gives ready access to binding screws. The base is provided with openings for the leading in wires and supporting screws and, in accordance with the Underwriters' rules, all screws which hold the contacts are counter-sunk and cemented in the back. The series clusters differ from the multiple form in that the contact plates are made in sections, each serving for two lamps, the inner and outer ones overlapping each other, but the first and last contacts in the series are necessarily single ones and they carry the binding screws.

These clusters are in two sizes with 2½-inch and 4-inch base. The former is made in two lights only, and the latter ranges from two to six lights, in both Edison and T.-H. base. They are made with enameled tin and polished aluminum reflectors in two sizes (10 inches and 13 inches) to fit over the base of cluster.

For conduit work are provided cast-iron flanges tapped for ½-inch iron pipe to which the cluster is attached and for out-door work, we add a canopy which serves as a watershed and reflector. They are also made in pendant form any length with crowfoot and canopy.



GOODWIN FUSE BLOCK.



CLUSTER FIXTURE.

New Fuse Block.

As we noted at the time in our columns, the Underwriters' National Electrical Association has recently laid down requirements as to fuse blocks, which some years ago would have been considered extremely stringent, the report giving specifications relating to such blocks which bar many of the older types. The fuse block shown in the accompanying illustration has been designed strictly to meet these requirements, and also embodies some specific advances. The block is made in sizes suitable for currents of from 10 to 100 amperes on circuits operated at 125 and 250 volts. For 125 volts the block is fused with the ordinary fuse wire of proper capacity. For 250 volts a special fuse is used, which is claimed to combine the advantages of the best enclosed fuse, besides being placed in a strong porcelain receptacle. A tell-tale button projects through the block and indicates positively whether or not the fuse has blown. This is an entirely mechanical feature and does not expose any of the electrically connected parts.

The block, which is the invention of Mr. W. R. Goodwin, of the Chicago Fuse Wire & Manufacturing Company, measures only 6 inches in length and 2½ inches in width for use on a circuit of 100 amperes at 250 volts.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was marked by rather sharp revulsions of feeling, and by a marked change for the better as soon as some of the humidity that has so long wilted the brokers' collars went West to help the corn. The trouble is there has been too much moisture in New York and too little in Kansas, but things have now been evened up a bit. Even as it was, people were more scared than hurt, for the short corn crop at current quotations is worth about $950,000,000, or $200,000,000 more than last year's big crop at the lower figures, while the wheat crop is a bumper, and all the world wants some. What there is depressing in all that is rather hard to find out, and now that the "big" steel strike has flattened out, Wall Street will probably let prices get somewhere near to real values again. Owing to the heat and the summer holiday dullness, there was not much activity in the market. The range of quotations is given below:

NEW YORK.

	July 20.	July 27.		July 20.	July 27.
American Tel. & Cable	100	—	General Electric	255	255
American Dist. Tel.	34	—	General Carriage	1½	—
Brooklyn Rapid Transit	77¼	77	Hudson River Tel.	120	120
Commercial Cable	—	—	Illinois Elec. Veh. Trans.	⅝	—
Electric Boat	17	16	Metropolitan Street Ry.	168¼	168
Electric Boat pfd.	43	40	N. E. Elec. Veh. Tran.	3	3
Electric Lead Reduc'n	1⅞	—	N. Y. Elec. Veh. Tran.	11½	11½
Electric Vehicle	9	6	N. Y. & N. J. Tel.	170	—
Electric Vehicle pfd.	16	16	Tel. & Tel. Co. of Am.	4	4
			Western Union Tel.	91⅞	92¼

BOSTON.

	July 20	July 27.		July 20.	July 27
Am. Tel. & Tel.	163	161	Mexican Telephone	2⅛	2½
Edison Electric Light		255	New England Telephone	—	134
Erie Telephone	48	48	Westinghouse Elec.	67	68
General Electric pfd.		203	Westinghouse Elec. pfd.	*79½	*79½

PHILADELPHIA.

	July 20.	July 27.		July 20.	July 27.
American Railways	39½	40	General Electric Auto	—	—
Electric Storage Battery	85	80	Philadelphia Electric	5⅝	5¼
Elec. Storage Batt'y pfd.	88	80	Pa. Electric Vehicle	1	—
Elec. Co. of America	6½	7	Pa. Elec. Veh. pfd.	1	

CHICAGO.

	July 20.	July 27.		July 20.	July 27.
Chicago Edison	176	176	National Carbon pfd.	86½	86½
Chicago City Ry.	206	206	Northwest Elev. com.	45	44
Chicago Telep. Co.	*275	275	Union Traction	17½	18
National Carbon	16½	16½	Union Traction pfd.	58	58

*Asked.

WESTERN UNION RUMORS.—Discussing recent rumors of Western Union-Postal Telegraph-Bell Telephone consolidation, the Wall Street News Bureau remarks: A fact in favor of Western Union is that the stock has had only one period of speculative activity in the last four years. Mr. Gould and Mr. Rockefeller made a campaign in the stock some time ago, in which the price ran above par. It is supposed that on the decline since May this interest has recovered a line of stock and is now in a move intended to carry the price higher than it went before. There is the advantage in buying Western Union that if a speculative purchase does not prove profitable the holder has a very safe investment. The story of a consolidation of Western Union with Bell Telephone came from Boston, and was exploited with some diligence. After what has occurred, it would be rash to say there is anything which cannot occur. But the chances at present are certainly against a telephone-telegraph consolidation. It is very likely true that the matter has been discussed as stated, because reports of such discussion would have speculative value, although without result. We think Western Union can be bulled better on its value at present than on combination rumors.

TELEPHONE, TELEGRAPH & CABLE.—It is stated that the directors of the Telephone, Telegraph & Cable Company, of America, will meet early in August to consider the reorganization of the company. It is planned to raise additional capital and actively push the business of the company. President Thomas says: "Our ultimate plan is this: We propose to connect Boston, New York, Albany and Philadelphia and all intermediate cities with our own wires. This will require several years to accomplish, and will probably demand $9,000,000 the first year after we start our campaign and $5,000,000 the second year. We hope some day to have 100,000 subscribers in Greater New York, and this would cost $20,000,000. When these plans are fully consummated, we will connect with the Interstate Telephone Company, which is operating in New Jersey, and also with the Keystone Telephone Company, which controls the independent telephone movement in Philadelphia. Our contracts with these two companies are signed. From Ohio and the West we will be connected by means of the Interocean Telephone Company, which is extending its wires along the Erie and New York Central Railroads. We will connect with this company at Albany. The plans of the independent telephone people are far-reaching and will end in there being two great telephone systems. I do not believe that the Western Union Telegraph Company is seeking control of its rivals, nor do I think it will enter the telephone field. We have not been approached."

CONSOLIDATION AT OMAHA.—The consolidation of the local street railway facilities, water works, electric light plant, gas plant and the street car lines connecting Omaha and Council Bluffs is well under way. The consolidated companies will be known as the Omaha Transportation & Power Company. The stock issue of all the companies involved will be largely increased by the issue of stock of the consolidated company. The Platte River Canal will be constructed and owned by this company, and from this source cheap power will be derived. Water sufficient will be diverted from the Platte River to operate all the consolidated industries. It will be transmitted by wires a distance of 40 miles to Omaha, and distributed throughout the city. Five million dollars will be invested in dams, engines, wires and suburban street railway facilities.

CHICAGO UNION TRACTION.—The Chicago Union Traction Company has held its annual meeting. Last year the company placed $4,000 to the surplus account after paying $150,000 in dividends. This year the dividends have been passed. There will be none until the franchise question is settled. Shareholders are informed that the completion of the Northwestern Elevated Road, and the opening of all stations on its line, has taken many thousands of passengers from the surface lines; that the Consolidated Traction Company purchased from Mr. C. T. Yerkes has added to their losses, and that the surplus has been drawn upon to make good the fixed charges of the company.

EDISON PORTLAND CEMENT.—Edison Portland Cement Company's initial plant has been financed by an underwriting syndicate taking a block of $500,000 preferred stock and some common stock which had been reserved in the treasury. Substantially all of the $9,000,000 common and $1,500,000 of the authorized $2,000,000 preferred is now issued and outstanding. The original unit now to be put in operation, as soon as it can be completed, which it is hoped will be early next year, will have a capacity of at least 1500 bbls. per day, and eventually 4500. The plant is so constructed that by an extension of 30 per cent of the original, a productive capacity of 10,000 bbls. a day is claimed.

TWIN CITY TROLLEY PROSPERITY.—The directors of the Twin City Rapid Transit Company have placed the common stock on a 4 per cent dividend basis, having declared a semi-annual dividend of 2 per cent on the common stock lately out of the earnings for the six months ending June 30, 1901. After the payment of the dividend, there was left a surplus of $34,475 for the six months ended June 30, which compares with a surplus of $30,436 after 1½ per cent was paid on the common stock for the corresponding period in 1900. President Lowry says that the earnings for the year ending Dec. 31, 1901, will show something like 6 per cent earned on the common stock.

UNITED POWER & TRANSPORTATION.—An assessment of $5 a share has been called on the United Power & Transportation Company stock, payable on or before Oct. 1. The present call makes the stock full-paid $25, removing all assessment liabilities. A director says: "We are spending this year nearly $2,000,000 for improvements, extensions and for newly acquired properties, and it is in this direction that the proceeds of the present call will be applied. An offer to lease the Reading Southwestern will be made next week, and we expect it will be accepted."

ENGLISH CAPITAL IN AMERICAN SECURITIES.—The chairman of the London & Westminister Bank, one of the largest institutions of its kind in England, declared at the annual meeting of the shareholders that English capitalists were again heavily investing in American securities. In 1890, he said, of all the advances made upon various securities, 33 per cent were on American. The proportion now, according to the chairman, is 48 per cent.

TELEPHONE CONSOLIDATION.—At Reading, Pa., on July 27, Mr. T. K. Leidy filed articles in amendment of the charter of the Schuylkill Valley Telephone Company. The company seeks to change its name to the Consolidated Telephone Companies, of Pennsylvania, and to increase its capital stock from $400,000 to $4,000,000. The object of increasing its capital is the purchase of a number of companies which are to be a part of the new combination.

DIVIDENDS.—The directors of the Denver City Tramway Company have declared the usual quarterly dividend of 1 per cent, payable Aug. 16. The Hudson River Telephone Company has declared the regular quarterly dividend of 1¼ per cent, payable Aug. 1. The directors of the Telephone Company have decided to expend between $200,000 and $250,000 to put the Troy service in fine modern condition. The Chicago Edison Company has declared the regular quarterly dividend of 2 per cent, payable Aug. 1. Books close July 25 and reopen Aug. 2. The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent, payable Aug. 15. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on its assenting stock, payable Aug. 15.

CENTRAL LONDON UNDERGROUND.—The Central London Underground Railway, otherwise known as the "Tuppenny Tube," has declared a half-yearly dividend at the rate of 4 per cent per annum and carried forward £19,000. The company has £440,100 in 4 per cent preferred shares and an equal amount in common. The line was opened in July, 1900. A dividend of 2 per cent per full share was paid in February.

MOBILE, ALA., CONSOLIDATION.—The Mobile Gas Light & Coke Company and the Electric Lighting Company, of Mobile, have each called meetings for Aug. 21, to consider a consolidation of interests. Plans for the consolidation are said to have been tentatively agreed upon.

BOSTON ELEVATED.—Directors of the Boston Elevated have declared a semi-annual dividend of 3½ per cent. This is an increase from a 4½ per cent to 7 per cent basis. The declaration of this dividend necessitates the division of 1 per cent or $100,000 with the State.

GENERAL ELECTRIC.—There are reports current that the long-delayed General Electric "melon" may be cut early this fall, and that a scrip dividend will be made representing the capital reduction in 1898, when the capitalization was literally cut in two.

THE ELECTRIC COMPANY OF AMERICA reports that the June net earnings of the 13 plants which it is operating show an increase of 23 per cent over those of the corresponding month in 1900.

AMSTERDAM, N. Y., TROLLEYS.—The Amsterdam Street Railway Company has voted to increase its capital stock from $250,000 to $1,000,000.

Commercial Intelligence.

THE WEEK IN TRADE was naturally influenced by the serious condition of the corn crop and by the steel strike; but not so much as the reports from the stock market might indicate, and now that both depressing influences have been minimized by the joint work of God and man, the solid conditions of a very stable prosperity again come into evidence. The demand for iron and steel is remarkably strong, and any lowering of price only brings more buying on a larger scale. As to general conditions, it is noted that retail trade in the West has never been better. Railroad earnings for half of July are 10.3 per cent in excess of last year, and 23.9 per cent over 1899. Bank clearings show a gain at New York of 82.5 per cent from 1900 and 56.4 per cent from 1899; while at leading cities outside New York the gain is 23.2 per cent over 1900 and 16.6 over 1899. The active demand for finished metal products, such as tin plates, iron and steel bars, hoops and sheets, is reducing jobbers' stocks rapidly and causing high premiums, such as $18 on sheets, $20 on tin plate, $5 on hoops, and $2 per ton on bar iron and skelp at Pittsburg, where a heavy business has been booked for structural material. No prices have formally been fixed for steel rails, but some business has been placed for next year at $28. Business failures in the United States for the week were 199, as against 208 last yeek, 183 this week a year ago, 170 in 1899, 189 in 1898 and 259 in 1897.

THE COALZACOALCOS REPAIR SHOPS, of the National Tehauntepec Railway, Mexico, are to be installed with American machine tools, driven by American motors. The Westinghouse Electric & Manufacturing Company has secured the electrical portion of the contract, and the Morgan Engineering Company, of Alliance, Ohio, will build the crane equipment. Milliken Brothers, Bowling Green Building, 7-11 Broadway, hold the original contract for the erection and complete equipment of the Coalzacoalcos shops, but as they are mainly interested in the supply of structural material the machinery end of the contract is being sub-let by them. The order regarding the machine tools has not yet been placed. The Tehauntepec Railroad is being constructed on behalf of the Mexican Government by the British contracting firm of S. Pearson & Son, which is purchasing considerable material, rolling stock, machinery, etc., in this market. The Pearson Company's offices are in the City of Mexico and London.

RUSSIA AND SIBERIA.—Some important contracts have recently been placed in this market through local export houses having connections with the Russian and Siberian trades. While a policy of great secrecy is being pursued as to the exact ultimate destination of the goods ordered, which in the first instance will be shipped to Port Arthur, it is believed that the contracts are placed here principally on behalf of the Chinese Eastern Railway authorities. One commission house alone is reported to have closed contracts within the last month for close on $200,000 worth of various American material, machinery, etc. The Worthington branch of the International Pump Company is understood to have received some large orders for pumping equipments, and Edward J. Etting, of 39 Cortlandt Street, has secured a fair-sized cupola order, which will be turned out by the Whiting Foundry & Machine Company, of Harvey, Ill. Some foundry supplies, including molding machinery, will be supplied by Byram & Co., of Detroit, Mich.

THE CONSUMERS' LIGHT & POWER COMPANY, of Middletown, N. Y., has placed a contract with Westinghouse, Church, Kerr & Co., for two compound vertical engines of 160 horse-power each. The Westinghouse people have also secured orders for all the necessary piping, condensers, heating apparatus, pumping equipment, etc., which will be sub-let by that firm. Two three-phase alternating-current generators of 100 kilowatts, with the requisite exciters for direct connection with same, will be furnished by the General Electric Company. The contract for boilers, stack and smoke flue has been allotted to the Hogan Boiler Works, 79 Broadway. The boilers will be water-tube ones of 150 horse-power each. The Middletown concern is now in the market for arc lamps, wire, poles and general material for line work for a general system of lighting, which it is intended to operate from their new plant.

INCREASE IN CANADIAN TRADE.—From unrevised figures obtained at the Department of Customs, it would appear that the foreign trade of Canada last year amounted to about $394,000,000, or about $13,000,000 more than the previous year, which was by far the largest in the history of the country. There was an increase of about $15,000,000, or 60 per cent, in exports of produce of the mine, and a growth of $2,000,000 in manufactures exported. The exports of produce of the farm, fisheries and forest have been practically stationary. The exports of foreign produce from Canada amounted to $20,379,212. In 1900 they were $21,252,354. Foreign farm produce to the value of $15,820,302 was imported by Canadian routes, while the year previous such imports amounted to $12,101,212. The total imports entered for consumption were $181,225,389; for the year previous they amounted to $180,804,316.

SNOQUALMIE FALLS POWER EXTENSION.—Charles H. Baker, president of the Snoqualmie Falls Power Company, announces that his company has completed plans for the construction of a new power plant at the falls, and the installation of new machinery which will more than double the present capacity of the plant. The company will spend approximately $350,000 on improvements. A new power chamber is to be excavated in the solid rock just north of the present chamber. Three generators of 4000 horse-power each will be installed. They will be operated by impact water-wheels of similar pattern to those now at the station, save that the wheels will be larger. One generator has already been ordered from the East.

MR. HARRY S. STALLKNECHT, of New York City, and his associates have secured franchises which permit of the utilization of water powers in Puerto Rico. There are seven small rivers on the island available for the development of power. The largest is in the vicinity of San Juan, and will show a capacity of 1500 horse-power, while the six others aggregate 6500 horse-power. Projects are now said to be under consideration with a view to the taking advantage of such power for industrial purposes. Mr. Stallknecht's offices are located in the Broad Exchange Building, 26 Broad Street.

MR. H. S. LOUD, managing director of the British Westinghouse Electric & Manufacturing Company, Limited, has just returned from Europe, whither he recently went for the purpose of inspecting the progress made in the construction of the Manchester plant and conferring with the English interests of the company as to the placing of contracts for equipment, etc. Mr. Loud is now in Pittsburg.

MR. F. A. ESTEP, president of the street car supply house of R. D. Nuttall Company, Pittsburg, Pa., sailed last week for Europe on a business trip. While abroad Mr. Estep will establish several additional agencies for the sale of his company's specialties in various parts of Continental Europe. The Nuttall Company is now filling fair-sized contracts for Great Britain, the Netherlands and Italy.

McCARTHY BROTHERS & FORD, of Buffalo, N. Y., have obtained an order for marbleized switchboards, which are to be shipped to the Singapore branch of the American electrical engineering and contracting firm of Bagnall & Hilles.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended July 25: Antwerp—202 packages electrical material, $7,464; 28 packages electrical machinery, $772. Argentine Republic —1 package electrical machinery, $67; 3 cases electric machinery, $557. Amsterdam—1 motor vehicle, $850; 2 cases electrical material, $40. British Possessions in Africa—1 package electrical material, $25. British East Indies—59 cases electrical material, $2,213; 150 cases electrical machinery, $3,249. Brazil—61 packages electrical material, $2,140. Bremen—1 package electrical material, $10. British West Indies—38 packages electrical material, $2,031; 1 case electrical machinery, $729. Cuba—9 cases electrical machinery, $1,265; 211 packages electrical material, $9,293. Central America—11 cases electrical material, $310. Cologne—6 packages electrical machinery, $400. Danish West Indies—1 package electrical material, $10. Dutch West Indies—4 packages electrical material, $70. Ecuador—53 packages electrical material, $1,140. Glasgow—19 packages electrical machinery, $2,900; 3 cases electrical material, $88. Hamburg—1 package electrical machinery, $18; 31 packages electrical material, $1,626. Havre—20 packages electrical material, $1,250; 6 cases electrical machinery, $231. London—202 cases electrical machinery, $9,496; 115 cases electrical material, $4,047. Liverpool—22 cases electrical machinery, $3,040; 54 cases electrical material, $2,004; 2 cases motor vehicles, $1,800. Mulheim—1 case electrical machinery, $125. Mexico—10 packages electrical material, $2,356; 1 package electrical machinery, $52. Manchester—17 cases electrical machinery, $1,643. Peru—1 case electrical material, $13; 88 cases electrical machinery, $7,000. Newcastle—43 cases electrical machinery, $5,250. Rotterdam—1 case electrical material, $100. Southampton—98 cases electrical machinery, $14,742. Santander—1 case electros, $6. St. Petersburg—2 packages electrical material, $132. U. S. Colombia—2 cases electrical material, $75; 2 cases electrical machinery, $172. Venezuela—35 cases electrical material, $906; 7 cases electrical machinery, $172. Walsall—11 packages electrical material, $520.

THE UNITED STATES & AUSTRALASIAN SHIPPING COMPANY'S steamship, "Knight of St. George,' is scheduled to sail July 29 for Sydney, with one of the most valuable cargoes ever forwarded from this country to the Antipodes. The vessel will carry not far short of 11,000 tons, which will represent an aggregate value of nearly $1,500,000. The principal item in the cargo will be electrical machinery intended to be installed in the central generating station of the Sydney City & Suburban Tramways. The Allis-Chalmers Company have forwarded from their Milwaukee plant a 32 by 64 by 60 vertical cross-compound engine, which will develop a nominal capacity of 1500 horse-power. This machine has been carried by rail from the West on 13 cars, representing a weight of almost 225 tons. The bed plate alone weighs nearly 50,000 lbs. This is the first of the three similar Allis engines ordered for installation in the Sydney plant. The Harrisburg Foundry & Machine Company, of Harrisburg, Pa., whose New York offices are in the Mail and Express Building, is forwarding a 9 and 16½ by 12 R. H. Standard tandem-compound engine, which is to be direct connected to a 100-kw generator to be furnished by the General Electric Company. The pumping equipment is being supplied by the Worthington branch of the International Pump Company. Another Allis engine is to be shipped, according to present arrangements, in September, while the last machine is to be forwarded in October. The "Knight of St. George" will also carry over $100,000 worth of electrical equipment built by the General Electric Company, which is under contract to carry out the complete installation of the Australian plant. The contract is worth almost $800,000. There will be three 1500-kw G. E. generators. The piping, etc., contract, said to be valued valued in the neighborhood of $50,000, has been sublet to the Crane Company, of Chicago. The Sydney power house is at present installed with four 850-kw generators supplied by the General Electric Company. The engines are horizontal ones, built at the Allis works. When completed the new Sydney plant will, it is said, be one of the most perfectly equipped power installations in any country.

TELPHERAGE IN CUBA.—A very interesting application of the telpherage system, for the overhead transportation of materials, is about to be made in the vicinity of Havana, Cuba. The United Telpherage Company, of 20 Broad Street, New York, recently secured the contract for carrying limestone from a quarry to a cement works. The circuit is about 1½ miles, up a slight grade, and across a small river. Until a few weeks ago the limestone had been brought to the works on a narrow-gauge surface tramway, which crossed the stream on a bridge near the works. The river rose rapidly one night, as rivers in tropical countries often do, the bridge was washed out to sea, and all connections with the quarry cut off. The company immediately prepared to build a new bridge, but before starting on the work decided to investigate the telpherage system. A representative of the United Telpherage Company, who happened to be in Cuba at the time, had very little trouble in convincing the manager of the works that any future trouble from floods would be avoided by the use of the overhead electric telpher line, which would not only be much cheaper and more economical in operation than any surface tramway, but which could also be installed for a sum less than the cost of a new bridge. A double line is to be built with a loop at each end, so that the telphers can run continuously. At present it is intended to operate only three telphers, running at an average speed of 12 miles per hour; but later on the number of telphers will be increased until 125 tons will be handled in 10 hours. By building a double line, using one track cable for carrying the loaded telphers to the works and the other for returning the empty telphers to the quarry, the capacity of the line is limited only by the number of telphers, so that as the work increases it is necessary simply to add more telphers. This case is typical of much of the work opening up for telpherage in the tropics, where it is often impossible and some times undesirable to lay tracks, and yet where the ordinary roads or bridges are not adequate to the duty. This would appear from the inquiries addressed to the United Telpherage Company, to be particularly true of coffee walks, fruit plantations, etc.

ORDERS FOR ELECTRIC CRANES.—The Case Manufacturing Company, Columbus, Ohio, report the following contracts for electric cranes, etc.: Lake Superior Power Company, Sault Ste Marie, Ont., one 15-ton, 69-ft. span electric traveling crane; John H. McGow & Co., Cincinnati, Ohio, one 10-ton, 45-ft. span electric crane; St. Louis Transit Company, St. Louis, Mo., one 15-ton, 40-ft. span electric crane; J. H. Mann, Lewiston, Pa., one jib crane, 5 tons capacity; Block-Pollak Iron Company, Cincinnati, Ohio, one 14-ton, 35-ft. span electric traveling crane; Best Manufacturing Company, Pittsburg, Pa., two 5-ton electric traveling cranes; Hoeffinghoeff & Lane Foundry Company, Cincinnati, Ohio, two 7½-ton hand-power jib cranes; Erie City Iron Works, Erie, Pa., one 6-ton jib crane; U. Baird Machinery Company, Pittsburg, Pa., one 15-ton, 38-ft. span crane; Wellman-Seaver Engineering Company, Cleveland, Ohio, for three trolleys to be used on the 75-ton Holden-Gantry crane; St. Louis Iron & Steel Foundry Company, St. Louis, Mo., one 15-ton, 38-ft. span electric traveling crane; Humphrys Manufacturing Company, Mansfield, Ohio, one 15-ton, 49-ft. span electric traveling crane.

TRADE WITH JAPAN.—The remarkable growth in the exports of the United States to Japan is shown by some figures just compiled by the Treasury Bureau of Statistics. The imports from the United States have grown from 6,000,000 yen in 1893 to over 60,000,000 yen in 1900, while the United States, which stood sixth in rank in the list of countries from which Japan drew her imports in 1893, is now second in the list, being only exceeded by Great Britain. In 1900 the list stood: From the United Kingdom, 71,638,219 yen; from the United States, 62,761,196 yen; China, 29,960,740 yen; Germany, 29,199,695 yen; British India, 23,516,350 yen; Hong Kong, 10,659,855 yen; France, 8,095,819 yen; and Belgium, 1,949,253 yen. In 1893 the United States supplied 7 per cent, Germany 9 per cent, and the United Kingdom 32 per cent of the total imports into Japan; in 1900, the United States supplied 21 per cent, Germany 10 per cent and the United Kingdom 25 per cent. The item of machinery has increased from $104,954 in 1893 to not less than $1,061,224 in 1900.

STOCKHOLM, SWEDEN.—Graham Brothers, said to be one of the largest handlers of machinery in Northern Europe, are at present placing some fair-sized orders for American engines, boilers and a general line of American labor-saving devices. Westinghouse, Church, Kerr & Co., of New York City, have secured an order calling for one 330-hp compound vertical engine, one 100-hp compound vertical, and a simple vertical machine of 30 horse-power. These engines are intended for installation in electric power and light plants in the Swedish capital.

ORDERS FOR BALL ENGINES.—Mr. Duncan Bond, Denver representative of the Ball Engine Company, Erie, Pa., recently furnished the Iowa Gold Mining & Milling Company, Silverton, Colo., with a 100-hp self-oiling engine for electric service. Messrs. Dravo, Doyle & Co., Pittsburg representatives of the Ball Engine Co., Erie, Pa., have recently installed in the Washington County (Pa.) Courthouse, for the electric plant, two 80-hp self-oiling engines, direct connected to Crocker-Wheeler generators.

THE MARINE ENGINE & MACHINE COMPANY, of 80 Broadway, N. Y., reports that in addition to its contract for the Washington Monument, it has recently secured two additional government contracts, and is at present installing its electric elevators under five contracts, also in New York City. There is a large and growing demand for electric elevators all over the country.

PORTUGAL.—Barber & Co.'s steamer "Dona Maria" is scheduled to sail for Spain with some 700 tons of equipment, etc., for the Lisbon Tramways. The cargo included 10 cars, built by the St. Louis Car Company, of St. Louis, Mo., and 25 miles of trolley wire supplied through the Morris Electric Company, of New York City.

General News.

ENGLISH NOTES.

LONDON OFFICE OF ELECTRICAL WORLD AND ENGINEER,
July 23, 1901.

WESTINGHOUSE IN ENGLAND.—On visiting Manchester and approaching the suburbs of the city where Trafford Park is situated, from long distances can be seen looming up the enormous buildings which the British Westinghouse Electric & Manufacturing Company are erecting there at an expense of considerably over a million pounds. The work is now being rapidly pushed in the hands of James Stewart, who, while Scotch, has got American methods. He is using all his abilities to push the work to completion. About 2600 men are engaged on the work, and every device for the saving of labor has been adopted. Needless to say, the building is entirely of steel with brick walls, and the whole of the steel work has been supplied by Dorman & Long, of Middlesborough, who had the contract for the steel work.

BALFOUR ON TROLLEYS.—Speaking at the extension of the London United Tramways a week or two ago, Hon. A. J. Balfour, Conservative leader in the House of Commons, made a notable speech, in which he said that the question of congestion in the centers of great populous areas might always be stated in terms of time and cost. There would be no congestion if we could all move at no expense with an indefinite speed from the outskirts to the center of London. He is a great believer in the providing of facilities for reaching the suburbs of the city from the great working portions of the metropolis, and he considered that the system of the London United Electric Tramways was no small contribution to the civilization and happiness of mankind. The chairman of the company referred to the progress which the company had made and to the tremendous opposition which they had met with, and stated that now at the end of five years they had 40 miles of route authorized, and he hoped in the near future they would have authority for an extension of other 54 miles.

LIGHT FOR CENTRAL AFRICA.—It is stated that Heriot-Watt College, Edinburgh, through Professor Bailey and Mr. A. S. Chalmers, one of its students, is introducing to the very heart of Central Africa an electric plant for lighting and power. At present kerosene oil alone supplies light to the great industrial college and Scottish mission stations around the head of Lake Nyassa. The freight raises the cost of sixty cents' worth of the paraffin oil to $7. The light thus supplied to the native students and purchased by the Europeans at present represents the interest of $20,000. This sum Mr. James Stevenson, of Glasgow, and others are supplying to send out Mr. A. S. Chalmers in a month or two with the electric plant. There is a fine water-power on the high uplands above Florence Bay to generate electricity enough to supply 600 lamps of 6-candle power each and to give power for motors to drive a brick-making machine, a flour mill, a pneumatic hammer, an iron-turning lathe, wood-working machines, and the printing press.

AMERICAN ENGINES IN ENGLAND.—Soon after the opening of the Glasgow Tramways the local newspapers and some of the London technical papers appeared to take delight in recording the fact that the Allis engines in the Pinkston power house would not start work. On investigation, it turned out to be quite true, that the main bearings of these engines had heated and had to be renewed, and that accordingly there had been a few weeks' delay. The Allis engineers claimed that the engines had been put into actual service too soon and without any of the usual trials and gradual increase of load. It is gratifying now, however, to find from a recent report by the consulting engineer that all of these troubles have been got over, and that the engines are now doing regular and good work. The Musgrave engines are also now in service, and, while they also heated somewhat on the start, they are now doing good work also. In the meantime the report goes on to say that the Stewart engines, which have been in constant service from the first, though not under full load, are to undergo certain alterations, as their governing properties have not satisfied the engineers. The coal handling devices have been tested and found satisfactory, as well as the economizers and the condenser and auxiliary plant.

BRITISH ELECTRIC TRACTION COMPANY.—Sir Charles Rivers Wilson, at a recent meeting of the British Electric Traction Company, of which he is chairman, after reviewing the prosperous financial position of the company, said that 45 miles of new tramways had been opened since the interim report was presented last November, the capital outlay on which was £128,000, which was unproductive in this year's balance sheet. The work carried out since the last meeting amounted to 60 miles of new electric tramways. They had also obtained acts of Parliament and orders which had been confirmed for South Staffordshire 7 miles, Morley and district 8¾ miles, Spen Valley Light Railway 19 miles, Worcester district 4¾ miles, and others, covering a mileage of 80 miles, which would be proceeded with as soon as circumstances would allow. Besides these there were light railways for Kidderminster, the Potteries and Wigan, making a total of 27 miles. Altogether there were now in active operation 238 miles of trams, of which 118 were electric, 56 steam and 64 horse, many of the latter being in course of conversion to electricity, and this did not include 75 miles covered with omnibuses. Last year they took in penny and two-penny fares £600,000, as against £400,000 for the preceding year, and carried over 100,000,000 passengers.

TEARING UP LONDON STREETS.—New arrangements are being completed for a wholesale upheaval of the streets again this year. Last year the whole of the Victoria embankment was open from end to end and traffic completely blocked, and it is now stated that it is again to be opened for the new River Company. It is also stated that the Post Office authorities, who are still working on their telephone system, are going to tear up Shaftesbury Avenue, Rosebery Avenue, and, most important of all, Queen Victoria Street, from Blackfriar's Bridge to the Mansion House. In addition to this the County of London and Brush Provincial Electric Lighting Company, the London Electric Supply Corporation, the Metropolitan Electric Supply Company and others intend to tear up Holborn, Holborn Viaduct, Blackfriar's Road, Trafalgar Square, The Strand, Northumberland Avenue and other important avenues of communication. This does not represent the complete list, but it will show how the citizens of London will again have to suffer from this form of street obstruction and what a boon to London it would have been had the main thoroughfares been equipped years ago throughout with a large underground tunnel such as does exist under a number of streets, and which is always put down under any new thoroughfare which may be built.

VISIT TO BABCOCK-WILCOX WORKS.—On the occasion of the meeting of the members of the Incorporated Municipal Electrical Association at Glasgow a number of very pleasant entertainments were provided, both in Glasgow and in Edinburgh. One of these was a visit which the members made to the works of the Babcock & Wilcox boiler works at South Renfrew, and the extremely hospitable manner in which this enterprising firm afterward entertained the members and their friends by a trip down the river Clyde at the invitation of James Rosenthal. A special train was provided from Glasgow to South Renfrew Station, and about an hour and a half was pleasantly occupied in an examination of their extensive works. The electrical engineers had an opportunity of seeing the commencement of a fine electrical power station, from which it is intended to further increase the distribution of electric power throughout the whole of these works. The firm intends to discard the use of small steam engines in various departments throughout, and from what was stated it is anticipated that this will be one of the most complete and up-to-date electric power plants for factory driving in existence. To go into all that was seen in detail would occupy pages. The works cover the best portion of 34 acres of ground, and are capable of an output of 300,000 horse-power of marine boilers per annum and an output of four boilers for stationary purposes a day, besides an immense quantity of steam pipes, mechanical stokers, superheaters and the various specialties for the generation of steam, in which this firm is so eminent.

BRITISH ENGINEERS IN BERLIN.—The members of the British Institution of Electrical Engineers visiting Berlin were entertained by the two big firms, the Allgemeine Elektricitaets Werke and Messrs. Siemens & Halske. Mr. Rathenau, who presided, after referring to the large programme which had been provided for the guests to enable them to study in detail the various branches of the manufactories, said: "We consider this a debt of gratitude which we owe to you. The electro-technical industry is nothing more nor less than the child of mechanical engineering, which we have learnt in your country—in your manufactories in London, Manchester, Leeds, Birmingham, Glasgow and other industrial centres of your country, and our young engineers considered their career finished only when they had studied the large works and excellent arrangements of such firms as Messrs. John Penn & Son, Messrs. Neilson, Reid & Company, Sir William Armstrong, Whitworth & Company, Messrs. Harland & Wolff and others. We have to thank your countrymen for the pioneer work in connection with locomotive and ship construction, tool, spinning, weaving and other machinery too numerous to mention, and if you see the exertions of Germany in the branches above stated, and the men of science who have framed and spread their theories after having got their initiative from England, their large works with hundreds and thousands of workmen, then you will do our countrymen the justice to admit that the masters may well be proud of their scholars. Notwithstanding this competition, your factories have not ceased to perform great things, and owing to this competition especially, they have been enabled to rule the markets of the world. In the same way the German electro-technical industry is following in their footsteps, in opposition to those countries which bar their doors against our wares by high protective duties. Having these principles and interests in common, we should stand side by side, and unite more closely in furthering our common aims and support each other in our trade."

VISIT TO THE BRUSH WORKS.—On the occasion of the meeting of the Incorporated Association of Municipal and County Engineers, which was held during the past month at Leicester, the Brush Electrical Engineering Company, Ltd., took the opportunity of inviting the members to visit their extensive works at Loughborough. From 200 to 300 visitors arrived there about noon. A start was made from the general offices, and, passing through the heavy-tool shop and erecting shop, the first inspection was made of their traction truck and car under frame shop. This is rather a new department for the Brush Company, and proved to be very interesting, as they are the first in England to go in for the complete manufacture of car trucks. After completing an inspection of the works a most elaborate luncheon was served in one of the new buildings, which has not as yet been equipped with machinery, Lord Vaux, of Harrowden, presiding, who, after the usual loyal toasts, proposed the Incorporated Association of Municipal and County Engineers, to which E. George Mawbey, the president of the association, replied. Mr. Mawbey then proposed the Brush Electrical Engineering Company, Ltd., to which R. P. Sellon replied. In the course of his remarks Mr. Sellon, while acknowledging the developments of electrical apparatus in America and Germany, stated that the Brush Company was not ashamed to adopt the best processes and best ideas of both countries, and that they prided themselves that they now had a factory equal to any in the world and combining the best practices of Great Britain, America and Germany. They had no hesitation in selecting that which was best in the methods and processes of their competitors, and had added them to their own traditional reputation for good and solid work. Some of the contracts now being executed by the company are the following: Leicester Corporation: Two 100-kw steam inductor alternators, to be direct-coupled to horizontal slow-speed engines, supplied by Hick, Hargreaves & Company, running at 100 r. p. m., with a periodicity of 50 per second. These are the largest machines of this particular class yet built in Great Britain; also for the same corporation, a high-tension main switchboard, which, when complete, will be one of the largest and finest examples of switchboard work built. Electric Lighting & Traction Company, of Australia, Ltd., of Melbourne: Two 500-kw steam inductors, constructed for single-phase working, each provided with its own condenser, air pump and direct-coupled exciter. The sets are to run at 250 r. p. m. and at a periodicity of 50 per second. One set is now delivered at Melbourne, and the second one is ready for shipment. Electrical Power Distribution Company and the British Electric Traction Company: Twenty-six sets of steam dynamos of various sizes. Each set comprises universal engine and direct-current traction dynamo. Pietermaritzburg Corporation: Two 120-kw steam dynamos for operating the tramways in that town.

The Telephone.

SACRAMENTO, CALIF.—The Pacific States Telephone & Telegraph Company has about 2500 telephones connected with its exchange in Sacramento.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently filed a protest before the San Francisco Board of Equalization. The assessment is $2,939,470, an increase on plant and franchise of $750,000.

CHICAGO, ILL.—At a meeting of the officers and directors of the Illinois Manufacturers' Association last week it was decided unanimously to at once bring legal proceedings to compel the Chicago Telephone Company to reduce its maximum charge for instruments from $175 to $125 a year, the rate fixed in the franchise under which the company is operating. The Illinois Manufacturers' Association has more than 500 members in Chicago, all of whom use telephones, and some of whom use from ten to fifty.

LAFAYETTE, IND.—The Mutual Telephone Association of Indiana held its annual meeting here on July 29. The delegates and visitors were entertained by the Lafayette Telephone Company and the Sterling Electric Company.

WABASH, IND.—Serious damage was done to the telephone system by the recent storm. The services of the Home Telephone Company were practically suspended for a time. At Portland, in an adjoining county, the storm caused the United Telephone Company severe loss in instruments.

INDIANAPOLIS, IND.—Despite the heat that has prevailed during the past week very satisfactory progress was made in telephone construction. It is acknowledged that the independent telephone movement has progressed more rapidly in Indiana than any other State, with the possible exception of Ohio. The assessment of the telephone property of the State by the State Tax Board was made last week. It was shown that the companies have made large additions, both to their pole and wire mileage; that companies have multiplied and telephone property has improved generally, and that there has been a gratifying increase in the earnings of the companies. The Board has not yet announced the rate of taxation.

LOUISVILLE, KY.—A restraining order has been granted in the suit of the Louisville Electric Light Company for an injunction to prevent the Cumberland Telephone Company from erecting poles or wires within twelve inches of the former's wires in a certain section of the city.

KINEO, MAINE.—The Moosehead Telephone & Telegraph Company closed a contract with the New England Telephone & Telegraph Company. The New England company will extend its line from Monson to Greenville, and the Moosehead company will build to Greenville from Kineo, via Spencer and Lily Bay.

BENZONIA, MICH.—The Benzie County Telephone Company is extending its line to Manistee. The company has had a rapid growth, having 180 local subscribers, and complete systems have been installed at Frankfort, Benzonia, Honor, Thompsonville, South Frankfort, Bear Lake and Beulah; also toll stations at Homestead, Arcadia, Eden and Onekama. The line connects with the Independent State line at Thompsonville. From a small beginning of a few hundred dollars the company has grown to a capital of over $10,000.

PLATTSBURG, MO.—The Plattsburg Telephone Company, of Plattsburg, Mo., with a capital stock of $10,000, was incorporated July 20 by J. C. Atcheson, F. R. Allen, E. E. Bowlen and others.

RALEIGH, N. C.—The Merchants' Association, in view of the fact that there are three telephone systems in the city, has passed a resolution by which each member agrees to have the Raleigh telephone put in, whenever having a telephone installed; also that the telephone committee be instructed to give notice of this action to the other companies, who have long distance lines with whom the Raleigh Company may be able to connect, and request them to effect such connection, if practicable.

TROY, N. Y.—The Troy Telephone & Telegraph Company is placing its wires underground in this city.

BUFFALO, N. Y.—The control of the Independent Telephone Company at Gowanda, N. Y., has been acquired by E. C. Fisher, of Gowanda, and will hereafter be operated under a license from the New York & Pennsylvania Telephone & Telegraph Company, a Bell concern. The present telephones will be substituted by Bell telephones. This closes out all the independent lines entering at Gowanda and heretofore operated in connection with the Gowanda exchange, reaching points in every direction.

LONG ISLAND, N. Y.—Justice Garret J. Garretson of the New York Supreme Court has granted a writ of peremptory mandamus directing Commissioner Henry S. Kearney of the Department of Public Buildings, Lighting, and Supplies to grant to the Seaboard Telegraph & Telephone Company a permit to repair its poles and wires on its line in Queens Borough between Rockaway Beach, Arverne, Far Rockaway, Inwood, Springfield, and Jamaica to East New York. The Seaboard Company two years ago made application, but the permit was refused by Deputy Commissioner Fowler of Queens, on the ground that the line of that company was paralleled by the line of the New York and New Jersey Telephone Company, and that it is contrary to the provisions of the charter of Greater New York to permit one line to be built parallel to another existing line. He has now been overruled.

COLUMBUS, OHIO.—The Perry Telephone Company, of New Lexington, has been incorporated; capital stock, $25,000.

HARRISBURG, PA.—The Northern Pennsylvania Telephone Company, of Wellsboro, has been incorporated; capital, $12,500.

JACKSON, TENN.—A franchise has been granted the Jackson Home Telephone Company.

KNOXVILLE, TENN.—The Cumberland Telephone & Telegraph Company will spend $100,000 in extending its system from Knoxville and East Tennessee to Kentucky.

MEMPHIS, TENN.—The City Council of Jackson, Tenn., has granted a franchise to an independent telephone company, which will co-operate with the Memphis independents in the long distance arrangements.

DOVER, TENN.—Lee Walker has extended his telephone line from [illegible] to Tobaccoport. It will be completed to Canton, Ky., in a few days. The People's Telephone Company is now building a line from Cumberland City to Big Rock, by the way of Fedora.

AUSTIN, TEX.—The San Angelo Telephone Company, of San Antonio, has been chartered; capital stock, $80,000. Incorporators: J. Y. Pust, J. W. Sims and L. Pust.

SAN ANTONIO, TEXAS.—The Alpine-Terlinger Telephone Company, of Alpine, capital stock $1,000, has been incorporated by A. M. Turney, R. L. Neville and J. C. Bird.

VERNON, TEXAS.—A company has been organized here to build a telephone line from this place to Quanah and Crowell, Texas, and Altus and Enid, Okla. Work will be begun at once.

VERNON, TEXAS.—The Vernon Telephone Company has purchased the Vernon electric light plant and consolidated the two systems under the name of the Vernon Light & Power Company.

FORT WORTH, TEX.—Representatives of seventeen independent telephone companies and exchanges in Texas, Indian Territory and Oklahoma met here on July 17, and formed a permanent organization. The convention decided that all independent telephone exchange companies within the territory mentioned were eligible to membership. The telephone situation in Texas, Oklahoma, Indian Territory and extensions to the stock ranch regions were fully discussed.

RICHMOND, VA.—President J. R. Kemper, of the Virginia Long Distance Telephone Company, is quoted as saying that the reported absorption of the Louisa Telephone Company by the Bell will be to improve his company's system and make it more valuable to local interests.

TACOMA, WASH.—E. A. Seeley has been granted a franchise for an independent telephone system in Tacoma.

OSHKOSH, WIS.—The Fond du Lac Street Railway & Light Company is installing a telephone system in connection with its lines.

Electric Light and Power.

SAN FRANCISCO, CALIF.—The members of the Sierra Club have placed themselves on record as being opposed to the installation of an electric light plant in the Yosemite Valley. A communication has been sent by the club to the Yosemite Commissioners as a result of a recent meeting in the valley, and the protest will be discussed by the commission.

LOS ANGELES, CALIF.—The Equitable Gas & Electric Company has filed articles of incorporation, with a capital of $1,000,000. The directors are Abbot Kinney, S. A. W. Carver, W. J. Washburn, John D. Pope, W. T. Botsford, J. A. Winans and Warren Gillelen. The new company is to absorb the East Side Lighting Company, of which it has already acquired control.

REDDING, CALIF.—The plant and business of the Redding Water Company and Redding Light Company are now owned by the Keswick Electric Power Company, which is interested in a large power plant on Mill Seat Creek, near Shingleton. Two months ago the local companies, of which Francis Smith was president, agreed to sell for $60,000. The Keswick Power Company paid $1,500 and has now paid the balance of $58,500. The new owners will enlarge the whole water and light system, giving the town an adequate supply. The Shingleton plant will be ready with the power by September 1.

AUGUSTA, GA.—President Orr, of the Orr Cotton mills, has awarded the contract for the electric power and machinery to run 100 new looms and 1100 new spindles.

ATLANTA, GA.—Atlanta, says the *Constitution*, of that city, is soon to have a new industry, involving an outlay of Northern and local capital to the extent of $1,000,000, which will practically revolutionize manufacturing conditions. It is the harnessing of the Chattahoochie River at a point about four miles from Bolton by means of a dam with a 40-foot fall, and the erection of a splendid plant which will supply the manufacturers of Atlanta with electricity up to 20,000 horse-power.

CHICAGO, ILL.—The right of way of the Illinois Central Railroad in Chicago, and as far south as Matteson, Ill., will soon be lighted at night by a large electric plant just completed at the foot of Twenty-seventh Street, which will furnish power for illuminating all the tracks, stations, and yards for nearly thirty miles.

TIPTON, IND.—The construction of a new electric light plant, to cost $35,000, is under way here. The plant is to be in operation October 1.

NEW ALBANY, IND.—The first church in this city to install electric fans for the comfort of its congregation so greatly increased the attendance that other churches are providing fans also.

LOUISVILLE, KY.—The Vanceburg Electric Light Company has increased its capital stock and reorganized with G. W. Stamper, president.

PORT DEPOSIT, LA.—The Port Deposit Electric Light Company will reorganize for the purpose of extension and improvement. R. E. McClenahan, W. W. Hopkins and D. George Wilson are among the incorporators.

ELLICOTT CITY, MD.—The Council has awarded the contract for supplying the town with lights to the Patapsco Electric Manufacturing Company.

CAMBRIDGE, MASS.—The plant of the Cambridge Electric Light Company was recently damaged by fire.

ST. LOUIS, MO.—Bids for lighting the city institutions and public buildings for a term of one year from next September were opened by the Board of Public Improvements, July 22. For lighting the buildings south of Washington Avenue, the lowest proposal was submitted by the Missouri-Edison Company, which offered to do the illuminating required for 6 cents per 1000 watt hours. The Laclede Company presented the lowest figures for the lighting north of Washington Avenue, its bid being 8 cents per 1000 watt hours. For the present municipal building lighting the city is paying these companies 12 cents and 13 cents, respectively, per 1000 hours.

BUTTE, MONT.—The Butte Electric & Power Company has been incorporated with a capital of $2,500,000.

RALEIGH, N. C.—The Board of Aldermen has authorized the issuance of $7,000 electric light bonds.

TYRON, N. C.—The town will issue $25,000 of bonds for the construction of a water works system, electric light plant, etc.

TRENTON, N. J.—The Citizens' Light & Power Company has been incorporated, with an authorized capital of $1,500,000. Incorporators: Wm. A. Jones, Melville A. Carpenter and Jos. B. Short, all of Newark, N. J.

BERNARDSVILLE, N. J.—The Bernards Light, Heat & Power Company has been incorporated; capital, $100,000. Incorporators: Grant B. Schley, C. Ledyard Blair, John A. Dryden.

NEWARK, N. J.—Articles incorporating the People's Light & Power Company have been recorded. The authorized capital stock is $1,500,000, and the incorporators are William A. Jones, Joseph B. Short and Melville A. Carpenter.

NEWARK, N. J.—The National Electric Light, Heat & Power Company has been incorporated, with a capital of $200,000. John E. Helm, of Newark, Frederick C. Fischer, of Newark, and William Pelzer, of New York, are the incorporators.

JERSEY CITY, N. J.—The Gould's Rifts Power Company has been incorporated in Trenton, to build a dam across the Delaware River for the generation of electric power. The incorporators are E. C. Hill, Harry Hill and Thomas C. Hill. The capital stock of the company is $100,000.

HEMPSTEAD, L. I.—The village trustees are negotiating with the Roslyn Light & Power Company for an estimate to light with electricity the streets of Hempstead.

CENTRALIA, N. Y.—The Centralia Electric & Power Company, capitalized at $10,000, has been incorporated by Theodore Hass, Herman Hass and Theodore Hass, Sr.

PORT JERVIS, N. Y.—The four local electric and gas plants have been consolidated under one management, with the title of the Port Jervis Electric Light, Power & Gas Company. A new directorate has been formed, and the officers are: R. H. Beach, of New York City, president; C. R. Horn, of New York, secretary and treasurer, and R. S. Weaver, general manager. The syndicate intends to increase the trolley service there and construct fifteen miles of road to summer resorts at Milford, Sparrowbush and Huguenot. The other plants will be developed for manufacturing, lighting, and fuel purposes. The properties are the Deer Park Electric Light Company, Port Jervis Electric Street Railway, Port Jervis Electric Light & Power Company, and the Port Jervis Gas Light Company.

ZANESVILLE, OHIO.—A telegram from Zanesville, Ohio, of July 14 says: "Zanesville is entirely in darkness to-night as a result of the visitation of June bugs in countless numbers. Electric light globes are filled and the lights are completely smothered by the ashes of the burned bugs. The hotel offices are infested with such swarms that it was necessary to close the doors, notwithstanding the intense heat. In several instances church services were interfered with. The river bridges are almost impassable to pedestrians. The atmosphere about the lights is filled with clouds of live insects and floors are covered to a depth of several inches by dead ones."

PARRY SOUND, ONT.—The Town Council of Parry Sound, Ont., may dispose of the corporation's newly acquired power plant to a new company, called the Seguin Power Company, of Parry Sound, with a capital of $40,000. The new company proposes to supply power to industrial works which it will also assist in promoting.

WILLIAMSPORT, PA.—The Eagle's Mere Electric Light Company will furnish electric light to the Muncy Valley towns. The power house, situated two miles up the mountain from the town of Muncy Valley, is now supplied with power from Hunter's Lake.

PHILADELPHIA, PA.—It is authoritatively stated that the basis of the effort to acquire the Kensington Electric Company for the Philadelphia Electric Company has been by purchase of stock in the open market and through private sources. It is admitted in official quarters that the Philadelphia Electric people are now owners of most of the Kensington minority stock.

GREENSBURG, PA.—The Westmoreland, Alleghany & Westmoreland Electric Heat & Power Company, composed of Fort Wayne (Ind.) and Pittsburg capitalists, is making a stubborn fight at Greensburg, Pa., for franchises. It has been turned down by the local councils, but will try again. The Westmoreland Street Railway Company promises, if the new company is not given a franchise, to build a plant of its own.

GREENVILLE, PA.—The Greenville gas and water companies have been optioned to the syndicate which is building the electric railway from Sharon, Pa., to Youngstown, Ohio, and now own the electric lighting, power and gas plants of Sharon, Sharpsville and Youngstown, with franchises for several other towns in that district. The Greenville Electric Light Company also hold a franchise for steam heating and have a large exhaust steam heating business. H. W. Whipple, of New York City, is active in the consolidation.

PROVIDENCE, R. I.—A large portion of the real estate of the Phenix Iron Foundry at Providence, R. I., has been sold by the receiver, Harold J. Gross, to the Narragansett Electric Lighting Company. The property sold includes only the land and shell of the building on it.

ATHENS, TENN.—The East Tennessee Light & Power Company, of Athens, is in the hands of a receiver.

BRISTOL, TENN.—The Bristol Light & Power Company has installed $45,000 worth of additional machinery in its plant.

NASHVILLE, TENN.—Fire in the power plant of the Cumberland Electric Light & Power Company damaged belting, etc., to the extent of perhaps several thousand dollars.

WAVERLY, TENN.—The Waverly Electric Light Company, of Humphreys County, capitalized at $5,000, has been incorporated by Arthur E. Justice, B. R. Thomas, J. P. Cowden, J. F. Fowlkes, W. N. McCreary, H. H. Harris and N. C. Harris.

GEORGETOWN, TEX.—The town will hold an election to vote on the municipal electric light plant question.

BELTON, TEXAS.—The Belton Light & Power Company has been incorporated, with J. T. Smither, president; W. A. Stewart, vice-president, and F. E. Merrill, secretary-manager.

TEMPLE, TEX.—The Belton Light & Power Company, of Temple, capital stock $30,000, has been incorporated by F. E. Merrill, W. A. Stewart, of Bell County, and J. F. Swither of New York.

RICHMOND, VA.—The Tower-Binford Electric & Manufacturing Company has been awarded the contract for a complete power transmission plant for the Blackwell's Durham Tobacco Company at Durham, N. C.; also the contract for a lighting plant for Hollins Institute, at Hollins, Va.

FARMVILLE, VA.—The Virginia Normal State School of this city is to have an electric light plant, which will be completed and ready for use by the opening of the school in September. The contract for the plant has been awarded to the Electric Construction Company of Richmond, Va.

CHARLESTON, W. VA.—The water works, electric light and artificial gas plants of this city have been sold to a party of Wheeling capitalists, who were represented by Charles W. Swisher, of Fairmont, and John A. Howard, of Wheeling. The price paid was $300,000. The new company is also said to have an option on the street car system of this city.

APPLETON, WIS.—A $3,000,000 mortgage has been issued on the property of the Wisconsin Light, Heat & Traction Company in favor of the Milwaukee Trust Company.

TACOMA, WASH.—Within a few months the residents of Cape Nome will have a modern electric light plant installed in their city. Capt. F. N. Selberg has purchased the equipment, which cost $25,000. Coal to operate the plant will cost $18 a ton. The plant will have a capacity of 2500 incandescent lights of sixteen candle-power. It is proposed to charge 20 cents per day per light.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—It is said that the Birmingham Railway Light & Power Company is making arrangements to institute a car line from Bessemer to East Lake, twenty miles in length. Tracks already extend between these points. Part of the line will be operated by electric power. One million dollars of the $6,000,000 bond issue recently decided upon will, it is said, be used for this purpose; 130 new cars, steel rails, etc., have been ordered.

SAN FRANCISCO, CALIF.—The Town Trustees of Berkeley, Calif., propose to declare void the franchise of the old horse-car line between East and West Berkeley. The road was purchased by the Oakland Transit Company, which recently removed the rails. As the franchise called for the continuous running of cars, it is claimed that the same can be declared forfeited. It is proposed in the event of a new franchise being granted, to stipulate that the town shall secure a percentage of the earnings of the line.

INDIANAPOLIS, IND.—The Valparaiso, Michigan City & Chicago Electric Railway Company has been incorporated. The capital stock is placed at $25,000, with privilege to increase.

FORT WAYNE, IND.—The Commissioners have granted to the Indiana & Ohio Traction Company the right to highways in Allen County for a line from Hicksville to Huntington, through this city.

INDIANAPOLIS, IND.—A contract has been signed by an Eastern construction company to build the Indianapolis, Morrestown & Rushville Interurban road. The estimated cost is from $1,000,000 to $1,500,000.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company has issued $300,000 of Citizens' Railway consols, to retire an equal issue of Citizens' first mortgage bonds. The new issue bears 5 per cent., against 6 for the old.

INDIANAPOLIS, IND.—The Eastern Indiana Traction Company has been incorporated, with a capital of $10,000. Peter Schwab, of Hamilton, Ohio, is president; Henry P. Lane, of Franklin, Ohio, vice-president, and Elias Falk, of Franklin, Ohio, is secretary and treasurer.

REITERSTOWN, MD.—The organization has been completed of a company which purposes building a trolley line from Reiterstown, Md., through Westminster to the Pennsylvania State line, and thence to Gettysburg, Chambersburg, Shippensburg and other Pennsylvania towns to Harrisburg. It is to be called the Baltimore, Westminster & Gettysburg Railroad Company. L. A. Sweigard is president. Engineers have been put to work locating the line in Maryland. Under the charter, which is from Maryland, the company is empowered to carry freight and passengers, and operate telephone and telegraph lines.

WESTBORO, MASS.—A charter is to be issued to the Westboro & Hopkinton Street Railway, to be in operation by Sept. 1. This line forms a link in the present chain of electric roads between Boston and Worcester, and considerably shortens the distance. A continuous line under single ownership is also thus established for about 27 miles, between Needham and Westboro. The route thus formed, while more direct than existing lines, is still somewhat longer than that planned by the Boston & Worcester Street Railway Company, which has now secured franchises over two-thirds of its total run and hopes to be running in a year or so.

LYNN, MASS.—The Lynn & Boston Street Railroad Company has ceased to exist. The system becomes the Boston & Northern Street Railway Company. The change is the result of the consolidation of the Lynn & Boston, Lowell, Lawrence & Haverhill, Nashua Street Railroad, Rockport Street Railway, Gloucester Street Railway, Gloucester & Essex Railroad, and the North Woburn, Wakefield, Stoneham, Reading and Lowell Street Railways. The entire system included 400 miles of road. The officers of the new corporation are Patrick F. Sullivan, of Lowell, president; E. C. Foster, of Lynn, vice-president and general manager, and H. C. Page, of Salem, general superintendent.

ST. PAUL, MINN.—Mr. Samuel Hill has announced that he will at once parallel the Twin City Rapid Transit system and establish a 5-cent fare between St. Paul and Minneapolis.

ASHEVILLE, N. C.—Work has been started on the Asheville and Weaverville electric road. M. F. Hart & Company are the contractors.

JERSEY CITY, N. J.—The North Hudson County Street Railway Company and the Paterson Street Railway Company have been merged into the Jersey City, Hoboken & Paterson Street Railway Company.

TRENTON, N. J.—The Lackawanna & Wyoming Valley Rapid Transit Company, which was incorporated about a year ago, has filed papers increasing its capital stock from $5,000,000 to $6,500,000. The company was incorporated to construct and operate railroads.

SCHENECTADY, N. Y.—A trolley line to Mount Pleasant and Athens Junction is to be constructed by the Schenectady Railway Company.

ITHACA, N. Y.—The Canastota & Gloversville Railway Company has been granted a franchise through the village of Canastota and the towns of Lenox, Lincoln, Fenner and Smithfield.

ROCHESTER, N. Y.—The New York State Railroad Commissioners, after a hearing, announced that they had decided to grant a certificate to the Ridge Trolley road from Rochester to Buffalo.

AMSTERDAM, N. Y.—The Amsterdam Street Railroad Company has decided to increase its capital stock from $250,000 to $1,000,000, the increase being necessary on account of the extension of the road.

ONEIDA, N. Y.—The Oneida Street Railway Company has ceased work on its proposed line to Utica. It is rumored that the Central-Hudson has bought out the company and will hold the franchise as a bar to possible competition.

HUDSON, N. Y.—The Albany & Hudson Railway & Power Company is making an endeavor to compromise the claims for damages arising from the collision on its road in May last, due to gross carelessness of employees. The claims already in amount to $330,000, and they are but one-third of the whole number.

FREEPORT, L. I.—The Mineola, Hempstead & Freeport Traction Company has received its franchise from the village trustees for building a trolley road from the northern limits at Seaman Avenue. The work of construction will be commenced next month. Franchises to build through Hempstead to Mineola have also been obtained by the company.

LITTLE FALLS, N. Y.—The Mohawk Valley Traction Company has filed articles of incorporation as an electric surface road. Its termini are to be the city of Little Falls and the village of Herkimer, a distance of eight miles. The capital stock is $8,000. The directors are residents of Central New York, excepting James D. Smith, of New York City, who subscribes for 764 of the 800 shares.

ONEIDA, N. Y.—The Oneida Street Railway has been bought by the Cleveland, Ohio, syndicate, which has recently bought all of the trolley lines in that vicinity. The syndicate was represented by Horace E. Andrews, of Cleveland, Ohio. The purchase price was not made public. The same syndicate has bought all the street railways in Utica and is extending double tracks east to Little Falls. A line will be built from Oneida City to Utica.

ROCHESTER, N. Y.—The Monroe County Electric Railway has incorporated with $250,000 capital. The directors of the company are Percy R. McPhail, Ira M. Luddington, George W. Aldridge, Merton E. Lewis, of Rochester; Andrew H. Bown, of Portfield; Walter A. Parce and D. C. Becker, of Fairport; W. H. Rowerdink, of Brighton, and Fred. W. Guernsey, of Pittsfield. The line will connect with the Rochester Railway Company.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has purchased the property necessary for the construction of the incline from Jamaica Avenue to the terminus of the Brooklyn "L" at Crescent Street, East New York. The connecting branch will start from a point on the "L" at Aetna and Crescent Streets, and winding around in a sort of double curve down to the level of the trolley line on Jamaica Avenue. There is no charter for the use of steam on Jamaica Avenue, and that method of propulsion, according to President Greatsinger, will have to be abandoned when the cars are run through to Jamaica.

NEW YORK CITY.—About 1200 men and women journeyed from Fordham, Morrisania, and other outlying districts in the Borough of the Bronx, last week to the City Hall to appear before the Joint Committee on Railways of the Council and the Board of Aldermen. The object of their journey was to convince the committee that the taxpayers of the upper district wanted a certain privilege granted to the Union Railway, which will be for the benefit of that entire section of the city. The measure advocated was the granting of a franchise to the railway company to extend its tracks across the Macomb's Dam Bridge, along the 155th Street viaduct, to the stations of the west side elevated railroad and to the Putnam Branch of the New York Central & Hudson River Railroad. At present those residents of that section who are compelled to take the Union Railway lines at Central Bridge for Tremont, Woodlawn, and other points are obliged to walk over a third of a mile from the terminals of the elevated and Metropolitan surface lines to the other end of Central Bridge, where they board cars upon transfers. The privilege asked, if granted, will do away with this walk.

FRANKLIN, OHIO.—The Cincinnati & Cleveland Railway Company has asked for a franchise through this place.

WAUSEON, OHIO.—The Toledo & Indiana Electric Railway Company has been granted a franchise through this place.

COLUMBUS, OHIO.—The Columbus Railway Company has declared the regular quarterly dividend of 1¼ per cent. on preferred stock, payable Aug. 1.

LONDON, OHIO.—The County Commissioners of Madison County have granted a franchise to the Findlay & Southern Railway for its line in this county.

YOUNGSTOWN, OHIO.—At a meeting of the directors of the Youngstown Park & Falls Electric Railway Company a semi-annual dividend of 2½ per cent. was declared.

UPPER SANDUSKY, OHIO.—The officials of the Findlay & Marion Railway Company are planning to secure a right of way for a spur line to extend from Upper Sandusky to Tiffin.

BRYAN, OHIO.—The County Commissioners of Fulton County have granted a franchise through the county to the Toledo & Bryan Air Line Railway, which is promoted by J. L. Yost, of Toledo.

LIMA, OHIO.—The Allen County Commissioners have granted a franchise to the Lima, Lewiston & Bellefontaine Railway Company, which proposes to build from Lima to Lewiston and Bellefontaine.

CLEVELAND, OHIO.—The Cleveland & South Lorain Traction Company has been incorporated, with a capital of $500,000, by James H. Burke, Charles H. Wells, H. A. Beckerman and Frank W. Nowak.

CLEVELAND, OHIO.—The Everett-Moore syndicate has acquired control, at a price said to be above par, of the Little Consolidated Street Railway, the local system, in which Senator Hanna is largely interested.

CLEVELAND, OHIO.—It is stated that the Western Ohio Railway Company will shorten its main line from Cincinnati to Toledo by building a direct line from Wapakoneta to Sidney, as well as the line by way of St. Marys, New Bremen and Minister.

FINDLAY, OHIO.—The Findlay & Southern Railway Company, which is promoted by J. Rosenstock, of Cleveland, has applied for a franchise to enter the center of the city, right of way for the entire route from Columbus to Findlay having been secured.

CLEVELAND, OHIO.—It is reported that the movement of Thomas Childs for a franchise between Cleveland and Akron, is part of a project for the electric line between here and Cincinnati. It is claimed Mr. Childs is working in the interests of the men who are backing the road which is being built between Akron and Canton, and that it will be simply a link in the great chain across Ohio.

FREMONT, OHIO.—The Kerlin Brothers Company, promoters of the Tiffin & Port Clinton Railway, have closed a deal for the purchase of the right of way held by the Lakeside, Napoleon-Western Railway Company, the line owned by the Fremont Street Railway Company, and the power-house and short line owned by the Creager Electric Light Company. The consideration for the properties is said to have been $35,000.

COLUMBUS, OHIO.—The old Grove City & Green Lawn line has been formally transferred to the Columbus, Grove City & Southwestern Railway, which is a part of the Appleyard-Fisher system of roads. New officers for the company have been elected as follows: Emmett T. Thompkins, president; H. A. Fisher, vice-president; John G. Webb, treasurer, and S. M. Merrick, secretary.

CLEVELAND, OHIO.—M. J. Mandelbaum & Company has closed the deal announced some weeks ago, for the purchase of the property of the Hamilton & Lindenwald Electric Transit Company, consisting of nine miles of lines in Hamilton and connecting with Lindenwald. This gives the Southern Ohio Traction Company its own line through Hamilton. The company has been reorganized by the election of new officers as follows: W. C. Shepard, president; H. C. Lang, secretary and treasurer, and F. J. J. Sloat, general manager. The above, with A. E. Feith, of Cleveland, constitutes the Board of Directores. The new owners will spend $50,000 in improvements at once. The present power house will be abandoned and the road will be operated in connection with the Southern Ohio Traction Company. It is stated that the amount paid for the property was $225,000.

PROVIDENCE, R. I.—The Milford, Attleboro & Woonsocket electric road is said to be seeking a franchise for an extension from Plainville to North Attleboro.

NASHVILLE, TENN.—The Woodbury & Nashville Railway Company has applied for a charter of incorporation. The capital stock is placed at $300,000, and J. T. Crass, of this city, is at the head of the new concern.

SALT LAKE CITY, UTAH.—The local street railways are arranging a combination with $3,000,000 capital.

TACOMA, WASH.—The Tacoma-Seattle electric railway line is now under contract, the construction work having been let to Hale & Smith, of Portland, Ore. The road will be over 40 miles in length.

NEW INDUSTRIAL COMPANIES.

THE BENNETT-BERNHARDT ELECTRIC MANUFACTURING COMPANY has been formed for the purpose of manufacturing electrical appliances. Their address is Columbia, Pa.

STAR ELECTRIC GAS LIGHTER COMPANY of New York City, has been formed; capital, $25,000. Directors: Jacob Harzfeld, Julius Wielar, and Siegfried Scherk, New York City.

WASHINGTON, MO.—The Libbe Electric Company, of Washington, Mo., has been incorporated with a capital stock of $40,000. The incorporators are Anton A. Libbe, Henry D. Hibbeler and Hugh J. Minhinnick.

THE STANDARD ELECTRIC COMPANY, of Danville, Va., incorporated April 1, will open a branch house at Charlotte, N. C. Jas. G. Penn is president, and W. Drummond Marrow, general manager. The principal business will be engineering and construction.

THE CONSOLIDATED ELECTRIC CONSTRUCTION COMPANY has been incorporated in Cleveland, with $25,000 capital stock, by C. C. Bateson, F. C. Werk, Abraham Oppenheimer, A. A. Bemis and P. A. Zizelman. The company will deal in electrical material and supplies.

THE HERR CONSTRUCTION COMPANY has been incorporated in Cleveland, Ohio, by H. H. Herr, H. S. Herr, Frank Seither, F. H. Turner and G. H. Cowdrey; capital stock, $5,000. The company will furnish material for the construction of telephone, telegraph, electric railway and electric lighting systems.

THE AMERICAN INCANDESCENT LAMP COMPANY, of York, Pa., has been incorporated with a capital of $25,000. The directors are C. C. Frick, D. F. Lapean, R. S. Cannon, R. E. Manley, E. K. McConkey, Lemon Love and

W. O. Thompson are the directors. Mr. Paul Junkin, formerly superintendent of the Sawyer-Man Company's works, will be superintendent for the new company.

LEGAL.

WIRELESS TELEGRAPHY SUIT.—A Honolulu despatch states that the Marconi's Wireless Telegraph Company, Limited, has brought suit against Frederick J. Cross, manager of the Inter-Island Telegraph Company, in the First Circuit Court, for $5,500 and £500 sterling, which the company claims is due it as the second payment of $11,000 for installing the system of wireless telegraph now in operation between the various islands of the group from Oahu to Hawaii. The company, by its attorneys, Kinney, Ballou & McClanahan, states that on October 31, 1899, the plaintiff and defendant entered into a written agreement. The name of their corporation was then the Wireless Telegraph & Signal Company, Limited, which was changed later to Marconi's Wireless Telegraph Company.

TROLLEY FARES.—The principle involved in a decision handed down by the Supreme Court of Errors last week in the case of the Fair Haven & Westville Railroad Company against the city of New Haven has attracted the interest of municipalities and trolley corporations. The municipal authorities of New Haven granted the petition of the company to lay a double track to East Haven, with the proviso that only a five-cent fare should be charged between New Haven and Morris Cove. The company, resenting the condition, appealed to the courts. The finding of the Supreme Court sustains the contention of the railroad corporation, and decrees that the condition is void because the municipality had no authority to impose it. The decision is important as defining and limiting the conditions which a Connecticut city may impose on a street railway company.

TRIAL POSTPONED BY TELEPHONE.—Note has been made in these columns to the effect that two men accused of creating a disturbance on a Maine railway train had had their case tried over a telephone. The Justice who had jurisdiction in the matter lived at a considerable distance from the town where the defendants had been arrested, and as they were anxious to continue their journey on the train, they were allowed to plead guilty over the telephone, the Justice in his turn imposing a fine. In an action brought by Henry B. Hardenburgh and Charles J. Tiensch against Frank Fish in a Justice's court, this State, the Justice allowed an adjournment of the case because the attorney for the plaintiff informed him by telephone a few minutes before the expiration of the hour that he was detained, but would soon arrive. Justice Edwards, for the Third Appellate Division, on appeal, says: "A Justice has a reasonable discretion to exercise after the expiration of the hour to which the cause is adjourned, and where he has knowledge or information that the party intends to appear and will soon arrive, he does not lose jurisdiction by granting a reasonable indulgence. In this case the plaintiff's attorney, whose office was in the same village with that of the Justice, informed the Justice personally by telephone a few minutes before 10 o'clock that he was detained, but would shortly arrive, and requested that Mr. Northrup appear for him, and that the case be held open. This was communicated to the defendant, who left the office of the Justice before the hour of 10 arrived, preferring perhaps the chance of success on an appeal, through some technicality, to a trial of the merits before the Justice. The indulgence of between five and ten minutes granted by the Justice was not unreasonable, and no advantage was taken of the defendant."

PERSONAL.

GENERAL THOMAS T. ECKERT, president of the Western Union Telegraph Company, has been elected a director of the Union Pacific road.

MR. HENRY C. PAYNE, the well-known electric railway and telephone manager of Milwaukee and vice-chairman of the Republican National Committee, is seriously ill with gout at the Frankfort Hotel in Berlin.

MR. WILLARD E. CASE, the well known experimenter and electro-chemist, has, we regret to note, just lost his brother, Mr. Howard E. Case, who died suddenly while on a coaching tour through England. The Cases are one of the wealthiest families in Northern New York.

HON. C. A. SCHIEREN, the distinguished merchant and ex-Mayor of Brooklyn, N. Y., has just returned from a long trip abroad, during which he represented the New York Chamber of Commerce at the reception given that body in England. He has just started in Hamburg a branch of his leather business which will serve as a center for the concern's large European trade.

MR. GARDINER G. SIMS is now back in the old harness of engine building, and his host of friends will be glad to learn that the shops of the Harris Engine Company, at Providence, R. I., are running 23½ hours daily. Mr. Sims is building both the Harris-Corliss and the improved Armington-Sims types.

Mr. R. A. BYRNS, General Sales Agent of the United Telpherage Company for Mexico and the West Indies, has recently returned from a short business trip to Cuba. The numerous and interesting inquiries as to this overhead system of light freight transportation promise a large business in the tropics.

MR. JOHN H. HARE, of Baltimore, has, it is said, invented an improvement in the making and handling of records for phonograph and graphophone. It will no longer be necessary to wrap up records in cotton, and they may be made to run for an hour if desired, so that whole lectures or concerts can be taken.

MR. F. BATHURST, of the Conduit & Insulation Company, Limited, London, who has been in this country for some weeks with his wife, on business, and has visited various cities, sailed for home by the "Teutonic" on Wednesday, well satisfied with the results of his trip. Mr. Bathurst is a keen and intelligent observer and is well known in electrical circles in this country.

MR. F. G. SYKES, formerly electrical engineer of the Brooklyn Edison Company, resigned his position with that company on June 1 to accept a position with the General Electric Company. He sails from San Francisco on August 10 for Sydney, N. S. W., Australia, where he will have charge of the installation of the machinery for the New South Wales Government tramway system.

MR. ALFRED SKITT, Vice-President of the Manhattan Railway Company, was asked by a friend with whom he was chatting when he expected to go on his vacation. "Vacation?" exclaimed the busy executive officer of the elevated system, "well, I may get a good long one three years from now, when the electric motive power is fully installed for Manhattan, but not until then. I have not had a vacation for fifteen years, but have lived it out at Yonkers, and, after all, I have not had such a very hard time of it." Mr. Skitt has the proverbial English staying power.

EDUCATIONAL.

STEVENS INSTITUTE.—The annual catalogue (for 1901-1902) of the Stevens Institute of Technology, Hoboken, N. J., has just been issued. Besides the curriculum, it contains much interesting information regarding this well-known institution, from which many eminent electrical engineers have been graduated.

UNIVERSITY OF MISSOURI.—The 1900-1901 Bulletin of the University of the State of Missouri, at Columbia, contains 268 pages of interesting information about this university. It gives outlines of the studies in the various courses, and at the back are lists of the students variously classified. The annual report of the Board of Curators to the Governor of Missouri shows that 1481 students were, at the time the report was made, enrolled in the whole university, fifty-two States, Territories and foreign countries being represented. The university gives a course in civil, electrical and mechanical engineering.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, have just issued descriptive matter pertaining to their new series and bridging cabinet type telephones. Circular will be mailed upon application.

A. L. IDE & SONS, Springfield, Ill., have issued a new little booklet descriptive and illustrative of their various types of Ideal engines at present being manufactured by them. There is little text, but the cuts are abundant and good.

INDUCTOR ALTERNATORS.—The Electric Machinery Company, Minneapolis, Minn., in its Bulletin No. 28 describes an inductor alternator of its manufacture. The bulletin is well printed on half-tone paper and every detail of the alternator is illustrated by excellent engravings.

STOW FLEXIBLE DRILL.—A new edition of the catalogue of the Stow Manufacturing Company, Binghamton, N. Y., contains 72 pages, in which are illustrated the application of the flexible drill to a surprising variety of uses. Some pages of the catalogue are devoted to the Stow multispeed motor, of which several types are shown.

MR. D. M. STEWARD, Chattanooga, Tenn., has purchased the entire plant and effects of the D. M. Steward Manufacturing Company, and the business will be continued by him under the same name. There will be no change in the management, as Mr. D. M. Steward has been for twenty-five years president and manager as well as majority stockholder in the old corporation.

"KILFYRE."—Mr. Denis J. Swenie, for so many years chief of the Chicago Fire Department, has just been made president of the Chicago Fire Appliance Company, which is the Chicago Agency for "Kilfyre." While Chief Swenie was head of the department, he had occasion to witness and prove the usefulness of "Kilfyre," and immediately upon his retirement took steps to identify himself actively with the "Kilfyre" interests.

M. B. ELECTRIC COMPANY, 203 Franklin Avenue, Cleveland, Ohio, have an exhibit in Electricity Building at the Pan-American Exposition, Buffalo, of a great variety of detail electrical apparatus. They make a specialty of small fan motors, medical appliances, lighting with batteries, and many other minor applications for which there is a large and growing demand. They invite inquiries and will be glad to send their catalogue and trade literature.

ENCLOSED FUSES.—The use of enclosed fuses is becoming so general and they afford such a superior protection to property and lessen fire risk to a minimum, that their strong endorsement by the National Board of Fire Underwriters is quite natural. The Central Electric Company, of Chicago, is agent for the D. & W. enclosed fuses, as well as other safety devices, and finds that the merits of the enclosed fuse are beginning to be fully appreciated.

STEAM SPECIALTIES.—The latest edition of the catalogue of James L. Robertson & Sons contains 64 pages, in which are illustrated and described the long line of steam specialties which this company has made so well known throughout the country. A number of pages is devoted to well written illustrated descriptions of the improved Robertson & Thompson indicator and of the improved Willis planimeter. One of the latest improvements to the latter is an adjustment whereby the horse power of cards may be read directly from a scale.

G. I. EXCURSION.—The officers and employees of the General Incandescent Arc Light Company participated in a pleasant and enjoyable outing at "Stimmels," Whitestone Landing, L. I., Saturday, July 27. A spirited and hotly contested game of baseball between the factory and office forces resulted in a tie, score 16 to 16. Bathing, bowling, wrestling and other sports occupied the time in ways that were more than pleasant, and after an enjoyable banquet, all voted the day a jolly one and to be long remembered. The outing was held under the auspices of the "G. I." Club.

LIGHTNING ARRESTERS.—Another artistic production of the General Electric press is a pamphlet on lightning arresters. The cover is remarkably effective and a number of the text pages have a decorative background that would attract attention in the best type of monthly magazines. The introduction to the pamphlet is an article on thunderstorms, written by Mr. Alfred F.

Simms, local forecast official at Albany, N. Y., which includes rules for forecasting such storms. The remainder of the pamphlet is divided into three sections, one of which is on the lightning arrester for direct-current circuits, another on the same for alternating-current circuits, and in the third and final section are given numerous diagrams of lightning arresters and their connections.

NOISELESS PINIONS FOR THE MINT.—The New Process Raw Hide Company, Syracuse, N. Y., has received a contract from the United States Mint at Philadelphia for 6 New Process Noiseless pinions 16 inch diameter, 6 inch face. These pinions are a part of the equipment of the new mint building, the machinery for which is just being installed. They are to be used for transmitting power from a 50-horse-power motor to a 10x9 inch rolling mill, and will run 175 r. p. m., meshing into a 60 inch iron gear. Six armature pinions for the same motors were shipped by the company a short time ago. They are 12⅔ inch diameter, 4 inch face, and will run at a speed of 525 r. p. m

AN AUTOMOBILE STORY.—It is said that no more original or more entertaining bit of nonsense was ever written than George Hibbard's "A Vehicle of Love," to appear in *McClure's Magazine* for August, and Howard Chandler Christy has caught the true spirit of the summer romance in his beautiful pictures. Two lovers have quarrelled, have parted forever, and have started on their separate ways. Unfortunately, or fortunately, their ways lie side by side, and the lovers are soon forced into an automobile hansom, greatly against their will, by a gray-haired "idiot." The chauffeur loses control of the electric carriage, which runs away, "at a quiet, decent enough gait," for some time. There are no accidents of any consequence, but something very interesting happens.

FEED WATER HEATERS.—Special machinery for heating and purifying feed water for steam boilers, as manufactured by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, is fully described and illustrated in a pamphlet of 96 pages, just issued by that company. The nature of steam boiler incrustation, the evils arising therefrom and the best manner of remedying the same, are explained and described, special emphasis being laid, of course, upon the advantages of this company's apparatus. Then follows a description of the operation of Stilwell's improved lime-extracting heater and filter combined, and several well executed illustrations show the construction of the apparatus. Various full-page illustrations show actual installation of these heaters and purifiers, and at the back of the catalogue there are several pages containing fac simile reproductions of letters from various concerns in which many good things are said about this apparatus. Accompanying the catalogue is a circular on Stilwell's cast-iron heater. This material is used in the construction of this heater on account of its resistance to the action of acids, salts and other impurities contained in water.

CHARLES H. BESLY & COMPANY, 10 and 12 North Canal Street, Chicago, Ill., report their general business very good. They are receiving many orders for chucks, vises, power hack saws and general supplies from many concerns that are closing down for their annual repairs. They are still working overtime at their factory, Beloit, Wis., and have added many new machines to their equipment in their endeavor to increase their output. They report that they have never sold as many Gardner grinders and Besly band machines as at the present writing, recent shipments having been made to New York, Pennsylvania, New Jersey, Massachusetts and Rhode Island. They are calling special attention to their new spiral paper circles to be used on Gardner grinders. They are now able to produce abrasive circles suitable for work on steel, cast iron, drop forgings, malleable iron, aluminum and the alloyed metals, gutta percha and wood, and have thus increased the field for the grinders. Samples of these new circles for trial will be sent to users of their machine without charge, stating metal to be ground. Their new 300-page illustrated catalogue is now ready for distribution, and will be mailed free to any address upon application.

Record of Electrical Patents

PATENTS ISSUED JULY 16, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

678,508. UNDERGROUND CONDUIT; J. T. McRoy, Chicago, Ill. App. filed Dec. 19, 1900. The invention consists in constructing the conduit so that an obstruction in the line of the same may be passed without interrupting the continuity of the conduit.

678,757. APPARATUS FOR AUTOMATICALLY FIRING SHIPS GUNS; L. Obry, Trieste, Austria-Hungary. App. filed Dec. 7, 1900. Involves the use of a gyroscope-like device for determining the moment the line of sight of the ships gun is horizontal.

PATENTS ISSUED JULY 23, 1901.

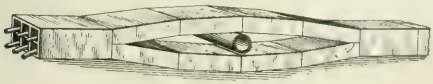
11,922. TELEPHONE CIRCUITS; P. G. Burgess, Mexico, Mexico, and H. W. Wilder, Albany, N. Y. App. filed Jan. 13, 1899. The invention comprehends a compound circuit arrangement wherein three telephones are so relatively placed and connected by appropriate circuit conductors that while the receiving instrument of one of them, which may be called A, shall be responsive to the transmission of both the others, B and C, and shall be able to reproduce the message transmitted by means of the said others, the receiver of B will not respond to, receive, or reproduce the transmission of C, and the receiver of C will in like manner be neutral or irresponsive to B.

678,851. APPARATUS FOR ELECTROLYSIS OF THE SALTS OF ALKALI METALS; Henry S. Anderson, of Springfield, Mass. App. filed Nov. 28, 1899. A mercury cathode contained in a vessel having a porous lining is kept in motion by being forced into and out of the vessel through vertically-arranged channels in the lining, which communicate with a vessel above the level of the mercury cathode.

678,853. MOTOR CONTROL SYSTEM; Albert H. Armstrong, Schenectady, N. Y. App. filed April 8, 1901. (See Current News and Notes.)

678,854. CONTROL OF INDUCTION MOTORS; Albert H. Armstrong, of Schenectady, N. Y. App. filed May 9, 1901. (See Current News and Notes.)

678,861. SYSTEM OF MOTOR CONTROL; F. E. Case, Schenectady, N. Y. App. filed Feb. 15, 1901. A system of control involving relays operated



678,508.—Underground Conduit.

by a small current taken from the trolley line for controlling the switches which operate the resistance cut-outs.

678,864. COIL RETAINING DEVICE; J. T. H. Dempster, Schenectady, N. Y. App. filed March 28, 1901. The armature slot is closed by a strip of wood reinforced with sheet metal.

678,873. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Nov. 14, 1900. Details of a clutch mechanism.

678,874. ELECTRIC MOTOR; J. A. Heany, Philadelphia, Pa. App. filed Nov. 19, 1900. The field magnet has two windings oppositely arranged and a commutator is adapted to connect either or both windings with the main circuit.

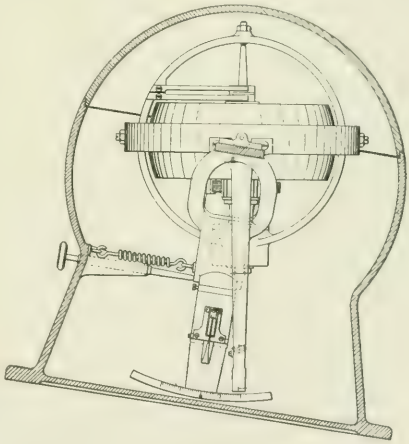
678,875. ELECTRIC MOTOR; J. A. Heany, Philadelphia, Pa. App. filed Nov. 19, 1900. The armature is provided with two oppositely arranged windings and a commutator is adapted to bring either or both windings into the main circuit to reverse or neutralize the two poles of the armature.

678,876. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Jan. 28, 1901. Details of a clutch mechanism.

678,878. LOCATING GROUNDS ON ELECTRIC CIRCUITS; Edward M. Hewlett, of Schenectady, N. Y. App. filed March 14, 1900. (See Current News and Notes.)

678,880. CONDUIT PLOW; J. Hoffman, Schenectady, N. Y. App. filed March 12, 1900. A conduit plow provided with a shank composed of two metal plates stamped with offsets to form, when assembled, a housing for the conductors leading from the collector shoes.

678,881. CIRCUIT-BREAKER; Charles E. Holmes, of Lynn, Mass. App.



678,757.—Apparatus for Automatically Firing Ships' Guns.

filed March 31, 1900. A plug switch has a metal socket forming one circuit terminal, the other terminal consisting of a stem movable in the socket, and having a helical spring which acts to retract the stem into the socket. When the stem is pulled sufficiently to overcome its friction in the contact hole, the spring rapidly rebounds, and any arc at the terminals is thus extinguished.

678,887. RESISTANCE DEVICE; C. W. Larson, Schenectady, N. Y. App. filed Jan. 18, 1900. An electric resistance comprising a metallic body provided with cavities, resistance-conductors in said cavities, and plastic material adapted to secure said conductors within said cavities by mechanically interlocking with said body.

678,894. TROLLEY SIGNAL; C. H. Morse, Cambridge, Mass. App. filed Aug. 11, 1900. The signals are set by means of mechanical devices and circuits controlled by the trolley pole.

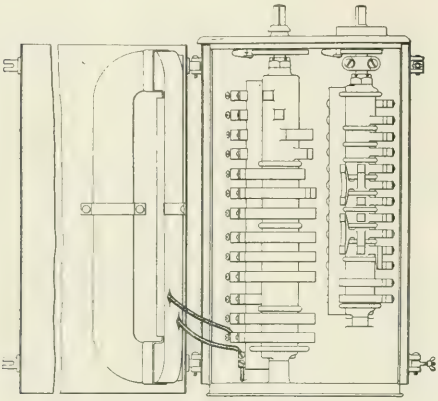
678,904. DYNAMO ELECTRIC MACHINE; Edwin W. Rice, Jr., of Schenectady, N. Y. App. filed April 25, 1900. (See Current News and Notes.)

678,905. CONTROLLING HIGH-POTENTIAL CIRCUITS; Edwin W. Rice, Jr., of Schenectady, N. Y. App. filed May 24, 1900. (See Current News and Notes.)

678,914. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed Jan. 14, 1901. The blowout coil is attached to the door of the controller box so as to be moved out of the way when the box is opened to inspect or repair the controller.

678,916. ELECTRIC ARC LAMP; Elihu Thomson, of Swampscott, Mass. App. filed Dec. 26, 1899. (See Current News and Notes.)

678,920. LAMP SOCKET; J. C. Tournier, Schenectady, N. Y. App. filed March 9, 1899. The threaded plug of a T.-H. socket is made of sheet metal stamped into required form and screw-threaded.



678,914.—Controller for Electric Motors.

678,925. HIGH OR LOW WATER ALARM; C. E. Zimmerman, Syracuse, N. Y. App. filed Aug. 1, 1900. Electrical devices operating to sound an alarm in which the circuit can be opened by hand and in which the circuit will be a second time closed in case the cause of the alarm is not at once removed.

678,929. ELECTRIC METER; John Henry Barker and James Alfred Ewing, of Cambridge, Eng. App. filed April 6, 1901. (See Current News and Notes.)

678,951. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Dec. 13, 1900. The feeding device is located in the air-tight arc-inclosing globe.

678,952. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed April 30, 1901. The clutch is in the form of a split tube, the parts of which are hinged together so as to swing towards or away from the carbon at the same time it makes its vertical movement under the attraction of a solenoid.

678,953. ELECTRIC CLOCK; G. Hookham, Birmingham, England. App. filed Dec. 15, 1900. Details.

678,957. ELECTRICAL INSTRUMENT; John Forrest Kelly, of Pittsfield, Mass. App. filed April 23, 1901. A reducing condenser is placed in series on each side of a static instrument and between it and the high-potential main, the condensers being located so as to remove any danger of contact with the high-potential mains connected thereto. A condenser of comparatively large capacity is also placed in shunt to the instrument in order to obviate disturbances due to the capacity of the static instrument with which it is connected.

678,964. COMMUTATOR FOR DYNAMO ELECTRIC MACHINES; F. A. Merrick, Johnstown, Pa. App. filed Nov. 14, 1900. A support for the commutator segments, having a raised center bearing therefor.

678,972. TELEPHONE TRANSMITTER; J. G. Nolen, Chicago, Ill. App. filed April 11, 1901. Details.

678,989. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed Sept. 28, 1900. Means whereby neither the controlling nor reversing handles can be moved unless the other is in its proper position.

678,990. CUT-OUT BLOCK; H. O. Swoboda, New York, N. Y. App. filed Jan. 22, 1900. The socket and plug are constructed so that the latter cannot be inserted in the former in any way except the correct way.

678,991. CIRCUIT BREAKER; H. P. Ball, New York, N. Y. App. filed July 7, 1900. Details.

678,998. SYSTEM OF ELECTRICAL DISTRIBUTION; Harry E. Heath, of Windsor, Canada. App. filed May 15, 1901. (See Current News and Notes.)

679,002. RAIL BOND; A. Markle, Hazleton, Pa. App. filed Jan. 19, 1901. A rail bond consisting of two conductors adapted to be fastened to abutting rails with their ends brought into parallel relation, plastic material electrically connecting said ends and an inclosing box containing the ends.

679,004. AUTOMATIC ELECTRIC STOP FOR ELEVATORS; H. B. Newhall, Jr., Plainfield, N. J. App. filed Oct. 31, 1900. Automatic controlling devices for an ammunition hoist, having ascending and descending platforms arranged on a cable and driven by an electric motor.

679,006. SYSTEM OF ELECTRICAL DISTRIBUTION; Edwin W. Rice, Jr., of Schenectady, N. Y. App. filed Dec. 12, 1899. (See Current News and Notes.)

679,008. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles Proteus Steinmetz, of Schenectady, N. Y. App. filed Dec. 9, 1899. (See Current News and Notes.)

679,029. CALLING DEVICE FOR TELEPHONE EXCHANGES; F. A. Lundquist, Chicago, Ill. App. filed May 17, 1899. Located at each telephone are certain devices by the manipulation of which a series of electrical impulses are sent through successive magnets located at a central exchange, which magnets operate other devices for making the desired connection.

679,050. LIQUID FEED DEVICE FOR ELECTROLYTIC APPARATUS; Raoul Girouard, of Westbrook, Me. App. filed May 11, 1899. A device for feeding liquid to electrolytic apparatus, which guards against accidental leakage of electricity. A stream of mercury is fed in small intermittent quantities through a tube, which causes the mercury to be supplied intermittently in drops, thus automatically insulating the columns from the continuous body of liquid in the feed apparatus and supply reservoir.

679,057. JUNCTION BOX AND ADAPTER FOR ELECTRICAL INSTALLATION; J. Meehan, Brooklyn, N. Y. App. filed May 16, 1901. The adapter is intended to be a permanent attachment which can be inspected without trouble and when so attached to the junction box, will be a guarantee that the work is well done and a preventive against grounded wires and wrong connections in the junction box.

679,092. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles Proteus Steinmetz, of Schenectady, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

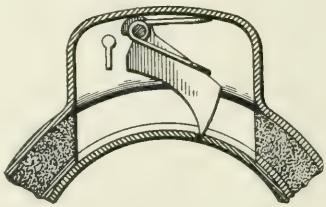
679,102. SYSTEM OF ELECTRICAL DISTRIBUTION; Ernst J. Berg, of Schenectady, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

679,138. ELECTRIC METERING SYSTEM; Dr. Louis Bell, of Newton Center, Mass. App filed March 26, 1900. (See Current News and Notes.)

679,151. COMBINED SWITCH AND CIRCUIT-BREAKER; Thos J. Johnston, of Schenectady, N. Y. App. filed Feb. 16, 1899. The usual circuit-closing switch is combined with an auxiliary circuit-opening apparatus by which the circuits of the coils operating the switch are so modified upon excessive current flow, that the switch acts as its own circuit-breaker.

679,174. POWER FACTOR METER; Paul M. Lincoln, of Niagara Falls, N. Y. App. filed March 27, 1901. (See Current News and Notes.)

679,175. FREQUENCY OR SPEED INDICATING AND REGULATING DEVICE. Paul M. Lincoln, of Niagara Falls, N. Y. App. filed March 27, 1901. (See Current News and Notes.)



679,206.—Locking Lamp Socket.

678,876.—Arc Lamp.

679,197. ELECTRICALLY OPERATED GAS BURNER; H. W. Webb, Columbus, Ohio. App. filed April 27, 1901. Details.

679,206. LOCKING SOCKET FOR INCANDESCENT ELECTRIC LAMPS; C. R. Barrett and E. C. Phillips, Chicago, Ill. App. filed May 13, 1901. The lamp base is locked in the socket and can only be released by insertion of the key into an orifice provided in the socket.

789,220. TROLLEY; N. Durant, North Adams, Mass. App. filed Aug. 18, 1900. A frame carrying the wheel is pivoted to the trolley pole at a point in the rear of the wheel.

679,222. PARALLEL ADJUSTABLE SWING JOINT; E. J. Filiatrault, Duluth, Minn. App. filed March 18, 1901. A conduit joint comprising interlocking bifurcated members, means for locking said members at any desired angle with relation to each other, and means for operating said locking means.

679,239. CATOPHORIC PAD; J. F. Mossberg, Minneapolis, Minn. App. filed Dec. 10, 1900. Details.

679,253. PROCESS OF OBTAINING VOLATILE ELEMENTS FROM THEIR COMPOUNDS; Alfred H. Cowles, of Cleveland, Ohio. App. filed July 19, 1900. An electric current is passed through a compound of a volatile electro-positive element, whereby such element is deposited on a porous cathode, and maintained in a state of vapor and the vapor caused to pass through the cathode and be condensed. The bath is maintained at a temperature higher than that of the volatilizing element. The porous cathode is of carbon or other suitable material and forms the floor of an electric furnace; the volatilized element passes through this floor into a receptacle underneath where it is condensed.

679,284. ARMATURE WINDING; W. Lau, Berlin, Germany. App. filed March 19, 1900. To avoid lengthening the armature, those portions of the coils crossing the end of the armature are provided with less insulation than the portions lying in the groove.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, AUGUST 10, 1901 No. 6.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 10, 1901.

CONTENTS. PAGE.

Editorial 209
Electricity and the New York Central Tunnel 212
Electrical Engineers of the Day: VI. C. J. Reed 212
Operating Features of the Boston Elevated, by Francis H. Shepard 213
The Telephone in Railway Service 217
The Delany Rapid Telegraph System 218
The Josse Waste Heat Engine 219
Elements of Illumination—XXIX., by Dr. Louis Bell 221
How Insects Put Out the Lights of St. Paul, by C. L. Fitch 222
Figures of Manufactured Exports 222
Recent Energy Meters 223
Current News and Notes 223
LETTER TO EDITORS:
Self-Starting Single-Phase Motor Without Brushes, by J. Fischer-Hinnen 225
Digest of Current Electrical Literature 227
New Books 230
Independent Telephony 230
Halsey Direct-Current Meter 231
Mine Electric Hoists on the Comstock 232
Three Rivers Elevator Controller 233
Improvement in Telephone Receivers 233
Combined Pan-American Exhibit of the Bullock and Wagner Companies 234
Handle for Lamps 234
Recent Signal Corps Work 234
Connecticut Corporations 234
DEPARTMENTS:
Financial Intelligence 235
Commercial Intelligence 236
General News 237
Illustrated Record of Electrical Patents 244

THE INSTITUTE MEETING.

In accordance with the arrangements which have been carefully made by various committees, the American Institute of Electrical Engineers will begin its New York-Buffalo meeting next week. The programme is of a varied character, both in its papers and its entertainments, while the presence of many foreign engineers and the visit to the Pan-American give a marked flavor of novelty to the whole affair. Remembering the cordial hospitality shown to it abroad last year, the Institute proposes to make its guests from Europe thoroughly at home in this country, and we are glad to learn that the contributions of members to the reception and entertainment fund are already of a most liberal and substantial nature.

There is great good in technical meetings, and particularly in those of an international kind. In electricity the activity is world-wide, and everywhere acute minds are at work upon its philosophical and engineering problems. That the workers and thinkers from all countries should thus get together and exchange ideas and experience is excellent, and we believe the present meeting will in this manner be productive of great benefit. Aside from the instructive aspect, there will be the renewal of many old friendships, and the international acquaintances formed will, as usual, add to the pleasure of the occasion. We trust the attendance, both in New York and in Buffalo, will be large. The programmes are now in the hands of all, and were noted in these pages last week, so that we need not again point out how worth while it is for every member who can manage it to participate.

TRACTION PROBLEMS.

We publish a most interesting article this week by Mr. F. H. Shepard on the operating features of the Boston elevated road, to which attention was duly drawn by us on the occasion of its opening last June. Mr. Shepard, who has been intimately associated with the engineering and installation work on the road throws light upon the peculiar nature of many of the problems to be met, and gives some valuable data as to the conditions that have developed since the line started. We are sure that all who read his pithy article will agree that in view of the nature of the line, and the heavy service required, electricity has proved remarkably successful in its application to the work. The results accomplished by Vice-President Sergeant and his staff are full of encouragement as to what may be expected when at last the Manhattan Elevated gets into operation with electric power.

When we recall how long it took to convince some of the Manhattan powers that electricity was adequate to the work now done by the objectionable steam locomotives, and when we note the changed situation here and in Boston—not forgetting Chicago—there is reason to believe that in due course the great New York Central Railroad will become convinced that electricity can redeem its tunnel terminal in New York City from the deserved odium that steam traction has at last brought upon it. We are not inclined, as are some of the critics of the New York Central, to belittle the problem. It is a serious one. Nor, like some other critics, do we deem it fair to throw doubt on the good faith of the officials in the matter. But it does seem a great pity that the question should have got before the Grand Jury before the company allowed it to be seen that it was actually endeavoring to effect an improvement—such an improvement, in short, as only electricity can bring. For even when the

work of abandoning steam for electricity is begun, much time must elapse before it can be completed, and meanwhile there can be little mitigation in discomfort for those who use the tunnel daily.

The Josse Binary Vapor Engine.

We print elsewhere an article compiled from a report describing a type of so-called "waste heat" engine as developed by Professor E. Josse, of the Royal Technical High School, of Berlin-Charlottenberg. The fundamental purpose of such an engine is to take the heat which an ordinary steam engine rejects and utilize a portion of it for the doing of useful work, thus increasing the total useful product without any increase in the initial supply of heat. This is most conveniently accomplished, as explained in the article, by the use of a second substance for which the exhaust from the steam engine may serve as a source of heat, and which will become thereby vaporized under a pressure suitable for use. In the present case sulphur dioxide or SO_2 is the substance thus employed, the condenser for the steam engine serving as the vaporizer or boiler for the SO_2, the vapor thus produced being used in a cycle of its own, as explained

The possibilities of this combination of two or more substances in one thermodynamic process have long been known, and so-called "binary vapor" engines are by no means a new thing. Their principles, however, have not always been clearly understood, and it has sometimes been imagined that through such a combination and in some mysterious way the second law of thermodynamics might be evaded, or that in some way the principles involved and mode of action are different from those of the more familiar steam engine. As a matter of fact, however, the principles involved are exactly those which govern the steam engine, and the same laws serve to explain the operation and limitations of one as well as the other. We have simply to recall the expression for the efficiency of an ideal or Carnot cycle heat engine. This is expressed as a fraction, the numerator of which is the temperature range through which the substance works in its cycle, and the denominator is the absolute temperature at which the heat is received into the engine. If T_1 denotes the upper and T_2 the lower limit of temperature, it is clear that if the temperature range $(T_1 - T_2)$ is widened by decreasing T_2, the efficiency of the operation will thereby be increased, and the useful work done will be greater for the same initial expenditure of heat. This is exactly what the binary vapor system proposes to do. It proposes to lower the temperature at which the heat is finally rejected from the engine, and thus to gain in efficiency in accordance with the expression above. In the actual engine, however, the full measure of the efficiency indicated by this expression is never realized, owing to various losses, chief among which is cylinder condensation. It is not enough, therefore, simply to increase the temperature range of a heat engine. We must at the same time make sure that the gain in efficiency, or at least a fair share of it, may actually be realized; that is, that some loss is not thereby introduced which will offset the ideal gain.

In the present case and by the process as described, the temperature T_2 is lowered from about 140 F. to, say, 70 F., or through a range of about 70 degs. Now, it should be clearly understood that in an ideal engine this range of 70 degs. would be worth as much in one place as another, and that in such an engine there would be no reason for coupling it up with a second cycle using a different substance. But the temperature range with steam cannot practically be extended down to 70 F., first, because to expand steam from 140 F. to 70 F. would require an additional expansion of over seven times. That is, there would be required a corresponding and enormous increase in low-pressure cylinder capacity in order to effect the expansion required. This is clearly out of the question. Secondly, when the temperature is carried down much below the limits now employed, the loss due to cylinder condensation becomes excessive, and experience indicates that with such excessive expansion in a steam engine the resulting loss due to added cylinder condensation would more than offset any gain expected. The use of steam over the lower part of the range is, therefore, impracticable for these two very good reasons. Assuming the upper limit of steam pressure fixed, we must, therefore, seek elsewhere for a substance with suitable properties in order to reduce the lower limit, and according to the claims made in the report, sulphur dioxide admirably fulfills the two fundamental requirements. That is, it has a convenient pressure and range of expansion for the temperature involved, and the cylinder condensation is quite small.

The surprising and perhaps the most significant feature of the results in the present case is found in the indication that what may be called the operative efficiency of the cycle is greater for the SO_2 than for the steam. That is, that the former comes nearer to realizing its full efficiency than the latter, and that a temperature range of one degree is worth more in the SO_2 engine than in the steam engine, whereas in an ideal engine a range of one degree is worth the same, no matter where on the scale it occurs. Indeed, it would result from this that the efficiency of the combination would be increased by increasing the range of the SO_2 engine and decreasing that of the steam engine. Mention is made in the report of certain tests which showed that such was the case for a very moderate decrease in the vacuum carried in the steam condenser and consequent rise in the temperature dividing the two cycles. It will be of much interest to learn through wider experiment the result of an increase in the initial temperature of the SO_2 as high as the practicable pressure may permit, and the corresponding increase in the range given to this part of the combination.

The use of superheated steam for raising the upper temperature and thus widening the range at the top, is now a well-assured feature of modern practice, especially in Continental Europe. The possibility of another considerable gain at the bottom of the range by decreasing the lower temperature, as indicated in this report, is such as to merit the careful attention of all concerned with the great problem of the economical development of power. As stated before, however, this possibility is one which has long been known, but the great difficulty has been to realize it in the face of the many practical difficulties that have been encountered with binary vapor engines. During the past century this type of engine has been the subject of numerous costly experiments, and while the report of Professor Josse indicates gratifying progress, the test of extended trial in practical service is lacking. As to the fluid employed by Professor Josse, we have vividly in mind a rust pile which, on a visit a year previously, had been a beautiful SO_2 refrigerating machine.

Popular Science and Corpuscles.

In the current number of our esteemed contemporary, the *Popular Science Monthly*, which is, alas! more popular than scientific in the single particular that its pages lie largely sealed from mortal eye until separated by that anachronous atrocity—the paperknife—appears a delightful article by Professor J. J. Thomson, "On Bodies Smaller Than Atoms," an abstract of which appears in the Digest. It is a commentary upon the spread of technical education that a paper on this most abstruse subject, and actually containing some little algebra, should find the light of day in popularized literature, and awake a gleam of recognition from the eyes of many who are

not scientists. Twenty years ago such an article on such a subject would have lain on popular benches as caviare to the multitude. It is difficult to say which commands our admiration the more—the article itself, or the fact that the great world should be capable of admitting it into semi-popular literature. Either consideration presents a triumph, the one over inanimate, the other animate, nature.

There is no one so well fitted to write upon sub-atomic matter as Professor Thomson, for in a large measure he has discovered sub-atomland. The story of that region and the scientific inroads which have been made into it are, when properly interpreted, more entrancing than the story of the early crusades, and more astounding than those of the Arabian Nights. In about a dozen pages this great physicist expounds the salient features of the knowledge already acquired in this most recondite subject. When physicists announced that according to their calculations there were about 20,000,000,000,000,000 of molecules in a cubic centimeter of gas at standard pressure and temperature, it was regarded as a hazardous guess by the rank and file of technologists, in view of the fact that such minute quantities of matter were individually far beneath the cognizance and appreciation of our senses, even with the aid of the most powerful microscope. In the case of hydrogen, Professor Thomson points out the experimental reasons for believing that instead of the molecule and its constituent atoms being the smallest entities known to science, we must admit that corpuscles of matter are capable of having an independent existence, all having the same size and weight, each weighing about the one-thousandth part of an atom of hydrogen, or about 2.2×10^{-27} gramme and carrying an electrical charge of 2.2×10^{-19} coulomb.

The view is offered that these corpuscles are electricity, so that a negatively charged body is a body which has received an accession of mass, and a positively electrified body is a body which has experienced a temporary diminution in mass. The mass changes, it being, of course, excessively small. It seems to us that either Professor Thomson's language is here subject to accidental misinterpretation, or that the evidence for this proposition has not yet been adduced. If this view were correct, then negative electricity would be matter, a conclusion which the experimental evidence does not yet seem to warrant. All that does seem to be conclusive is that corpuscles, or atomic chips, are invariably accompanied by, or indissolubly linked with, a definite negative electrical charge. In other words, the corpuscles and the negative charge invariably go hand in hand; but it does not follow that they are identical. After pointing out that the presence of corpuscles in liquids or gases is capable of accounting for the phenomena of conduction in gases and electrolytes, the article goes on to indicate that the process of conduction in metals may be accounted for on the same supposition of free ions in their midst, which, wandering aimlessly at average speeds of 60 miles an hour in the substance of the metal, undergo very rapid changes of direction and velocity by reason of collisions with neighboring molecules. Under these lively but checkered conditions of existence, the free corpuscles do not ordinarily travel far in any direction. When, however, an e. m. f., or more strictly, an electromotive intensity or field of force is exerted in the metal, the corpuscles steadily drift up-stream along the lines of force and the amount of electricity conducted, for a given gradient of electrostatic field intensity, depends upon the number of free corpuscles and upon the freedom of their motion. The more violently they are jostled by the molecules and atoms which obstruct their path, the more slowly will be their drift in obedience to electric direction. Consequently the effect of rising temperature in increasing the obstructive jostling, and diminishing the conductivity, is satisfactorily accounted for on this theory.

It would [illegible] that in the future we may [illegible] theory of electric conduction developed along the corpuscular lines here sketched. If, therefore, this theory is true, and if some metallurgical process could be discovered which would shake more chips off the atoms or copper, and thus present more free corpuscles for conduction, then we might expect copper to increase in conductivity in corresponding measure. The annealing of copper on this view is merely such a treatment as permits of molecular disengagement and therefore aids the wily corpuscle upon its wending way. It is quite conceivable that at some future time it shall be possible to obtain corpuscle-full copper of such good conductivity for heat and electricity that a wire of 100 circ. mils. should be the electrical equivalent of a million circ. mils. of modern copper, and at a corresponding economy in weight and price. In other words, it is conceivable that the present number of free corpucles per cubic centimeter of copper may be an incident, and not an inevitable necessity. According to the views which the article lays down, the reasons why copper conducts better than bismuth is that copper has more free corpuscles, and has no correspondingly greater obstructions in the way of their drifting under electric force.

A brief review is made upon the subject of mechanical inertia. Every corpuscle, and, in fact, every charged mass, possesses electromagnetic energy in virtue of its motion, and magnetic work has to be stored in the surrounding medium in order to accelerate a charged body in general, or a corpuscle in particular. The law of this action is precisely analogous to the law of mechanical inertia. Consequently, if this purely electromagnetic inertia were sufficiently great it would entirely account for and explain the ordinarily observed mechanical inertia of matter. Previous to the discovery of corpuscles, the electric charge capable of being attributed to a molecule of matter, say, hydrogen, was quite insufficient to account for its mechanical inertia. In other words, the amount of electromagnetic energy of motion stored in the neighboring ether was much too small, on the basis of the charge attributable to a molecule, to account for its mechanical inertia. If, however, a molecule of hydrogen contains, say, 1000 corpuscles, and each has a corpuscular charge, then the total quantity of electrical inertia might be sufficient to account for the observed mechanical inertia. Professor Thomson shows, however, that while this view is a fascinating one, there is as yet no direct substantiation for it. He has tried experiments with the object of testing the hypothesis, but these experiments, which are most ingenious, have hitherto yielded either negative or nugatory results. We therefore rest at present on the electromagnetic theory of inertia in matter with the verdict of possible and interesting, but not proven.

According to the theory laid down for the above-mentioned experiments, the impact of corpuscles upon matter must give rise to Röntgen rays; in other words, cathode rays, which are rapidly moving corpuscles, must give rise to the phenomena of Röntgen rays, when striking the walls of their containing Crookes' tube, and the Röntgen ray itself is a little solitary electromagnetic wave shed by the suddenly arrested corpuscular charge, which shed electromagnetic pellicle or integument, after the collision moves on in the ether with the velocity of light, as a solitary impulse, a periodic train of which would correspond to light. On this view the electromagnetic inertia energy of a corpuscle residing in its surrounding ether moves on as a Röntgen ray after the corpuscle itself is stopped by the glass wall of the tube, in a manner suggestive of the difference between the soul and body of the late respected John Brown.

Electricity and the New York Central Railroad Tunnel.

The Grand Jury of New York City has had under consideration the complaints laid before it as to the unhealthy condition of the tunnel through which the New York Central Railroad and its allied companies reach the New York City terminal. This tunnel is about two miles long, is divided by two interior brick walls, and is used daily by some 530 passenger trains, many of which are crowded with commuters. During the recent hot weather, when doors and windows had to be closed as usual to keep out the smoke and gases from the steam locomotives, the complaints were numerous and couched in strong language. Among other parts of its presentment made after hearing several witnesses, the following is of interest:

"From evidence adduced before it, the Grand Jury is convinced that in the present state of the art of electric application to mechanical ends the progress has been so general and uniform that everything requisite for an electrical installation in the tunnel and its approaches is as standard at the present time as steel rails or car wheels; that to install electrical traction in these tunnels and the approaches thereto everything required can be had without difficulty, delay, or great initial expense."

Electrical Engineers of the Day—VI.

C. J. REED.

Charles John Reed was born June 29, 1858, in Jasper County, Iowa. In 1877 he graduated from the Morris High School, and in 1881 from the University of Michigan. Though graduated from the classical course, he made all of his elective studies in physics, chemistry, mineralogy and mining, and received at his graduation, in addition to the regular diploma, the "special teacher's diploma" in physics and chemistry. For five years following his graduation he was Professor of Physical Sciences in the Township High School of Princeton, Ill., and in the Burlington (Iowa) High School. In 1886 he married Mary J. Crawford, of Burlington, and has three children.

In the summer of 1886 finding that the duties of the classroom were wearing on his nervous system, he moved to Idaho Springs, Colo., where, in company with Mr. M. T. Morrill, he engaged in the business of mineral surveying and minng, and in the installation of electric lighting plants in Georgetown, Idaho Springs, Golden, Denver, and other places. In this latter work he was also associated at first with Mr. Morrill and later with Mr. Paul Dyer and Mr. J. C. Hatzel, acting as the representatives of the Edison United Manufacturing Company for Colorado, Utah and New Mexico, with offices in Denver. At this time the electric lighting industry was in its infancy, and electric power plants had not come into existence, while the territory included, though extensive in area, was but thinly settled and unpromising. In addition to this circumstance, Mr. Reed could never make up his mind to be satisfied with commercial pursuits always longing for an opportunity to devote himself to physical and chemical research.

Thinking it would be a step in this direction, he accepted, in the fall of 1888, a position with the Jenney Electric Company, at Indianapolis, in charge of the incandescent lamp department, which gave the desired opportunity for study and investigation. Although the business was entirely new to him, and although little of practical value pertaining to the manufacture of incandescent lamps had been published at that time, within six months he had reduced the cost of lamps to less than half, and had at the same time improved the life and efficiency. One of his improvements was the introduction of methods of securing uniformity, which enabled him to produce lamps of an exact, predetermined voltage, temperature and candle-power. Shortly after these improvements were worked out, the Jenney Electric Company was absorbed by the Thomson-Houston Company, and the lamp department closed. From the fall of 1889 to July 1891, Mr. Reed was engaged in the surveying and examination of mining properties for Mr. T. A. Edison.

The study of electro-chemistry has been to Mr. Reed from youth one of intense fascination, and during the last ten years he has devoted his time almost exclusively to study and research in electro-chemistry and allied subjects. He has occasionally published papers on electro-chemical subjects, many of which have appeared in this journal. His publications have usually been prompted by a desire to correct what he conceived to be an erroneous doctrine or theory.

In 1894 Dr. W. Borchers published his sensational claims of having discovered a method of getting electrical energy directly from fuel by a galvanic process, which was hailed by Ostwald and other high authorities in Germany as the "prototype" of the galvanic cell that would revolutionize electrical industries. Mr. Reed promptly (*Electrical World*, Dec. 22, 1894) refuted this claim and showed that the electrical energy of the Borchers cell was derived from the oxidation of his copper electrode, a fact now generally admitted.

When in 1897 the Jacques "Carbon-consuming primary battery" was heralded as a discovery that would revolutionize industries by producing "electricity direct from coal," Mr. Reed at once pointed out the fallacy of these claims, showing, both by experimental demonstrations and theoretical considerations, that the electrical energy of this cell is of thermo-electric origin. He has also pointed out from time to time the fundamental fallacy of similar claims made for other "revolutionizing" carbon-consuming batteries, all of which have silently disappeared from public view. Mr. Reed has been frequently accused by his opponents of trying to discourage and belittle progress. He claims in reply that a pleasing error which inspires a false, sensational hope is not progress, but retrogression.

The dominant theory, to which Mr. Reed is now opposed, is that of electrolytic dissociation. This theory supposes that the constituents of an electrolyte in solution are in some manner dissociated or separated into ions having positive and negative electric charges; that these ions move in opposite directions through the body of the electrolyte under the directive influence of the electric current in quantities proportional to the current, and are deposited or set free at the electrodes by surrendering these electric charges to the electrodes.

Mr. Reed's belief is almost exactly the antithesis of this theory

According to him the molecules in a solution are neither dissociated in any way, nor electrically charged until an electric circuit has been completed through the electrolyte and two terminal electrodes; that the process of electrolytic separation of ions at the electrodes is one in which the ions in separating become charged instead of discharged; that the e. m. f. required to charge the pair of separating ions (that is, to produce the separation) is that which, multiplied by the coulombs, equals the chemical formation energy of the compound destroyed; that the current itself produces no directive motion or translation of matter, but merely overcomes chemical affinities; that all motion of the electrolyte and of the constituents of the electrolyte is due to diffusion (osmotic pressure), convection (mechanical currents), chemical affinity (in the formation of new molecules), and molecular rotation (caused by the formation of new molecules in a position which necessitates rotation through 180 degs.).

He rejects the theory of electrolytic dissociation on two grounds, namely, that it is not competent to account for all the facts to which it relates, and that such facts as it does explain may all be explained as well or better on the hypothesis substantially stated above. It does not, for example, account for the electrolytic conduction and decomposition of fused electrolytes, a class co-ordinate in general character with dissolved electrolytes.

Mr. Reed is a member of the American Institute of Electrical Engineers, to the *Transactions* of which he has made a number of contributions.

Fig. 1.—Typical Boston Elevated Station.—"City Square."

Operating Features of the Boston Elevated.

By Francis H. Sheppard.

In its issue of June 15, the Electrical World and Engineer published an illustrated article on the Boston Elevated road, opened that week, and gave then a number of interesting details as to the road, system, etc. Now that the road has been in most successful operation for some weeks, the writer, who has been actively engaged upon the work and has watched its development, welcomes the opportunity to call attention to some of the features of operation.

Probably never in the history of transportation was a more difficult problem undertaken than the inauguration of the elevated service on the lines of the Boston Elevated Railway. As is well known, the transportation problem in Boston is most complex. The streets are narrow and crooked. The inner terminus for most of the traveling public is a restricted area and extremely congested. The congestion of the car service was considerably removed by the construction of the famous "Subway," built by the Rapid Transit Commissioners of the city of Boston, and leased to the railway company. This afforded temporary relief, but it was early found to be inadequate for Boston's growing needs.

The necessity for improved service was seen, and plans made were vigorously put into execution. The boldness of the conception of the present service can hardly be appreciated. On the 10.17 miles of track now operated the degrees of curvature number 3395, and the longest stretch of straight track is less than .28 mile. If the track were laid out with this amount of curvature from a common center, it would double on itself over nine times.

The ascending grades are as high as 5 per cent, or 264 ft. per mile, the descending grades as high as 422 ft. per mile, or 8 per cent. The problem was to secure rapid transit, and the greatest possibility of increased capacity for traffic. The present elevated route comprises 10.17 miles of track, of which 2.27 miles is underground in the Subway and the remainder on elevated structures at each end of the road. The subway portion will be supplemented shortly by the elevated structure of the Atlantic Avenue division, having 4.69 miles of track, which is nearing completion.

Surface cars were run on the subway tracks now occupied by the elevated lines since the Subway was opened. In order to make the track connections to the elevated structure, and to reconstruct the subway platforms for elevated trains, it was necessary to discontinue the surface cars on the tracks in the Subway. In order to discommode the public as little as possible, this change was made between Saturday night and Monday morning. On Saturday evening, June 8, at 8 o'clock, the last surface car was run over these tracks, and on Monday morning, June 10, at 5.30 o'clock, the elevated service was begun. A large force, over 1200 men, were busied during this time to make the change. In addition to perfecting the track, signals, platforms and equipment necessary to be placed in operation, the largest task in this limited time was to rearrange the operation of the surface lines and to provide for the changed conditions of traffic. Sixteen hundred surface cars are run on the Boston system. During Saturday night and Sunday, temporary schedules and lines were in operation. This would not have been possible during the middle of the week, as the street traffic would not permit the great number of cars on the streets.

The starting of the elevated service involved the changing of 51 lines of surface cars, and the inauguration of 23 transfer points. It also called for the provision of a new transfer system requiring the instruction of no less than 2500 conductors of the surface lines. Of the 850,000 daily passengers, fully 45 per cent were diverted from their accustomed routes of travel. When this service was undertaken not one of the trainmen had ever made a complete trip over the road, and few had ever seen train service, the whole equipment was entirely new, and last, but not least, few of the patrons had ever ridden on an elevated train. Under the extraordinary conditions surrounding this operation, every precaution to secure the greatest safety has been adopted. The cars are all provided with automatic trips, so that if a train is run past a stop signal, the air on the train is immediately thrown into "emergency." The guard rails are of 100 lbs. section, and are rigidly fastened. They are placed somewhat higher than the track rail so that the possibility of derailment is practically eliminated. The operation of the control is surrounded with perfect safeguards against improper or unsafe operation. If accident befalls the motorman, the current to the train is immediately cut off.

The strength and rigidity of the structure commends itself, and the excellence of the detail of track alignment and special work is

notable. The movement of trains is governed completely by interlocking stations and by automatic block signals. They are of the electro-pneumatic type manufactured and installed by the Union Switch & Signal Company. One of the track rails is insulated from the other, so that a track circuit signal system can be used.

The question of control and equipment of the trains was probably one which called for the most exacting consideration. It was early appreciated that more than the usual motive power should be used. Equipment on more than one car in the train, the "multiple unit system, was considered imperative. In order to determine the safest and best system for their use, it was decided to invite the installation of the different equipments on test trains to be run over the most difficult portion of their road—the Subway. The tests and investigation made were without doubt the most complete and elaborate ever undertaken in competition for electrical apparatus. The contract was awarded the Sprague Electric Company.

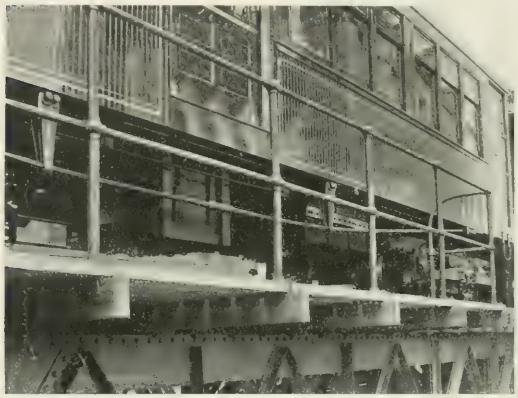


FIG. 2.—UNDER THE CAR, SHOWING GRIDS, AIR COMPRESSOR AND MOTOR TRUCK.

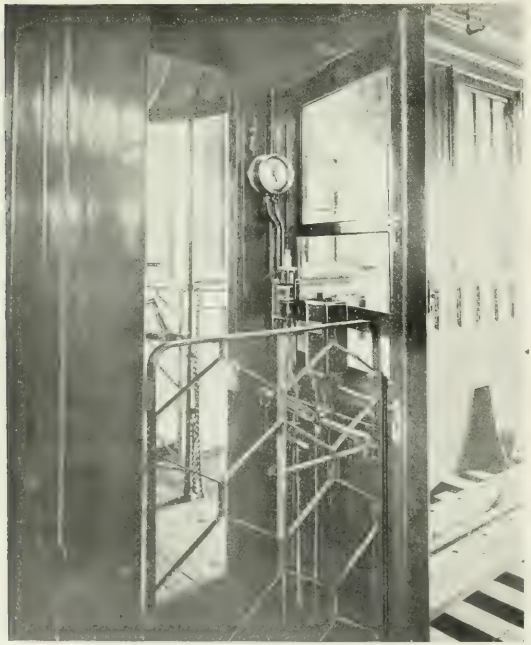


FIG. 3.—AIR BRAKE AND CONTROL APPARATUS IN CAB.

For the construction of the cars and the installation of all apparatus on them most careful and exacting specifications were made. The cars are substantial and very solidly built. The seats are longitudinal and center doors are used. The platforms are longer than customary. The familiar "Sprague" folding cab is used for the motorman and operating apparatus. It permits the gates on each side of the platform to be of the same size and gives free access across the platform. The cars seat 48 passengers; 80 more can comfortably stand up. The trucks were built by the Baldwin Locomotive Works. Both motor and trailer trucks are solidly built and of heavy construction. The motor axles are 6½ inches diameter at center, with 7½-inch wheel fits. The wheel base of the motor truck is 6 ft., and the wheels 33 inches in diameter. The wheel base of the trailer truck is 5 ft. and the wheels 30 inches in diameter. The wheels are steel tired, and the gears solid and pressed on the axles. The side bar type of motor suspension is used. Automatic couplers of the Van Dorn type of extra heavy construction are used.

FIG. 4.—STANDARD CAR COMPLETE.

Two Westinghouse motors, type "50 C," of 150-hp capacity each, are used. They are rights and lefts, so that the commutators are on the same side to permit of ready inspection. The air brake system is that of the Christensen Engineering Company. The motor-driven compressor has a capacity of 20 cubic feet per minute to a pressure

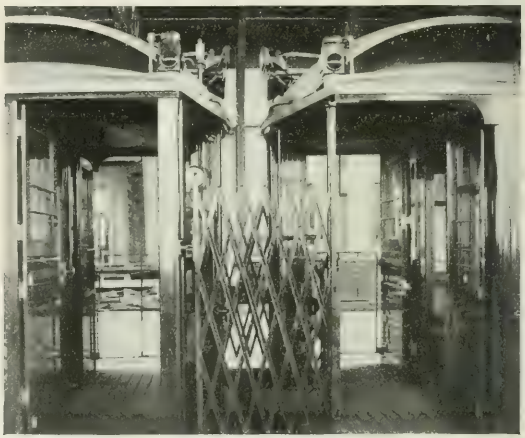


FIG. 5.—CAR PLATFORMS IN MIDDLE OF TRAIN.

Fig. 6.—Sullivan Square Terminal Yard and Shops.

of 90 lbs. The engineer's valves are of the Christensen type with excess pressure adjustment. The tripples are also their standard type. The governors are of the equalizing type, and control all of the compressors in a train. The cars are heated electrically with heaters

Fig. 7.—Trains ascending incline from subway to north station.

furnished by the Gold Car Heating Company. There are three degrees of heat, respectively taking 7, 14 and 21 amperes per car.

The cars are fitted with combination electric colored markers, which are wired in the car lighting circuit. There are 21 inside lights and 4 platform lights. The lights are uniformly distributed, and the cars are exceptionally well lighted.

The multiple unit control equipment is the Sprague standard type. The working apparatus is located in a compartment under a portion of the seat at one corner of the car. This compartment is open through the bottom of the car. Complete isolation of working currents from the inside of cars is thereby secured with all the advantages of ready and efficient inspection which on the lifting of the seat such location insures. The protection and isolation of the car wiring is a matter to which especial attention has been given. It was appreciated that the current value of any local short circuit would be in excess of any reached in any service existing elsewhere, and that any such short circuit might be hazardous. The current is collected from four contact shoes carried on long wooden shoe beams on the trucks. The main car wiring is led to each shoe through a detachable shoe fuse. The shoe fuse clears any accidental ground either on the car or by a contact shoe. From the junction of the contact shoe leads, the main wiring extends to a protected compartment in the hood at one end of the car, where the taps are made for lights, heat, air and control apparatus, to the main switch, then back to an enclosed main fuse of the "Noark" type, located under the car; then to the control apparatus and motors.

All of the truck, car and motor wiring is of special high grade 3000-volt insulation. It is removed from all vibration as far as possible, and enclosed for mechanical protection. The resistances are the well-known "Sprague" cast loop type, and are of sufficient capacity to permit of continuous operation on them. All the wires are laid up in standard cables and fitted with terminal lugs, which secures wiring of the simplest and most efficient kind.

Current for the elevated service is delivered from the stations as follows:

Stations.	Maximum Capacity Amperes.	Circular Mils Elevated Feeders.	Feet to Elevated Structure.
Central	40,350	8,000,000	800
East Cambridge	7,650	6,000,000	5,000
Charlestown	4,350	4,000,000	1,000
Lincoln	21,150	20,000,000	200

Reference to this table will show the possibility of current flow which would follow a short circuit on the elevated lines. By reason

Fig. 8.—Dudley Street Terminal, showing surface line loop.

of the grades and alignment of the system and the high speed and frequent service maintained, the fluctuations of load are severe. A-

the stations feed both elevated and surface lines, the fluctuations due to the elevated service are taken care of without difficulty. Observations as far as made indicate that the current demand for a section of the elevated line 1½ miles long having in operation 9 trains, varies from 500 amperes to 6000 amperes. Even with such extraordinary demands for current, the minimum voltage at the contact rail is 500 volts. This is because of the large section of feeders and the proximity of the power stations. The feeders used are of 2,000,000 circ. mils. section, and are run in conduit to the structure where bare tinned copper cables mounted on special glass insulators are used. They are covered by a cable box, the top of which forms a convenient walk on the structure. The several sections of the contact rail are tied together by enclosed fuses of 2400 amperes capacity.

Some of the elevated and the surface line sections are fed from two or more separate stations. This ties the stations together and distributes heavy pulls among the different stations. To further assist in this distribution of "pulls," the generators are given a drooping characteristic. Thus when an extremely heavy pull occurs in close proximity to one station, its voltage falls and the other stations assist in carrying it. In addition, if any station by reason of locally heavy traffic is overloaded, a portion of its load is shifted to other

FIG. 9.—LINCOLN POWER STATION.

stations by voltage reduction at the generators by the field rheostats.

The feeder system is very carefully laid out, so that any section may be cut out without interfering with the operation of the rest of the system. In order to prevent the contact shoes bridging from a live section to one in trouble, a rail of suitable length fed through permanent resistance is inserted between the two sections. Specially designed "protected" rail bonds are in use for feeder taps to the contact rail. The track is well bonded to the structure to provide an efficient return circuit.

Lincoln Power Station is the one most recently built. It is thoroughly modern in every respect. Vertical engines direct connected to generators of 2700 kilowatts normal capacity are used. The ultimate rated capacity of this station will be 18,900 kilowatts, with ability to carry for one hour 28,000 kilowatts, and for brief periods 38,000 kilowatts.

During acceleration each car takes a maximum of 550 amperes, and an acceleration of 1.8 miles per hour per second is obtained. The maximum speed reached between stations is 46 miles per hour. The acceleration is uniform and the track is of such excellent construction that it is most difficult to realize the high speeds that are attained.

As near as has been determined the current consumption per car mile is 4.5 kilowatt-hours. The present mileage is 15,000 car-miles per day. The grades encountered and the high speeds run reflect strikingly in the extreme wear of the brake shoes and wheels. The shoes first used were completely worn out after 200 miles of service. Special shoes are now used and longer service is secured. This also means exceptional wear on the wheel tires.

The present elevated service runs from Sullivan Square, Charlestown, through the Subway to Dudley Street, Roxbury. At Sullivan Square, the main shops and a large terminal transfer station and office building are located. This terminal building and train shed for surface and elevated cars is one of the largest and most commodious in existence. The train shed is 200 ft. long, and is spanned by a single arched roof of 175 ft. span. In the building on the first floor, are large and well appointed waiting rooms, and on the second floor are the elevated division offices. At this point free transfers to and from 16 lines of surface cars running through Arlington, Somerville, Malden, Medford and Everett are given. The traffic through this station is heavy, as many as 125,000 passengers per day, and for an hour 24,000 passengers having been handled.

Leaving Sullivan Square, the run is made around a loop of 112 ft. radius, then following Main Street and its numerous curves to City Square station, also in Charlestown. This station is an intertrack station. Transfers are made here to and from 18 lines of surface cars running to the numerous towns east of Charlestown and through Lynn, Swampscott, Revere and Chelsea. Leaving City Square, the run is over the Charles River drawbridge, a massive double-deck structure, thence past Causeway Street Junction with the Atlantic Avenue division, around the curves to the North Station. This station is quite an important one as transfers are issued to and from 37 lines of surface cars radiating over practically the whole system. By reason of its proximity to the terminal station of the northern and western steam railroads a large volume of traffic originates here.

Leaving Union Station, a descent down an incline on a 5 per cent grade is made into the Subway. At the foot of the grade around a reverse curve is Haymarket Square station. Transfers may be secured here to and from no less than 38 surface lines which radiate over practically the whole system. Leaving Haymarket Square, the run is made around some rather severe curves and up a varying grade, which is at one point in combination with a sharp curve equal to 5.5 per cent, and Scollay Square station is reached. This is one of the most important inner terminals, and a good deal of traffic originates here. This station is the terminus for the Boston lines of the Lynn & Boston Railroad, and also for 10 lines of surface cars operated by the Boston Elevated Railway Company.

The run to Park Street, another important subway terminus, is made around numerous curves and up grades, stopping at the station on 3 per cent descending grade. Free transfer is made here to and from 35 lines of surface cars radiating from Neponset on the southeast to Arlington, Cambridge and Somerville on the north. This station is a combined surface and elevated station and an exceedingly busy one. Leaving Park Street, a sharp reverse curve is met and passing around several other curves and down a varying grade as high as 2 per cent, Boylston Street station is reached. Free transfer is made here to the same lines as at Park Street.

Leaving Boylston Street, the run is most tortuous. Descent is made down an 8 per cent grade around a sharp reverse curve without connecting tangent around other curves and over a changing grade, ascending 4.5 per cent, descending 3 per cent, ascending 2.9 per cent, descending 3 per cent, ascending 5 per cent, then finally descending 1.5 per cent to Pleasant Street station. This station is located just outside the Subway, at the foot of the incline to the elevated structure. Transfers are issued to and from nine lines of surface cars running, through Jamaica Plain, Brookline and South Boston.

Leaving Pleasant Street, ascent is made of a grade of 5 per cent around a long curve over the Boston & Albany tracks, past Castle Street Junction, then by Washington Street to Dover Street station. This is a busy transfer station, and transfers are issued to 13 lines running through Cambridge, Milton, Neponset and South Boston. From Dover Street, a continuous run is made, few curves being met, on a level track to Northampton Street. Transfers are exchanged here with 13 surface lines running through Cambridge, Newton, Forest Hills and South Boston. From Northampton Street, the run is made to Dudley Street, around several curves and varying grades, and around a loop of 105 ft. radius into Dudley Street terminal. Twenty-four lines of surface cars terminate here and ex-

change passengers with the elevated. These lines radiate over practically the entire system on the south. The traffic here is very heavy and probably equals that at the Sullivan Square terminal. The average day's traffic through each of these terminal stations is approximately 80,000 passengers.

Perusal of the foregoing data will indicate the extreme density of traffic over the whole line, and how imperative the appointments for the safe and rapid handling of the service had to be. Not the least important are the platform arrangements necessary to care for such traffic. At the terminals and also at the busy stations in the Subway, free access on the same level is given between elevated and surface cars. At other points, ticket transfers are issued to and from the street. The traffic has so far exceeded all expectations that both the platform gates and center doors are used at all stations. On each platform opposite car entrances is painted, "Enter here," to ensure the prompt loading of passengers.

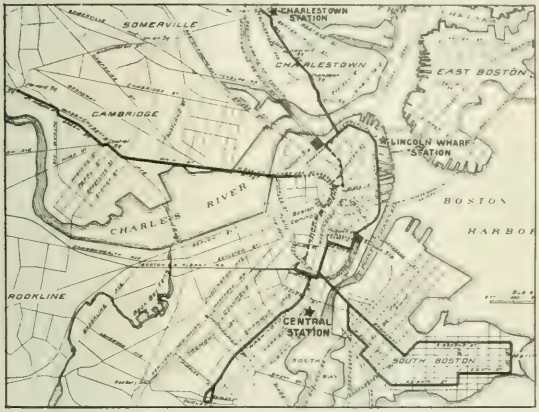


FIG. 10.—MAP OF LINE SHOWING POWER PLANTS.

By printed notices in the cars and signs at stations, passengers are requested to leave the cars at the center door and enter at the gates. At each station the trains are "rung off" by a large gong. The gates are then shut immediately, and the station stops are thus reduced to a minimum. There has been a most remarkable development in the alacrity which the patrons of the road have attained in entering and leaving trains. The positive manner in which the gates are closed on signal has much to do with this. The smoothness of operation and the speed of the trains have served to make the service very popular.

Additional contracts for more equipment have already been made. Plans are being made for the extension of the elevated structure and for the construction of an additional subway. The near future will doubtless see no less than 50 miles of elevated track and 600 cars in operation.

Great credit is due the management for the energetic manner in which the undertaking has been carried along. The executive committee is comprised of Mr. William A. Gaston, chairman; General William A. Bancroft, president, and Messrs. Robert Winsor and J. M. Prendergast, directors. The working out of this great problem in passenger transportation has devolved upon Mr. Charles S. Sergeant, vice-president, who has long been known as an able railway manager of the advanced type, and upon Mr. Paul Winsor, his assistant, who is also directly responsible for the workings of the technical side of this undertaking.

In the operating department Mr. S. S. Neff is superintendent, assisted by Mr. Eugene McKernan, trainmaster. The careful schooling they have given the trainmen is reflected in the excellent service. The structure, stations and track were laid out and constructed under the supervision of Mr. George A. Kimball, chief engineer of the elevated lines, and are noteworthy as the most elaborate known in the art.

Mention should also be made of Mr. A. D. Campbell, superintendent of construction of the Sprague Company, for the excellence of the installation on the cars. Since the commencement of the service there has not been an accident of the slightest nature. This result, in view of the difficulties to be met, is most remarkable. The equipment of this road is conceded to be the most advanced in all respects, and its successful operation will certainly continue to be followed with interest by those engaged in transportation work.

The Telephone in Railway Service.

The Delaware, Lackawanna & Western Railroad Company is building a copper metallic circuit over its main line and branches, to be used, as already noted in these columns, in the dispatching of trains and transacting other railroad business by telephone. The system is already in practical operation on some of the branch lines, and as the construction work on the various sections of the road is finished the telephone is immediately put into service. It is expected that the entire railroad system will be equipped telephonically within six months.

The railroad company has become a licensee of the American (Bell) Telephone & Telegraph Company, and is permitted by the latter to connect its wires with the telephone exchanges at the principal points where private branch exchanges are maintained by the railroad, thus enabling the railroad people to reach any subscriber in the places so connected. In return for this privilege the railroad company agrees to use Bell apparatus exclusively, which it gets at a very low rental. In the construction of the new line the Bell standard is followed, No. 12 copper wire (170 lbs. per mile) being used.

The dispatching of trains by telephone has been criticized on the ground that no record is made of orders or messages. The fallacy of this objection is obvious when it is remembered that telephone messages in railroad work are required to be written down just as telegraph messages are, hence there is really no more liability to error in a telephone message than there is in a telegram. The system of sending train orders by telephone, as developed by the Delaware, Lackawanna & Western Railroad officials, is simple in the extreme, and rapid as well. For each class of order a printed form is provided, having blank spaces to be filled in by telephone. The printed portions of the message being invariable as to phraseology, do not require to be transmitted over the telephone, only the words or figures necessary to fill in the blank spaces to complete the order. The company, we understand, uses over 40 different forms in its telephone service.

In order to secure a permanent record for reference the company is having some interesting experiments conducted. It is proposed to combine the telephone and the phonograph for this purpose. Mr. Thomas A. Edison now has the experimental work in hand, and assures the railroad people that he will produce for them an instrument that will meet their requirements. Mr. Edison proposes to use a phonograph of special construction for this work. It will have a cylinder of such dimensions as to make a record of orders given during 24 hours. These phonographs will be placed in the various dispatchers' offices, and will make records of all orders issued by the dispatchers and the same orders as repeated back. In case of an error the record will enable the dispatcher to determine at once who made the error—the sender or receiver of the message. In this respect the telephone-phonograph system will prove superior to the telegraph, since in a telegram it is impossible to determine whether the sender or the receiver is at fault. The actual mechanical details of the phonograph combination cannot yet be learned, as the work is still in Mr. Edison's hands.

Apart from the use of the telephone in the dispatching of trains, it affords an equally, or even more important service to a railroad. It enables every official to personally communicate with every other official on the line of the road in much less time than by telegraph, the two telegraph operators being entirely eliminated in each communication—the advantage of this feature was exemplified during the recent strike in the coal regions controlled by the Delaware, Lackawanna & Western Railroad Company. Conferences were held by telephone between the president at his summer home, the general superintendent at Buffalo or elsewhere, and the superintendent of the mining district. At these conferences, the situation was discussed and plans were laid down as readily and effectively as if all the officials had conducted their deliberations together in one office. Such uses of the telephone enabled the officials to be everywhere on the line of the road at the same time, and this without moving from their desks.

The private car of the general superintendent of the road is furnished with a telephone outfit and wherever that official goes he keeps in personal touch with affairs all along the line by plugging in

his telephone at sidings. The private car of the president is being similarly equipped.

The introduction of the telephone on the Delaware, Lackawanna & Western Railroad is due largely to the enterprise and far-sightedness of Mr. L. B. Foley, superintendent of telegraph of that road. Mr. Foley years ago perceived the possibilities of the telephone in railroad service, and has never ceased to advocate its use, although he found much conservatism to break down. In this connection it may be of interest to note that this subject was well covered in a paper read by Mr. F. P. Valentine at the recent convention in Buffalo of the Association of Railway Telegraph Superintendents, an abstract of which paper appeared in these columns June 29, 1901.

The Delany Rapid Telegraph System.

The Delany rapid telegraph system, which has been undergoing a long process of improvement at the hands of its inventor, P. B. Delany, of Orange, N. J., is now being exhibited at the Pan-American Exposition. Mr. Delany some time ago perfected apparatus for the perforating of tape and sending of messages to be received and read in the ordinary way by a Morse operator. The greatest interest

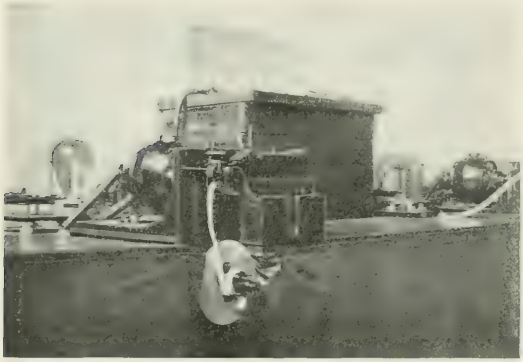


FIG. 1.—CHEMICAL RECEIVER.

centers, however, about the recently completed very rapid system which uses a chemical receiver. The chemical receiver marks a radical change in rapid telegraph methods. It is based on a principle conceived some time ago by Mr. Delany, but not put in a shape to make it commercially available until the invention of a punch which could be worked by an ordinary Morse operator without previous practice. Such a punch has been perfected and completes a system of rapid telegraphy which has overcome many of the obstacles that have stood in the way heretofore.

One of the greatest obstacles to rapid sending by the Morse code has been the "tailing" or drawing out of the dots on account of the capacity or condenser effect of the line. If the line is long it acts as a condenser to discharge current through the receiving instrument for an interval after the current has been cut off at the sending instrument. Mr. Delany has ingeniously made this condenser effect or tailing help instead of hinder his work. In fact, a certain amount of capacity is necessary in the line to have the receiver work successfully, and if the line is not long enough to give this a condenser must be used.

In the Delany system a tape is first perforated by an operator working as he would with an ordinary Morse key. The tapes so prepared by the operators in an office are then put into a sending instrument to be run through at the rate of 100 to 8000 words per minute, according to the length of the line. The message is received on a tape by a chemical receiver, and this tape is given to the various tape readers in the receiving office to decipher.

The chemical receiver, which is shown in Fig. 1, and is driven by a small motor, makes use of a receiving tape which has been dipped into prussiate of potash, an electrolyte which will make a blue mark when an iron cathode is brought against the tape. The damp tape is

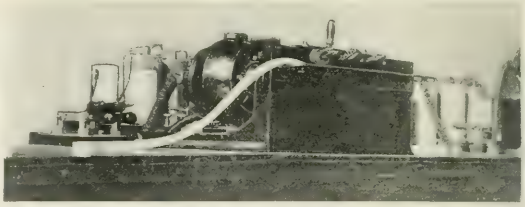


FIG. 2.—SENDING INSTRUMENT.

passed over rollers under three electrodes arranged side by side. The middle one is of iron, and the two outside ones of platinum. When a current passes in one direction from the two outside electrodes through the moist tape to the iron electrode in the middle, the electrolytic action causes the iron electrode to make a blue mark. Current in the other direction leaves no record, as the outer electrodes are of platinum.

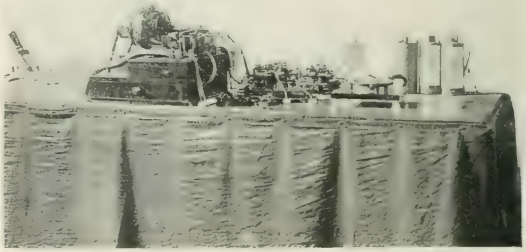


FIG. 3.—PUNCHING INSTRUMENT.

To understand the working of the receiver it is now necessary to go into the working of the sending tape and instrument. The sending tape is perforated, as shown in Fig. 4, and is run through a motor-driven sender, as shown in Fig. 2. On the tape there is a punch mark on the upper half (as shown in Fig. 2), at the beginning of each dot or dash, and a punch mark on the lower half at the close of each dot or dash. The horizontal distance between punch marks represents the relative length of dots, dashes or spaces. As this tape goes through the sending machine in Fig. 2 it passes under two contact fingers, one of which is over one row of holes and the other over the other row of holes. When a hole on one side of the tape passes under the contact finger on its side, a current impulse is sent over the line and through the receiver in one direction. When a hole on the other side passes under a contact finger, current is sent over the line in the other direction.

FIGS. 4 AND 5.—SENDING AND RECEIVING TAPE (ABOUT HALF SIZE).

When a dot or dash is to be made, current is sent over the line in such a direction by the punch mark at its beginning, that the iron electrode on the receiving tape leaves a blue mark on the tape. The battery is, of course, immediately cut off as the punch mark passes from under the contact finger, but the capacity of the line causes it to discharge through the receiving tape and continue the blue mark until current is sent in a reverse direction by the punch mark at the close. The instant the current is reversed the electrolytic record of the dot or dash is stopped. All difficulty from tailing due to the capacity of the line is thus avoided and the capacity is made a help instead of a detriment.

The rate of transmission possible with this arrangement is almost inconceivably rapid, and telegraphers who watch the sending of a message by this system at the Pan-American can hardly realize that a telegram has been sent in the second or two which it takes to run through a lengthy message.

In a system of this kind it is extremely desirable that the tape be perforated by a Morse operator by methods he is accustomed to. A punching machine by which the peculiar kind of tape used in the sender can be punched by the ordinary operation of a Morse key has recently been perfected by Mr. Delany. It operates one punch upon the depression of a key and the other punch upon the release of the key. This punch machine as exhibited at the Pan-American is shown in Fig. 3. Figs. 4 and 5 are reproduced from samples of the sending and receiving tape on which the marks are made by electrolysis.

The Josse Waste Heat Engine.

On several occasions we have referred to a type of engine developed in Germany by Professor E. Josse, of the Royal Technical High School of Berlin-Charlottenberg, for which great claims in economy have been made. From a pamphlet recently published by Professor Josse we are enabled to give some details of the engine. The system consists briefly in utilizing part of the heat in the condensing water of the ordinary condensing steam engine to evaporate sulphur dioxide (SO_2), the vapor being used to drive another engine.

Fig. 1 gives a diagrammatic representation of the system. *A* is the ordinary steam engine and *B* the steam surface condenser into which the steam exhausts, which condenser also serves as a boiler for evaporating the sulphur dioxide. *C* is the SO_2 engine and *D* its condenser, from which the sulphurous acid is drawn from the pump *E* and returned to the steam condenser *B*.

A vacuum of 24 inches in the cylinder of the steam engine corresponds to an exhaust temperature of 140 degs., and at this temperature sulphur dioxide vapor has a pressure of 156.5 lbs. per square inch absolute, and at 60 degs. of the temperature of the condenser cooling water, it has a pressure of 40.8 lbs. per square inch absolute. Consequently, under these conditions as to temperature the sulphur

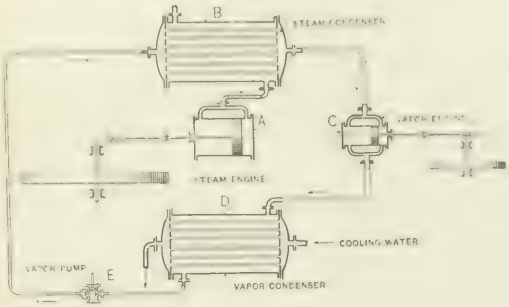


FIG. 1.

dioxide may be used for developing power in the cylinder in expanding from 156.5 lbs. to 40.8 lbs. per square inch.

The mechanical laboratory of the Technical High School of Berlin-Charlottenberg possesses a 150-hp triple-expansion engine, used for electric lighting and experimental purposes, and the Josse system was experimented with in connection with this engine. The engine is supplied with a second crank, with rod guides, etc., adapted for attaching compressors or pump cylinders for experimental purposes, and an SO_2 engine was connected with this crank. The dimensions of the steam engine are 10⅝ inches by 16 15-16 inches by 26 9-16 inches, with 19 11-16-inch stroke, the normal speed being 150 r. p. m. The vapor cylinder has a diameter of 16 15-16 inches, and the same stroke as the steam piston. The vapor cylinder was sup-

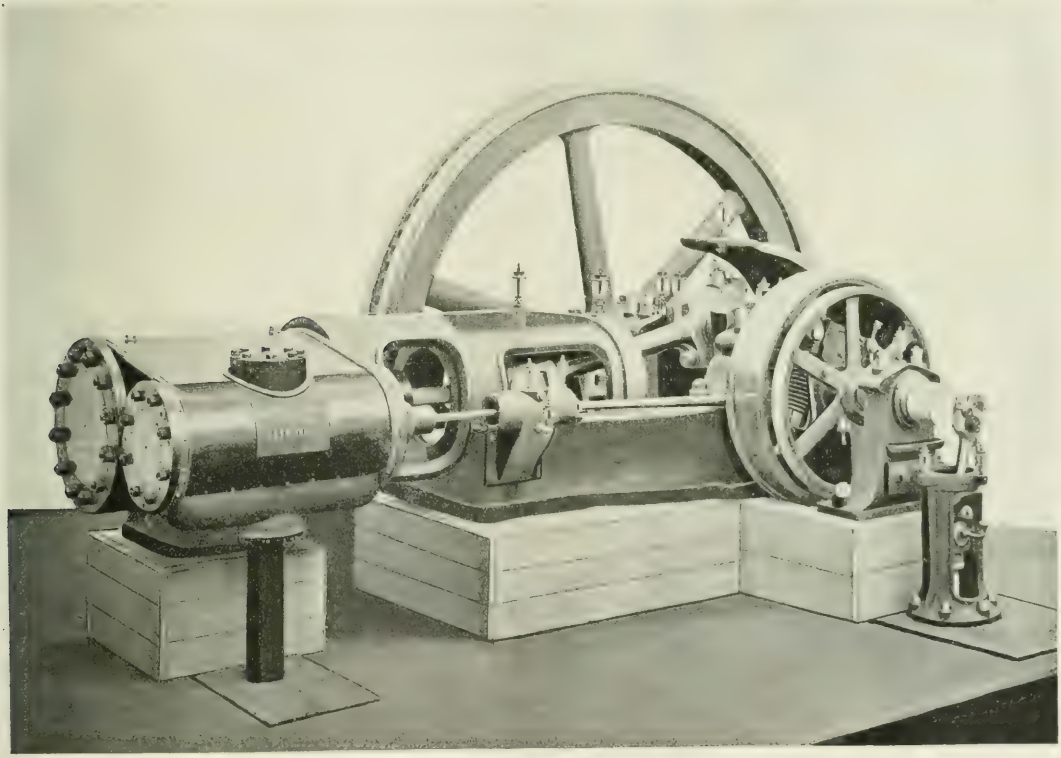


Fig. 2.—Waste Heat Engine, Berlin Electric Light Station.

plied with poppet valves, a departure from the usual design of these valves having been made in order to obviate any possibility of leakage at the stuffing boxes. Instead of operating the vertical valve spindles directly from the eccentrics, the valve gear with oil dashpots and springs for closing the valves, was enclosed in the valve chest, and motion imparted from the gear to the valve spindles in the completely closed valve chests by means of oscillating shafts and bell cranks. A similar arrangement was chosen for the exhaust valves. The piston rod stuffing boxes also required special construction in order to provide for the most perfect packing possible. While SO_2 itself is an excellent lubricant, since the purpose of the packing is to prevent its escape, grease is used in the outer end of the stuffing boxes, and it was necessary to so construct the stuffing boxes as to prevent the piston rod from carrying the grease into the cylinder.

In operation it was found that the condensation in the SO_2 cylinder was remarkably small, and not the slightest difficulty was encountered from this score in spite of the absence of drain cocks on the cylinder.

It is well known that sulphur dioxide in the presence of atmospheric air, and more especially in the presence of water, rapidly oxidizes into sulphuric acid, which, of course, attacks metals. The necessity of very complete means for preventing leaking, not only at the engine, but in the condenser, is therefore apparent. The entrance of water into the engine is, however, impossible under normal conditions, since the internal pressures are higher than the atmospheric pressure, and the present state of the technical art enables joints and packings to be so constructed as to be perfectly tight. During the period of the earily experiments with apparatus at the High School, the vapor engine stood for more than a year filled with SO_2 and condensing water without giving the least trouble, and the parts of a new 60-hp engine for the same school have been filled over nine months and no trouble experienced. Numerous examinations have shown that everything remains continuously in excellent condition.

The vaporizer, or steam condenser, was of a cylindrical form about 10 ft. long, and contained 753 square feet of cooling surface. The SO_2 condenser was 41 inches in internal diameter, and contained about 1720 square feet of cooling surface. The power required for the SO_2 feed-pump was about ¾ of 1 per cent of the total power of the engine.

In the tests of this arrangement superheated steam of about 300 degs. C. was used. For the steam engine alone the best economy obtained was 11.15 lbs. of water per ihp-hour. The waste heat engine delivered at the same time an amount of energy amounting to 34.2 per cent of that of the steam engine. Consequently, the steam consumption for ihp-hour of the combined engines was reduced to 8.34 lbs. In this test the total output was 170 ihp-hour.

In the test corresponding to the above economy the admission steam pressure was 156 lbs., the temperature 588 degs. F., and the vacuum 24 inches. The admission vapor pressure was 128 lbs., the temperature 134 degs. F., and the pressure in the SO_2 condenser 33 lbs. above the atmosphere. The temperature in this condenser was 70 degs. F., and that of the entering and discharge circulating water, 50 and 60 degs. F., respectively. The mechanical efficiency of the whole arrangement was 85.5 per cent.

A number of tests were made in order to determine the relation of economy with the steam vacuum. The tests, which were comparative, extended over a range of vacua from below 21 to 28 inches, and demonstrated that the best economy of the combined machine was secured with a vacuum of 21 inches. The explanation offered for this is that with a low vacuum, and consequently smaller difference of temperatures in the low-pressure cylinder, the condenser losses in that cylinder are appreciably decreased, while the smaller amount of work delivered by the low-pressure cylinder is more than made up by the corresponding increase of work in the vapor cylinder. Professor Josse concludes that possibly still better results may be obtained with vacua less than 21 inches. It was not thought advisable to experiment with lower vacua for the reason that the safe limit of pressure in the vapor cylinder was 215 lbs., corresponding to a vacuum of about 21 inches.

It is pointed out that the percentage of gain to be obtained by the waste heat engine is dependent upon the specific steam consumption of the steam engine entering into the arrangement. That is to say, the larger the specific steam consumption of the steam engine, the greater percentage of power developed in the vapor engine; and there is a larger gain when the boiler supplies saturated steam than when superheated steam is supplied to the high-pressure engine cylinder. The vapor cylinder permits of a further slight gain of economy by utilizing the heat energy contained in hot condensation from steam jackets and intermediate receivers of the steam engine.

Professor Josse makes a digression in order to discuss the relative advantage of triple and compound-expansion engines where superheated steam is used. In order to test this question some experiments were made by running the triple-expansion engine of the High School with the intermediate cylinder cut out, and the result was that the economy was precisely the same when two cylinders were used as when all three were in service.

As to the greater amount of cooling water used with the waste heat engines, it is stated that it is advisable to use about 25 per cent more water than would be required by the steam engine alone. The power consumption of the water and circulating pump is about the same as that of the air pump of a jet condenser, assuming the same quantity of circulating water. A consideration of the relative sizes of the steam and vapor condenser leads to the conclusion that the former should have a surface of from 5 to 7½ square feet per ihp, and the latter from 20 to 25 square feet per ihp.

It is stated that the waste heat engine is not suitable for small steam plants, nor for those operated during but a few hours daily. In the case of a new design, the steam engine may be a two-cylinder compound engine with a third cylinder added for the vapor in place of the intermediate cylinder of the triple-expansion engine. The relative proportions of the three cylinders in this arrangement would be somewhat different from those customary for a triple-expansion engine. Owing to the lower vacuum carried, the low-pressure steam cylinder would be about 30 per cent smaller, and the cold-vapor cylinder would also be smaller than the intermediate cylinder of the triple-expansion engine, owing to the high mean pressure of the sulphur dioxide. It is stated that in consequence of the simple valve gear used with this cylinder, and the fact that it would have no steam jacket, it would be decidedly cheaper to build than the intermediate steam cylinder. The vaporizer, or steam condenser, would hardly be larger than a liberally-proportioned receiver. Such a combined steam and waste heat engine, it is stated, would certainly not cost more than a triple-expansion engine of normal output with jet condenser. In large combined engines of a capacity from 1200 to 2000 horse-power, Professor Josse believes that the data now available indicate that the steam consumption would be decreased by 7 lbs. per ihp per hour.

It is stated that the principle of the waste heat engine may also be economically applied to utilize the waste heat from boiler furnaces and gas engines, and that a test of this application will soon be made. Another application of this engine is in the utilization of the heat from hot water in places where such water naturally flows. As an example, it is stated that at some mountain mines in Chili, water brought to the surface has a temperature of more than 170 degs. F.

The waste heat engine, shown in Fig. 2, is now in operation in one of the stations of the Berlin Electric Lighting Company. In this station the steam engines are of 360 horse-power, and consume about 40 lbs. of steam per ihp-hour. The vapor engine installed utilizes 175 horse-power of the waste heat from the steam engines.

The pamphlet from which this is extracted gives data as to the cost of a combined steam and waste heat plant of 1600 horse-power, and the economy to be derived from such a combination. The cost of the plant complete, not including steam generating plants, is given at $51,000. The annual expenditure for fuel for a 1600-ihp steam engine plant on the basis of coal at $4.50 per ton, is given as $14.000 per year for 3000-hours' service. For a combined steam and waste heat engine plant of 1600 ihp the fuel cost is given as $3,400. The difference in cost between a combined plant and a steam engine plant of the same capacity is estimated at only $1,500.

University of Missouri.

One of the best endowed of the Western universities is the University of the State of Missouri, at Columbia, Mo. The buildings, equipment, etc., have cost more than $1,000,000, and the buildings, equipment, etc., have cost more than $1,000,000, and the income of the University, from all sources, in the next two calendar years, will be about $416,000 per year. Among the buildings there is an engineering building, one for mechanic arts, power house and a chemical laboratory, and an engineering laboratory will shortly be erected. A full course is given in electric engineering, in which especial attention is paid to alternating currents, testing and construction of electrical machinery, and long-distance electrical transmission of power.

Elements of Illumination—XXIX.

By Dr. Louis Bell.

THE problem of effective illumination is still further complicated when the object is a large building or group of buildings. The arcs with reflectors which may be so well utilized for illuminating a comparatively small object become almost useless on a large scale, owing to the total impracticability of furnishing from suitable directions enough light for the purpose. The lighting of a single monument may be regarded as a special case of the illumination often used on the stage, but architectural illumination is a matter very different from both this and from the illumination of large open spaces purely for utilitarian purposes. It has for its object the display in the most artistic manner, of the architectural values of great buildings and their surroundings. It is essentially decorative rather than utilitarian, and the methods must be governed by the effect desired to be produced rather than by considerations of rigid economy.

Such work must be done in connection with great expositions, important public places, and sometimes in a temporary manner for great civic functions. The object to be attained is no longer solely the illumination of a plane near the ground, but the bringing into splendid prominence architectural features which would otherwise be lost in the darkness.

The first fundamental rule in this class of work is to abandon any attempt to simulate daylight, and after providing for adequate illumination of the ground by means which shall not interfere with higher planes of illumination, to sketch in light the principal effects of the scene before the eye.

Illumination of a great mass of buildings by reflected light is out of the question. If of dark material, it is a sheer impossibility, and even if the buildings be white the shadow values of the daylight cannot be successfully imitated by radiants placed near the objects, which will therefore look either white and flat or mottled with petty shadows which melt in the distance into a muddy gray.

The configuration of the lights to be used in the luminous sketch that seems needful for the best artistic results may be roughly determined by making by daylight, or better, near sunset, a rough, clear line drawing of the scene to be illuminated from a rather distant viewpoint, the further as the scale of the work increases. Then the distribution of lights following the principal points and outlines of this drawing will give the main effects that one wishes to produce. The sketch may be filled up by adding necessary details not too brightly, and the ground illumination must be such as not to interfere with this general arrangement. Reflected light from the radiants thus distributed plays a useful part in adding to the general brilliancy of the effect without marring its artistic unity.

The result of this general method has never been so magnificently shown as in the lighting of the Pan-American Exposition now in progress at Buffalo. This was planned by Mr. Luther Stieringer, a pastmaster in the art of decorative lighting; in fact, the builder of the art itself. Two buildings illustrated in the Electrical World and Engineer, of May 18, show with beautiful distinctness the artistic value of the sketching principle just indicated. One, the great Electric Tower, 400 ft. high, is a perfect example of the application of the principles just laid down. This tower is the dominating note of the whole scheme of illumination, and it is therefore brought to an intensity greater than would be called for were it considered by itself. Even this would be indicated by a line sketch of the whole Exposition in grand perspective.

The treatment of a less important building is admirably shown by the other, the Temple of Music. It is strikingly beautiful, yet perhaps might have been improved by indicating some of the vertical lines in the lower part of the dome. A feature worth mentioning in the Electric Tower is the simultaneous turning on of all the lights and their gradual increase to normal brilliancy by the use of a huge motor rheostat.

In this method of illumination powerful radiants are both needless and harmful, since they interfere with the freedom of the sketching and blurr the effect by masses of reflected light. If used at all in the architectural work they should be used very sparingly, and Mr. Stieringer very wisely chose the 8-cp incandescent lamp as his unit in the great work at Buffalo. Number of lights, power of free sketching with them is what is wanted, and for this an 8-cp lamp is quite as effective and far more economical than one of higher power.

Arcs must not be allowed to intrude themselves on the effects thus produced, following the principle long ago laid down in these papers. When used as they may sometimes be, for ground or interior illumination, they should be so effectively guarded by opal globes that there shall not be a violent contrast in brilliancy between the various plans of illumination. At Buffalo Mr. Stieringer has dropped the arc altogether, save in certain features of display lighting, like the illumination of fountains and cascades by reflectors, and produces the ground lighting by clusters of incandescents. The real question, however, is not so much the choice of one or another source of light as the preservation of a uniform or skillfully graded tone of brilliancy in the general illumination. This is most easily secured by the use of incandescents alone, although there certainly are cases in which arcs could be used with admirable results as part of the general scheme. One difficulty with the use of incandescents heavily massed near the ground is the certainty of a number of them being burned out every evening, producing unsightly gaps in the symmetry of the display. Such failures are far less conspicuous at a distance, when the lights melt together. The general effect produced may be greatly modified by varying the number and intensity of the lights used. Small luminous units not too thickly crowded give a transparency, an airy, unsubstantial appearance, that is lost when the radiants are so powerful or so numerous as to render much of the structure visible by reflected light.

The principles of architectural illumination have been well understood and acted upon, though perhaps not definitely formulated for

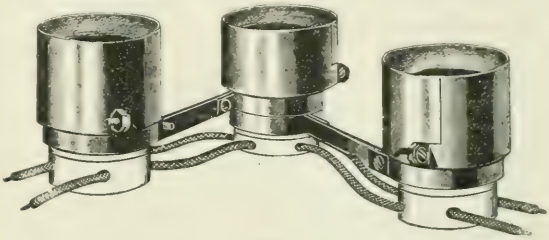


Fig. 1.

many years. Before the introduction of electric light reliance had to be placed on gas jets, lamps, and even candles for such work, and there is no doubt that very beautiful effects were produced, although at great cost of labor, and temporarily. The nature of the radiants was such as almost to preclude the possibility of overdoing the illumination, and only with the advent of electric lights has there developed a strong temptation to try for daylight effects, always a failure from the artistic standpoint.

The absolute number of lights required to produce certain effects is more a matter of judgment than of calculation. If a row of radiants is intended to melt into a line of light, of course, far more lamps are needed than if one merely desires a row of star-like points. Both arrangements may be advantageously used even on the same building. The ordinary 8 or 16-cp lamps melt into a practically continuous line at 800 or 1000 times the distance between lamps, so that if, as on high buildings, they are normally to be viewed from a considerable distance, they may be rather widely spaced, while near the ground they may well be more closely spaced. A little tack will enable a certain perspective effect to be attained if desired.

The use of illumination by reflected light cannot well be combined with any other method, except as the lights used for the illumination may give enough surface reflection to enhance the general brilliancy. Therefore the beams from reflector arcs must be kept away from surfaces which are to be sketched out in lines of light.

Colored light can be effectively used with refector arcs, on white surfaces, on cascades, in fountains and the like, but is seldom successful when tried with incandescent lamps, save on a rather small scale. The difficulty lies in the dimness of colored bulbs and the failure of attempts to get delicate tints in this way. Colored glass bulbs are expensive and coated bulbs accumulate dust and are seldom weather proof.

Much decorative lighting is for temporary purposes, but with the present facilities for obtaining current and the temporary mountings that can readily be obtained, the work is comparatively easy.

Special receptacles for signs and decorative designs are now made in convenient form for quickly putting together and enable temporary work for special occasions to be very easily done. Fig. 1 shows one useful form of mounting device, in which the weather-

proof receptacles can be quickly strung together with clamps and held neatly spaced in any way desirable. For decorative work on a considerable scale the retaining clamps would, of course, be longer than here shown. There is a fine chance for art in turning on the lights in architectural and other decorative work. The water rheostat, bringing all the lights simultaneously from a dull red glow to full brilliancy, is by far the most comprehensive scheme for the purpose. In the absence of this or in permanent work of which only a part is regularly used, the circuits should be so arranged as to allow a perfectly symmetrical development of the lighting without throwing on a huge and sudden current at any one time.

In any and all decorative work the illumination must be subordinated to the general architectural effect. Sins against art in this respect are all too common. Imagine, for example, a Doric temple with arc lights at the corners of the roof and festoons of red, white and blue incandescents hung between the pillars. About a structure of such severe simplicity lights must be used with extreme caution, while more buildings can be treated with far greater freedom of decoration. It requires both fine artistic instinct and great technical skill to cope adequately with the problems of decorative illumination.

The tricks of the art are manifold and mostly meretricious. The facility with which electric circuits may be manipulated is a continual temptation to indulge in the ingenious and the spectacular without due regard for the unity of the results. Whirligigs, waving banners, rippling water, *et id omni genus,* are better suited to a Coney Island merry-go-round than to serious attempts at decoration.

Another class of work, hardly a part of ordinary lighting, but yet of considerable interest is the use of lights purely for decorative purposes in interiors, in halls and auditoriums for special designs, as part of the decorative scheme of ballrooms and the like. This is really a branch of the art due to electric lighting, since only by this means can it be rendered fully serviceable. Most branches of illumination are in a measure independent of the particular radiants employed, but the ease and safety with which incandescent lamps can be installed renders them peculiarly applicable to such interior work. In operating on a comparatively large scale all sorts of decorative designs can be carried out by means of 8 or 16-cp lamps strung together in receptacles in the manner of Fig. 1, or otherwise, temporarily mounted for the purpose. For work on a smaller scale, or in the preparation of very elaborate designs, other means may be taken.

How Insects Put Out the Lights of St. Paul.

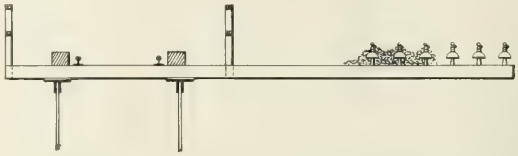
By Charles L. Fitch.

It is hard to believe that a slender, wasp-like fly, less than an inch in length, a thousand of which would scarcely weigh an ounce, should gather in sufficient numbers to shut down the electric lights of a large city, yet this is exactly what happened at St. Paul one day recently.

During the months of June and July of each year that section is visited by large numbers of a pale green diptherous insect familiarly known as the "shad-fly," possibly because of its resemblance to the variety which appears in more easterly localities about the time the shad are running. These little pests are most in evidence after dark in the neighborhood of the electric street lamps, about which they hold a nightly carnival, incidentally dropping on the back and neck of the passer-by, about which they crawl to his infinite annoyance. Their presence in the cities is undoubtedly due to the attraction of the electric lights, as their especial breeding ground is found in swampy neighborhoods and on the banks of rivers and lakes, where they appear in great numbers. The accompanying illustration shows the shad-fly full size.

The power for the St. Paul lights is supplied from Apple River Falls, some 27 miles away, in the State of Wisconsin, and the electric transmission line, which was built under the supervision of the writer and is operated at 25,000 volts, crosses the St. Croix River on the Wisconsin Central Railroad bridge. The wires, six in number, are here supported on 8-inch by 8-inch oak beams, as illustrated herewith, extending out 16 ft. from the south side of the structure at the level of the track, each wire being 18 inches from its neighbor, and over 12 inches above the supporting arm below.

A large portion of the power transmitted is utilized as direct current, through the medium of six-phase rotary converters, and when one evening about 8 o'clock, the converters went "out of step," thereby paralyzing the whole system, the attention of the operators



TRANSMISSION LINES SHORT CIRCUITED BY FLIES.

at the generating station was at once directed to the St. Croix bridge, some five miles away, by a series of brilliant electric discharges, which illuminated the whole heavens. The line was at once cut out, and an emergency crew dispatched to repair the supposed breakdown. They were much puzzled upon their arrival to find everything in perfect order, no evidenec of any short circuit being visible on either wires, insulators or cross-arms. After some delay the current was again turned on, and the cause of the trouble then became apparent, for the flies soon gathered in such numbers on some of the arms that they formed a solid bridge from wire to wire, and the flash of each discharge, while it destroyed thousands, only added fuel to the flames by attracting additional thousands to the spot.

The shut-down lasted about an hour, and it was found necessary to station an attendant upon the bridge, who was provided with a wooden hoe attached to a long pole, with which, from time to time, he dislodged the insects from the cross-arms, as soon as they collected in dangerous numbers. This incident is unique and probably unprecedented.

Figures of Manufactured Exports.

In four important articles of our manufactured exports there is a material reduction in the value of exports in 1901, compared with 1900. These articles are: (1) copper, a reduction of $14,500,000; (2) iron and steel, a decrease of $4,500,000, which is entirely accounted for by the absence of figures on the exports to Hawaii, to which the exports of iron and steel alone from the United States last year were over $5,000,000; (3) mineral oils, in which there is a reduction of $3,800,000 in value, due entirely to a reduction in the export price of oil. Taking the entire available list of exports of manufactures, numbering about 200 distinct articles or classes of articles, it is found that 60 per cent show an increase in value, as compared with last year, while in a considerable number of those showing a decrease the loss is entirely due to the reduction in price per unit, the actual quantities being in several cases greater and the values less than last year.

The following table shows some of the exports in 1900 and 1901 of manufactures in which the total in 1901 exceeded $1,500,000:

	1900.	1901.
Iron and steel and mfrs.....	$121,913,548	$117,319,270
Copper, manufactures of	57,852,960	43,267,021
Scientific instruments	6,435,766	7,361,231
Carriages and cars	3,694,138	4,210,108
Railway cars	2,558,323	4,195,019
Brass manufactures	1,866,727	2,007,450

Mosquitoes and Power Plants.

Newspaper reports from Connecticut state that the power house of the Norwalk, Conn., Traction Company was invaded by mosquitoes in swarms, a few nights ago, and the inmates were driven from the place. They finally hit upon the expedient of bathing their faces and hands in water in which tobacco had been soaked, which proved effective in discouraging the pests.

Recent Energy Meters.

Among electrical patents the class comprising energy meters has for several years been one of the best represented, one or more meter patents issuing weekly. Among the patents issued July 23 and 30 there are five relating to this subject, several of which are of unusual interest. One issued to J. H. Barker and J. A. Ewing, of Cambridge, England, combines with an energy meter an indicating device which gives a record of the rate of supply of current by causing contact to take place from time to time between an indicator and a record surface in the form of a scale blank over which the indicator moves in the course of its deflection. The contacts are made to take place more or less frequently, but are of short duration, so that during the greater part of the time the indicator is free to move in response to the changes in the rate of speed, and to exhibit the actual rate at any instant. Use is made of the mechanical movement of the energy meter to produce the necessary contacts of the indicator from time to time. The magnetic brake of the energy meter is pivoted and can turn about its axis of suspension against the action of a spring. This gives motion to the lower end of the indicator, the upper end of which gives a magnified indication of the amount of movement of the magnet brake, which movement corresponds to the rate at which energy is being registered.

Dr. Louis Bell, in a patent dated July 23, describes a multiple-rate meter whereby devices such as a motor may be automatically cut out and locked during the peak in the station load curve; or such devices may be used during the time of the peak, but at a higher rate for the energy consumed. A sealed starting box is provided for, say, an electric motor, the operating handle of which is accessible from the outside, and controlling devices are supplied by which the motor can be cut out and locked against further operation at times of high load. The automatic control of the device may be effected either by a clock which electrically releases the operating handle at certain hours, or by means of a control wire leading from the central station, whereby motors located at different parts of the distributing system may be simultaneously rendered operative. In order to permit the use of the motor at a higher rate during peak load, there is a mechanically-controlled device by which the circuits inaccessible from the outside of the starting device may be changed so as to operate the meter at a higher rate.

Walter C. Fish, in a patent issued July 30, describes an electric meter, in which movement of the recording device is produced as the resultant of a differential action of two armature windings, the torques of which oppose each other. The disk armature has two windings and two commutators. In one of the supply mains with which the meter is connected is a resistance having a very low temperature coefficient. One brush of each commutator winding is directly connected to the other supply mains; the other two brushes are connected, one at each terminal of the above-mentionel resistance. When there is no current flowing in the mains there will be no drop of potential across the resistance, and consequently the e. m. f. impressed upon the circuit of the two armature windings will be exactly the same, and there will be no motion. When current commences to flow it passes through the resistance in the main, across which there will exist a difference of potential proportional to the amount of current flowing. The current flowing through one winding will, therefore, be less than that through the other, and the armature will be given a motion proportional to this difference of e. m. f., and consequently proportional to the amount of current flowing in the main.

A patent granted July 30 to W. H. Pratt relates to means employed to register the energy consumed in a circuit including a storage battery, in which case it is desirable to provide for forward or backward motion so as to indicate on a single dial the condition of the battery from time to time. The invention consists in the use of a polarizing controlling device responding to the working current, whereby either a forward or backward starting coil may be thrown and kept in circuit. The polarized relay for this purpose has its magnetic field developed by a storage battery main passing in close proximity to its core, a winding to carry the heavy battery current being thus dispensed with.

A multi-rate meter described in a patent issued July 30 to F. P. Cox and C. E. Holmes has two or more dial frames, there being a clutch for engaging either train. The clutch is operated by a clock at definite times, thereby alternately releasing and engaging the several trains. Either train is locked against rotation when disconnected from the clutch, this being effected by spring-actuated clutch shoes.

CURRENT NEWS AND NOTES.

ENGLISH TO STUDY OUR SUBWAYS.—In the House of Commons on Aug. 8 Gerald Balfour, president of the Board of Trade, stated that the Government was considering the question of sending an engineer to American and Continental cities to inquire into the subway systems there and report on their advantages over the London tubular system.

TOKYO ELECTRIC RAILWAY SYSTEM.—Representatives now in the United States of the Tokyo Electric Railway Company are about to let a contract to American manufacturers for the equipment of the new railway system of Japan's capital. There will be three 1200-kw polyphase generators, which will furnish current for sub-station rotary converters for transformation to direct current. The municipality has required the use of the double trolley.

CARS WITHOUT ROOF.—The Transit Company, of St. Louis, Mo., has put into operation on its surface lines an open car without a roof, which has been named "Moonlight." The car will be run only at night when no rain threatens, and will be much like a huge motor vehicle. The cords by which the conductor signals the motorman run along the foothboards instead of overhead, and the only lights used are a bunchlight with a reflector at the rear end of the car. It is intended for pleasure rides.

STATE SCHOOL OF ELECTRICITY.—The proposition to secure an appropriation by the New York Legislature to establish a school of electricity in connection with Union College at Schenectady was defeated, but the project is to be accomplished by independent means. The General Electric Company has agreed to give $12,500, provided an equal amount is obtained from other sources. President Raymond announces that he has secured pledges for practically all of this sum, and that the new department will be at once instituted.

DYNAMO WORKING DRAWINGS.—Professor E. Arnold, of the Technical High School, Karlsruhe, Germany, is preparing a revision of the excellent collection of working drawings of direct and alternating-current machinery, which was originally published about two years ago. The direct-current section will contain about 40 new designs, and the alternating-current section about the same number, embracing the latest European practice in design and construction. The price of each section will remain 20 marks. The portfolios will be ready about December, and orders may be addressed direct to the author.

POWER FACTOR AND FREQUENCY METERS.—Two patents issued July 23 to P. M. Lincoln describe, one a power factor meter and the other a frequency meter. The former consists of two fine-wire coils mounted at right angles on an axis free to turn in a field supplied by a coil in series with one leg of the main supply circuit. The two fine-wire coils are connected in shunt across the devices of which the power factor is to be determined, one being in series with an inductance and the other in series with a non-inductive resistance—the currents flowing through the two coils being thus in quadrature. With unity power factor the current flowing through the coil in series with the resistance will be substantially in phase with the e. m. f., and the coil will take up a position at right angles to the magnetic field in which it is placed. With a lag of 90 degs. the other coil will take up this position, the first-mentioned coil being then parallel to the field. At intermediate positions equilibrium will be reached such that the angular movement of a pointer on the axis of the coils will show the precise angle of lag. The second patent describes the application of a similar arrangement to the determination of frequency. In this case the coil setting up the magnetic field is in shunt with the main circuit and contains in series with it an inductance and a capacity of such value as to produce a resonant circuit at normal frequency. The fine-wire coils are connected as in the previous case. At any other frequency than normal the current in the magnetic circuit will be out of phase with the e. m. f., and the coils at right angles will assume a new position at which the forces acting upon them are in equilibrium; the angular movement will then correctly measure the angle of lag, and on a properly calibrated scale will show the change in frequency. The application of the arrangement to indication of speed is also shown.

A SOCIALIST PLATFORM.—At Indianapolis on July 30, a platform was reported by committee to the National Socialist Convention. It advocates as "immediate demands" public ownership of all means of transportation, communication, and all other public utilities, as well as all industries controlled by monopolies, trusts and combines.

TROLLEY SLEEPING CARS.—H. A. Fisher, general manager of the Appleyard roads which radiate from Columbus, Ohio, announces that within one year the syndicate will be operating through sleeping cars on its lines from Columbus to Cincinnati, and that within two years there will be through service between Cincinnati and Cleveland.

CONVERTING A STEAM ROAD.—The Blackhills & Fort Pier Railroad is to be converted into an electric system this month. The Burlington Railroad operates the line. Owing to the heavy grades and the bad conditions with smoke and cinders, it has now decided to equip the road electrically. It is six miles long, connecting Deadwood and Lead City.

BRITISH PACIFIC CABLE AUTHORIZED.—The House of Commons, by a vote of 180 to 55, has passed the bill for the construction of the Pacific cable. Colonial Secretary Chamberlain explained that of the £2,000,000 necessary to build the cable, the United Kingdom would contribute five-eighteenths and Australia, New Zealand and Canada the rest.

CHEAP CABLE MESSAGES.—A cable dispatch from London of July 17 says: At a meeting to-day of the Eastern Telegraph Company the chairman, Sir John W. Barry, announced that in conjunction with the Post Office authorities, the directors of the company were formulating a scheme to enable the public, by means of a code, to cable to the Far East for about 2 cents a word.

STRUCK SIX TIMES.—The Hope Methodist Church at Belvidere, N. J., was struck by lighting for the sixth time on July 30. The lightning in almost every instance has struck in the same place, at the top of the tall spire. So common has the thing become that the people say when storms come, "Well, look out for the Methodist Church." If a shower comes on Sunday when the congregation is in the church, the pastor immediately dismisses them, telling them it is best to go home. The trustees are somewhat alarmed and have hired an electrician to make an investigation.

BOW BELLS ELECTRIFIED.—A dispatch from London of Aug. 3 says: Whatever may be the case with St. Paul's, partial damage has already been sustained by the historic Church of St. Mary-le-Bow, on Cheapside, the beautiful tower of which already leans 23 inches out of the perpendicular. This, it is stated, is caused by the vibration of the adjoining tuppenny tube, the Underground Electric road. The company has agreed to pay $5,000 by way of compensation. Meanwhile, owing to the dangerous condition of the belfry, the famous Bow Bells, that called back Dick Whittington, must remain silent until necessary underpinning operations are completed.

HARTFORD TROLLEY TO BOSTON.—The organization of the Stafford Springs Street Railway Company means the probable early development of a through electric railway line from Hartford to Boston. The company has a franchise right to build a trolley line from the terminus of the Hartford, Manchester, and Rockville Tramway Company's system at Rockville, through Stafford Springs to the Massachusetts State line, and the work of construction will begin as soon as the preliminary details can be completed. The promoters of the enterprise are making arrangements for building through various Massachusetts towns under the general railroad law, and entering Worcester where connections can be made with Boston, thus forming a through line between the capitals of Connecticut and Massachusetts. Conferences are being held with the local authorities of the various Massachusetts towns through whose streets it will be necessary to run the road in order to execute the project.

CAUSING MENTAL ANGUISH.—Two years ago a citizen of Columbia, S. C., brought suit against a telegraph company and received a verdict of several thousand dollars damages for "mental anguish," resulting from the non-delivery of a telegram. The Supreme Court decided that a person could not recover damages for mental anguish disconnected with and in the absence of bodily injury. The last Legislature passed an act making telegraph companies especially liable to damages for mental anguish caused by their negligence, even in the absence of bodily injury. The first case tried under this act has just been won by the plaintiff, who suffered because she supposed her husband was ill, when, in fact, he had telegraphed that he was all right. The telegraph company has appealed and is employing two of the strongest law firms in the State to fight the case in the Supreme Court.

DESTRUCTION OF TALL POLES.—With reference to the recent destruction by lightning of some very tall poles of the Western Union Telegraph Company in Texas, Mr. P. G. Tompkins, the manager of the American District Telegraph Company at Beaumont, Texas, writes: "The poles referred to were the two poles erected in May last at the crossing of the Neches River. They were 150 ft. long, stood 135 ft. out of ground, and carrid three 10-conductor cables. These poles were made of Michigan Cedar and of Washington fir (commonly called "Oregon pine"). They cost about $1,200 each. They were side guyed as well as wire guyed. The stretch between the poles was 854 ft. In the electric storm of July 15 the pole on the west bank of the river was struck by lightning, completely demolishing it, and in its turn it pulled over the other pole. An interesting fact connected with the destruction of these poles is that nothwithstanding they were completely surrounded by heavy iron side guys (four in number), reaching from the bottom of the pole to within 10 ft. of the top, making as perfect a "lightning rod" as could be desired, the rods failed to ward off the lightning, putting a damper upon the lightning rod agents' business. These poles have since been done away with and submarine cable used.

A LIVE WIRE NOT DEAD WEIGHT.—Our esteemed contemporary, the New York *Sun*, is responsible for the following, written more in humor than in anger: It contributes not a little to the gayety of the nations that the gentlemen in responsible charge of the East River Bridge do not know what not to say or when to say nothing. Commissioner Shea, in his laudable desire to correct the erroneous impression which the statement of some misinformed engineer has created, that the bridge is carrying dead weight, makes haste to say: "As to the statement that the bridge is carrying a lot of dead weight in the shape of wires and pipes and rails, I want to say that this is not so. We are carrying a pneumatic tube and wires, but all of these are in constant use and are not dead weight." Certainly not. The man who calls a live wire "dead weight" speaks without knowledge, and deserves to be answered according to his folly. The same is true of a pneumatic tube in use for the transmission of mails, and rails over which cars are continually running. All this is the livest kind of live weight, and the amount of it does not count. We should miss Commissioner Shea if for any reason he should pass into the penumbra of official eclipse. In his present position he is a source of great joy to the unofficial citizen, to whom he is ever ready to impart information.

SHIPS' COMPASSES.—Rear Admiral Bradford, chief of the Bureau of Equipment, has received an interesting letter from Lieutenant-Commander F. M. Bostwick, navigator of the Oregon, in which he describes the effect on the standard compass of a "ground" in the bridge electric circuit. While the Oregon was steaming up the China coast on course N. E. by N., the navigator reports that it suddenly became necessary to change the course about a point to the eastward by bridge and steering compasses, to make the allotted course by standard. Upon investigation it was found that the trouble lay with the standard compass. A time azimuth taken showed the deviation of the standard compass to be 10 degs. and 4-100 min. east, the tabulated deviation being 1 deg. and 4-100 min. Upon inquiry it was found that the bridge circuit had just been turned on, and later a "ground" was discovered. Experiments showed conclusively that the fault was due to this "ground." In order that this trouble may be avoided in the future, the Secretary of the Navy has authorized the chief of the Bureau of Construction and Repair to inform the commandants of the navy yards and the superintending naval constructors that hereafter the platforms for carrying the standard compass should, whenever practicable, be insulated from the structure of the ship by three-eighths of an inch of hard rubber fibre, and that the bolts securing platform stanchions to the structure should also be insulated by bushings and washers of the same material; also that all horizontal railings within 12 ft. of the compass should be made either of wood or Manila hemp rope.

SIX-PHASE ROTARY CONVERTER SYSTEM.—A patent issued July 23 to Edwin W. Rice, Jr., describes a method of connecting a six-phase rotary converter to a three-phase circuit. The secondary of each of the three transformers used in connection with the rotary is divided into two independent parts. One terminal of each of these parts connects with one of the six rotary terminals. The second terminal in one arrangement shown is connected with one of the secondary sections of another transformer, the other side of this section connecting with another terminal of the rotary. An advantage claimed for this system is that in starting the rotary converter from the direct-current side, it is unnecessary to open the leads connecting the alternating-current side of the converter to the transformer windings, as is necessary when only a single set of transformer windings was employed.

LOCALIZATION OF INSULATION STRAINS UPON BREAKING HIGH-POTENTIAL CIRCUITS.—In the case of lines of high-potential which possess a certain amount of capacity and self-induction, such as underground cables, it is hazardous to cause any sudden or abrupt change in the current flowing by opening and closing the circuit with an ordinary switch or circuit-breaker. Any such sudden make or break in the circuit usually produces a high resonant rise of potential, which is generally of an oscillating nature and causes violent surges of current back and forth in the line. In order to obviate this danger, E. W. Rice, Jr., in a patent issued July 23, proposes to place an inductance on each side of each switch terminal. By this arrangement the rise of potential which takes place upon making and breaking the circuit, together with result oscillations of current, are limited in their activity to the locality of the induction coils, which serve to damp out and suppress transmission of high e. m. f.'s to other portions of the line. If, therefore, any damage takes place due to breaking down of insulation, it will occur in the neighborhood of the inductance coils, and consequently in places where it is easily detected and remedied.

COMPENSATING ARMATURE WINDING.—A patent issued July 23 to Edwin W. Rice, Jr., describes a means for reducing the apparent self-induction of armature coils lying between pole pieces, thereby greatly decreasing the sparking in commutator machines both of the direct and alternating-current type, and decreasing any tendency to hunt in the latter. The method consists in the addition of a second winding superposed upon or intermeshed with the main armature winding, this additional winding being provided with a separate commutator, with which it is connected in the ordinary manner. Short-circuiting brushes are placed upon this latter commutator at segments corresponding to the portions of the armature winding lying between the poles. These brushes produce a short-circuit in the secondary winding, which is constantly progressing or shifting with respect to the conductors of the winding, but is fixed with respect to the interpolar space. By this means the self-induction of the coils in the main winding passing through the neutral region is so greatly reduced that practically no sparking occurs. In commutator alternating-current machines and rotary converters this same advantage is present, and in all alternating-current machines, whether provided with a commutator or not, any tendency to hunt which may exist may thus be prevented. It is stated that this method of preventing hunting is superior to the use of conducting bridges or other devices located upon the field magnetic structure.

A NEW FRANCHISE AT OTTUMWA.—The new franchise which has been granted the Ottumwa (Iowa) Electric & Steam Company is of peculiar interest to those connected with Iowa properties of the kind, as it is the first of its kind that has been granted by any of the larger towns of Iowa. Under the present Iowa laws a franchise ordinance after passing the city council must be submitted to a vote of the people for ratification. The new Ottumwa franchise is for 25 years. The company had a shorter one before, but wished to increase the plant and issue bonds, and to do this needed the 25-year franchise. The company operates 7½ miles of street railway, 137 alternating-street arc lamps, 100 commercial arcs, 6000 incandescents, a 500-volt power service, and 3 miles of exhaust steam heating mains. The new electric light franchise provides that all poles and wires shall be painted, and the latter shall at all times be kept well insulated. During the life of the franchise the maximum price for arc lamps of a nominal 2000 candle-power shall never exceed $75 a year for an all-night schedule, or $67.50 for a moonlight schedule. The rates for incandescent lighting are from 13 cents per kilowatt-hour for a consumption of 10 kilowatt-hours and under to 8 cents for a consumption of from 301 to 400 kilowatt-hours. The former rates were 15 cents for commercial and 18 cents for residence lighting, with a sliding scale down to the present rates for 151 kilowatt-hours. Power rates remain unchanged at 20 cents per kilowatt-hour, with a minimum charge according to the size of the motor. All city buildings are to be lighted free. Royal H. Holbrook, one of the leading young mechanical and electrical engineers of his State, took charge of the Ottumwa plant April 1, and is working to bring the commercial efficiency of his plant up to the high standard of the other properties with which he has been connected in an active and consulting capacity.

STREET LIGHTING IN MONTREAL.—In our issue of July 27 appeared a news item relating to proposals for the electric street lighting of Montreal. As stated in the note, the figure submitted by the Royal Electric Company, which has now the contract, was $95 per arc light per annum; the Lachine Hydraulic & Land Company, $90, and the Standard Light & Power Company, $99—all of the above for either a 5 or 10-year contract. The Imperial Electric Company submitted a bid of $85 for a 5-year and $80 for a 10-year contract. Among the bids were also two from companies that thus far have been doing no lighting in Montreal, one being the Shawinigan Water & Power Company, which submitted a price of $79.935 for a 5-year contract and $78.475 for a 10-year contract; and the St. Lawrence Power Company, which handed in a bid of $54.75 for a 5-year contract. No action has yet been taken owing to various claims of contending bidders, the most important being a charge of ambiguity with respect to the kind of lamp and service involved in the different bids. The Royal Electric Company specified that it would supply a 9.6-ampere or 480-watt open arc series lamp, that being the kind of lamp now in use in the city, and those interested in that Company claim that the article in the tender for bids has been interpreted by some of the bidders to mean any kind of lamp of 480 watts, including alternating-current enclosed arcs; and that as the Royal Company had based its bid upon a lamp costing more to operate, it was placed at a disadvantage with respect to those companies which had bid on other types of lamps. This company has consequently requested that it shall have an opportunity to submit figures on other types of lamp, should the council specify that one different from the type now in use may be employed. As to the bid of $54.75 per year, it is charged that the company which offered this bid has as yet no legal existence, having neither directors, shareholders, officers nor place of business, and the propriety is questioned of allowing the city to be used to assist the formation and financing of the company. The promoters, it appears, have obtained from the Dominion Government a right to the use of the surplus or overflow of the recent Soulange Canal at the nominal cost of 10 cents per horse-power per annum. It is also claimed that the new company is expressly restricted in its authorization to territory which does not extend into the city of Montreal. The entire matter of the street lighting contract is now being reconsidered by the council.

Letter to the Editors.

Self-Starting Single-Phase Motors Without Brushes.

To the Editors of Electrical World and Engineer:

Sirs.—In a letter which appears in your issue of July 20, Mr. L. Gutmann makes the statement that though the motor described by me in your issue of June 22 may start with sufficient torque, the increased self-induction of the exciting circuit after switching would naturally reduce the available flux and consequently also the torque. I wish to say that this statement is in contradiction with the results of tests made with a small motor of this type and in which the torque became two or three times greater after the inductor M^2 was thrown in circuit. This accords also with the theory of the motor, which I might remark, is very complicated.

I agree with Mr. Gutmann that it is possible to construct single-phase motors which may be started under a load in a more simple manner, but for the special case where a large torque is not required and where the motor is to be reversed, the system which I have described has a particular value. This type of motor moreover seems

to me to be interesting from various points of view, for it is capable of several applications. I have tested its application to an arc lamp by putting one of the coils in shunt and the other in series with the arc. After several trials it was possible to obtain an automatic regulation of carbons; owing, however, to the fact that the moment of inertia of the armatures was relatively large, the motor only began to regulate with difference of potential too large for practical operation, and for the same reason did not cease to act until the distance between the carbons had become too small.

PRAGUE, BOHEMIA. J. FISCHER-HINNEN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Rectifying Alternating Currents by Means of Aluminum Valves.—E. H.—After some historical notes he gives the French Academy paper of Pollak in full, an abstract of which was recently noticed in the Digest. He has succeeded in forming aluminum plates to be used at 200 volts. He used for this purpose as electrolyte a slightly acid solution of phosphate of potassium, through which he sends a direct current. The first operation consists in cleaning the plates in a slightly concentrated solution of caustic soda, in order to remove the impurities. During the formation the purified plate gets "irisated." A plate formed for 200 volts, when placed in a circuit, even of low tension, gives off a little gas. A small current passes continuously in the apparatus. As a result of the purely chemical action of the electrolyte upon the "dielectric layer," it is slowly reduced. A certain current is therefore necessary to recompose by electro-chemical action what has been decomposed by purely chemical action (local action), and to establish thus the equilibrium between these two actions. The current required to maintain this equilibrium depends mainly on the purity of the plates and represents the "no-load loss" of the apparatus. The efficiency of the apparatus is 75 to 80 per cent for a system of four cells with purified aluminum plates, at a normal load and a frequency of 40 cycles per second. The aluminum plates, when left in the electrolyte during the periods of no load, lose by and by their dielectric layer and must be formed again before every application. This disadvantage can be easily overcome by removing the electrolyte from the cell during the periods of rest. When dry, the aluminum plates do not lose the dielectric layer. When the apparatus is working, much heat is developed with the result that the efficiency decreases and the plates finally dissolve. The maximum limit of temperature, up to which the apparatus works satisfactorily, is 40 degs. C. Artificial cooling is therefore required. It is thought to be desirable not to cool with water. He uses therefore the following arrangement to retard the moment at which the temperature increases above the critical limit. He employs a receptacle much higher than the plates, so that the column of electrolyte has a height several times that of the plates. In his experiments the height of the electrolyte was three times that of the plate. The current density was 1 ampere per square decimeter of the surface of the aluminum plates. The time during which the apparatus could be satisfactorily used as rectifier was four hours. At the end of this time the temperature had increased to 40 degs. C. He also gives data on experiments made with an apparatus consisting of four cells and used for charging a battery of 70 accumulators, alternating current at 110 volts and 40 periods being furnished from supply mains. After 2¼ hours the temperature was 15.6 degs., the density of the electrolyte 1.049, the current 4.5 amperes, the voltage 143.5; after five hours, 28.8 degs.; density, 1.044; 5.5 amperes, 154 volts; after six hours, 32.6 degs.; density, 1.042, 5.8 amperes, 156 volts. The wear and tear of the apparatus consists in the electrolyte becoming more and more alkaline and the plates becoming destroyed by the hydrogen bubbles. When a plate has been used for 500 to 800 hours, it is wholly destroyed. It is impossible to connect several such cells in series, either as rectifiers or as condensers. After a short time the tension diminishes in some of the cells and increases correspondingly in others, until the tension becomes too high in one or several cells, and the current passes in both directions. This phenomenon is due to the fact that it is impossible to make two cells exactly identical. The rectifier of Pollak has been exhibited in a session of the Internat. Soc. of Elec. in Paris. The present author points out which enormous advantages, especially for traction purposes, a rectifier based upon these principles, would have, if the difficulties mentioned above can be overcome.—*L'Ind. Elec.*, July 10.

Synchronous Motors and Alternators in Parallel.—RUSSELL.—The conclusion of his "Notes on the theory of synchronous motors and of alternators in parallel." This part deals with the power factor of a synchronous motor, and with the theory of two equal alternators working in parallel. Some of the conclusions of his article are as follows: There is only one position of lag or lead of a synchronous motor on a given load where the equilibrium is stable. There is a necessity of adjusting the excitation of both the motor and the generator where it is wanted to get the maximum efficiency. It is misleading to refer to a synchronous motor as having a certain power factor at a particular load. The power factor of a motor circuit is a variable that depends not only on the shape of the wave of the generator, but also on what is happening outside of the motor circuit. The greater the excitation of two alternators working in parallel, the nearer the angle of lag between the synchronizing e. m. f. and the synchronizing current is to 45 degs., and the less the resistance of the circuit of the armatures (Mordey's rule), the better will they work in parallel. Alternators will in some cases cease to work in parallel on heavy inductive loads. This could be remedied by connecting condensers or over-excited synchronous motors eithers directly or through the medium of a transformer to the bus-bars.—Lond. *Elec. Rev.*, July 19.

REFERENCES.

Theory of the Synchronous Motor.—BLONDEL.—A long article, illustrated by diagrams, in which he develops what he believes to be the simplest theory of the synchronous motor. He uses the graphical method and applies to the investigation of the synchronous motor the theory of the "two reactions" (direct and transversal), which he had formerly worked out for the alternating-current generator. (See Digest, Dec. 9, 1899.) His graphical method is comparatively easy and gives a good insight into the action of the synchronous motor. It may also be applied to the theory of the synchronous converter. After a general discussion of the problem the method is applied to several special cases. The article is well illustrated, but is too theoretical to be abstracted briefly.—*L'Eclairage Elec.*, June 22.

Diagrams of the Action of an Alternator.—BARBILLION.—An article in which he gives the diagrams respresenting the working of an alternating-current dynamo, which is connected to any circuit. He first discusses the most general case, and then the following typical cases: Constant-current distribution and constant potential distribution.—*L'Eclairage Elec.*, June 15.

The Regulation of Alternating-Current Generators.—A. S. McALLISTER.—An illustrated article dealing with the causes of variation of terminal e. m. f. with change of magnitude or character of load. The author points out wherein European and American alternators differ in the shape of armature slots, and discusses the counter e. m. f. of self-induction. The effect of armature resistance and reactance on the terminal e. m. f., and the effect of the armature current phase upon the field.—*Am. Elec.*, Aug.

POWER

Design of Electrically-Driven Factories.—An editorial calling attention to some special points mentioned in Aldrich's A. S. M. E. paper on "Requirements of electricity in manufacturing work." Electric driving for large works has been proved to be the most economical method, and it is decidedly one of the chief merits of electric transmission that the producer can arrange both his buildings and machinery as best suits the economic production of his wares. The site for buildings may be chosen independent of power considerations, and located on most suitable ground. There is no necessity for buildings being placed around or adjacent to the power house, as required for mechanical connections to engines or turbines. "We

are afraid that too often the British manufacturer designs his buildings and groups his shops first, and only when the construction work has commenced does he start to consider whether he will transmit the power by shafting or by electricity." As another advantage of electric driving the ease is mentioned with which future areas of work may be planned, irrespective of power considerations. "It is with the use of electric power from an outside source that the unlimited expansion by small steps may be utilized to the greatest extent."—Lond. *Elec.*, July 19.

The New Buffalo Terminal Transformer Station.—Woodbury. An illustrated article on the new terminal transformer station of the Cataract Power & Conduit Company, at Buffalo, N. Y. There are seven transformers in the station, connected in two batteries of three each, with one to spare in case of an emergency. The primary and secondary switchboards have each two sets of bus-bars, three transformers being connected to each set. The station receives about 14,000 kilowatts over three three-phase transmission lines from the power house at Niagara Falls at an e. m. f. of 22,000 volts, and delivers it at 11,000 volts, three-phase to the underground system of the city.—*Am. Elec.*, Aug.

REFERENCE.

Utilizing the Sun's Energy.—Thurston.—An article on the practicability of solar motors.—*Cassier's Mag.*, Aug.

Traction.

REFERENCES.

London Electric Tramways.—An article on the recent formal opening of the system of the London United Tramways, and a brief description of the power house in High Street, Chiswick. To supply the outlying portions of the system three-phase currents will be transmitted to synchronous converter sub-stations.—Lond. *Eng'ing*, July 12.

Polyphase Traction Plant.—H. S. Meyer.—A reply to the criticism of Eborall, noticed in last week's Digest. He sustains all his former statements.—Lond. *Elec. Rev.*, July 19.

Third-Rail Electric Railway.—An illustrated article on the Albany & Hudson Railroad.—*Elec. Rev.*, July 20.

The Sprague Multiple Unit System.—Chilton.—The fourth article on this system, the present article dealing specifically with the safety provisions.—*Am. Elec.*, Aug.

Installations, Systems and Appliances.

Resonance Phenomena in Direct-Current Circuits.—Armagnat.—There can be, of course, no resonance phenomena in a circuit in which a strictly continuous current is flowing. In practice, however, an industrial direct current is generally the sum of a strictly continuous current and superimposed periodic currents of different frequencies. This can be proven by plotting the waveform of a so-called industrial direct current by means of an oscillograph. The superimposed periodic currents are often much greater than one might suspect. The e. m. f. curve furnished by a Gramme ring dynamo, giving 60 amperes at 120 volts, is nearly a straight line, but shows superimposed teeth, of about 1 to 2 volts maximum amplitude. When a four-polar motor with toothed armature, with 24 commutator segments, and running at 20 r. p. s., is connected to the circuit, a periodic perturbation of the frequency 480 is introduced, the maximum amplitude being nearly 14 volts. It is very easy to realize the electric resonance by the well-known method of condenser and self-induction coil in series. By this means, which is the same which has been used by Pupin for the analysis of alternating-current curves, one can obtain very increased voltages, and from their measurement one can determine the effective value and the frequency of the alternating current which must be superimposed on an exactly continuous current, in order to obtain the same waveform. This is worked out mathematically. This case is very similar to the practical case that a circuit contains self-induction coils and cables, the latter representing a certain capacity.—*L'Eclairage Elec.*, June 29.

Electro-Physics and Magnetism.

Masses Smaller Than Atoms.—J. J. Thomson.—A very lucid and interesting review of the work done in recent years, which has led to the assumption of "Bodies smaller than atoms." He gives an account of the experiments by which the charge and mass of the particles occurring in the cathode rays inside a discharge tube have been determined. The mass of each of these particles is only about 1-1000 of that of a hydrogen atom. These negatively electrified particles which he calls corpuscles, have the same electric charge and the same mass, whatever be the nature of the gas inside of the tube or whatever the nature of the electrodes. The charge and mass are invariable. They therefore form an invariable constituent of the atoms or molecules of all gases and presumably of all liquids and solids. These corpuscles have not only been found in cathodic rays, but are given off by incandescent metals, by metals when illuminated by ultra-violet light, and by radio-active substances; in fact, in every case in which the transport of negative electricity through gas at a low pressure, "i. e., when the corpuscles have nothing to stick to," has been examined, it has been found that the carriers of the negative electricity are these corpuscles of invariable mass. A very different state of things holds for the positive electricity. The positive electricity is found to be always connected with a mass which is of the same order as that of an ordinary molecule and which, moreover, varies with the nature of the gas in which the electrification is found. "These two results, the invariability and smallness of the mass of the carriers of negative electricity, and the variability and comparatively large mass of the carriers of positive electricity, seem to me to point unmistakably to a very definite conception as to the nature of electricity. Do they not obviously suggest that negative electricity consists of these corpuscles or, to put it the other way, that these corpuscles are negative electricity, and that positive electrification consists in the absence of these corpuscles from ordinary atoms? Thus this point of view approximates very closely to the old one-fluid theory of Franklin. On that theory electricity was regarded as a fluid, and changes in the state of electrification were regarded as due to the transport of this fluid from one place to another. If we regard Franklin's electric fluid as a collection of negatively electrified corpuscles, the old one-fluid theory will, in many respects, express the results of the new." Negative electricity, i. e., the electric fluid, has mass; positive electrification is accompanied by a diminution in mass. He then discusses the motion of the charged corpuscles and the obstruction offered to the passage of the corpuscles through different substances. He further discusses the existence of free corpuscles or negative electricity in metals, and points out the cosmical effects produced by corpuscles.—*Pop. Sc. Mo.*, Aug.

Influence of Oscillations on Electrolytes.—Morris.—A brief article on the work of Broca and Turchini, who have discovered that a disruptive discharge with electric waves of from 350 to 400 meters in length—i. e., with oscillations at the rate of about a million per second—has very different effects on an electrolyte in the circuit from those produced by an ordinary galvanic current. Under certain conditions—i. e., when the electrolyte is a relatively very good conductor—disruptive sparks of great power are produced in the electrolyte itself. This shows that to oscillations, at least of the particular frequency above mentioned, the electrolyte behaves almost as a dielectric. This is undoubtedly the cause of the transparency of electrolytes to light, a transparency which it was impossible to explain by means of the ordinary electromagnetic theory of light. Some details of the experiments of Broca and Turchini are given.—*The Elec. Chem. & Met.*, July.

Calorimetric Measurements of Electric Oscillations.—Harms.—An account of some experiments which he has made with the bridge arrangement for rapid electric oscillations, suggested by Nernst. Working with waves 10 m. long, he found that in the case of alcohol the telephone minimum became very bad, much worse than in the case of substances conducting 100 times better. This could only be due to anomalous absorption in alcohol. He used a calorimetric method for proving the existence of such absorption. If, on the other hand, Ohm's law is to preserve its validity in the domain of anomalous absorption, the resistivity must be taken as varying with the frequency. He used a bulb provided with platinum electrodes and a narrow thermometer tube, and proved the existence of anomalous absorption in five different alcohols.—*Ann. der Phys.*, No. 7; abstracted in Lond. *Elec.*, July 19.

Hertzian Waves in Thunderstorms.—Larrogue.—"The influence which thunderstorms exercise at a distance of thousands of miles upon persons affected with certain nervous diseases, long before any physical instrument announces an atmospheric disturbance, suggested to F. Larrogue that Hertzian waves emitted by thunderstorms might possibly be propagated over enormous distances through the middle and higher atmosphere by means of something corresponding to relays." He has made experiments with an elementary kind of "receiver" in the shape of a horizontal plate of zinc, 40 cm. in diameter, earthed by a thin copper wire, containing a spark-gap

in a dark cellar. He has made several series of nocturnal observations, while severe thunderstorms were far away and the sky was serene at the place of observation.—*Comptes Rendus,* July 1; abstracted in Lond. *Elec.,* July 19.

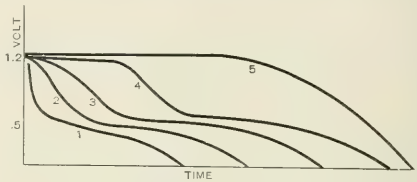
Natural and Radio-Active Air.—ELSTER and GEITEL.—They point out some analogies between air in its natural state and air which has been blown over radio-active substances. Such air imparts to other substances a temporary radio-activity, which can be considerably enhanced by giving these other substances a negative charge during exposure to the air. A similar kind of radio-activity may be produced by ordinary air, by exposing a negatively charged piece of wire gauze for several hours to the open air. The wire gauze then behaves like a body of feeble but distinct radio-activity. It imparts electric conductivity to air, even across a piece of aluminum foil, and they have even obtained photographic effects.—*Phys. Zeit.,* July 6; abstracted in Lond. *Elec.,* July 19.

Röntgen Ray Tubes.—A reprint of the report of the jury in the Röntgen ray tube competition of the British Röntgen Society. The tubes were mainly examined regarding definition, penetration, photographic effect and price. It is noteworthy that about 75 per cent of the tubes failed to satisfy the required tests for definition, and in the opinion of the jury the attention of makers of tubes should be drawn to this defect, because unless a tube defines well, all other advantages it may possess are to a great extent valueless for most of the purposes to which Röntgen ray tubes are put.—Lond. *Elec.,* July 19.

Hall Effect and Resistance of Bismuth.—VAN EVERDINGEN.—An account of experiments made with small columns of pure bismuth, cut from a crystal, some parallel to the main axis, and the others at right angles of at an angle of 60 degs. to it. The Hall effect was found to be large when the magnetic force is normal to the main axis, very small when the two directions are parallel and follows an ellipsoid of revolution for any intermediate angle. A similar ellipsoid may be constructed for the resistivity when the substance is not placed in a magnetic field.—*Phys. Zeit.,* July 6; abstracted in Lond. *Elec.,* July 19.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Fused Salts.—LORENZ.—An account of some investigations which have recently been made in the electro-chemical laboratory of Zuerich on the electrolysis of fused electrolytes. He describes the following galvanic cell: Carbon electrode, fused lead, fused chloride of lead, gaseous chlorine, carbon electrode. Such a cell gives a constant e. m. f. at the galvanometer for several hours, provided that the electrolyte at the anode is carefully separated from the electrolyte at the cathode and that the chlorine gas is held under constant pressure. The results obtained are in good agreement with Helmholtz's formula for the relation between the e. m. f. of a cell, its temperature coefficient, and the heat-toning of the chemical processes in the cell (the modified Thomson rule). Besides cells with chloride of lead, analogous cells with chloride of silver and with chloride of zinc were investigated. The e. m. f. of the cell with chloride of lead in volts was found to be 1.2818-0.000584 (t-506 degs.), and that with chloride of zinc equal to 1.662-0.000751 (t-430 degs.), where t is the temperature in degrees C., the temperature coefficient of the cell being constant in the limits between 506 and 890 degs. and between 430 and 660 degs. for the chloride of lead and for the chloride of zinc cells, respectively. Such cells act exactly like "fused storage batteries," their action being reversible. In quantitative investigations regarding the validity of Faraday's law for fused electrolytes the following trouble is generally experienced. The fused metals are very liable to dissolve in their fused salts. Dark colored "metallic fog" is formed which is distributed in the fused electrolyte. Diffusion and convection bring it from the cathode to the anode where it combines again with the deposited chlorine, so that the output of electrolytic deposition becomes smaller than it ought to be according to Faraday's law. Exact researches have shown that the recombination of the metallic fog with the chlorine takes place essentially under the influence of the anodic carbon, "which hereby plays the part of a contact substance." While the combination of the metallic fog with chlorine also takes place when the chlorine gas is blown into the fog by means of a glass tube, this combination is much slower than when it takes place with chlorine gas electrolytically produced at the anodic carbon. (It is perhaps interesting to note that the author does not attribute this fact to the properties of "nascent" chlorine, but to the presence of a "contact substance"). The e. m. f. of a cell with chloride of lead, as described above, is about 1.2 volts. When, however, the "metallic fog" starting from the cathode reaches the anode, the e. m. f. drops suddenly to 0.6 to 0.8 volt. He has a special arrangement by which he can regulate the arrival of metallic fog at the anode. When he prevents new metallic fog from reaching the anode, the e. m. f. suddenly rises again to 1.2 volts. It is therefore evident that the dropping of the e. m. f. is due to metallic fog reaching the anode. In order to obtain an output exactly corresponding to Faraday's law, it is necessary to prevent as much as possible the formation of such metallic fog, or to prevent it at least from reaching the anode. This may be accomplished by using a relatively low temperature and by separating mechanically the electrolyte at the anode from the electrolyte at the cathode. He then describes the following interesting phenomenon. Chloride of lead was electrolyzed in a simple V-tube with carbon electrodes in the two arms of the tube. After it had been electrolyzed for a certain time with constant current, the whole apparatus was filled with the metallic fog. The current was then broken and the cell discharged like a galvanic cell. The curve of discharge is the curve 1 in the adjoining diagram. The cell was then



DISCHARGE CURVES.

charged again with the same constant current as before, and again discharged. Charging and discharging was repeated several times. The curves which correspond to the several discharges are plotted in the diagram as the curves 1, 2, 3, etc. The characteristic features are that in the first discharge the voltage goes instantaneously down from the normal value 1.2 to about 0.5; in the second discharge the e. m. f. remains longer at the normal value 1.2 volts, still longer in the third discharge, and so on. This diagram is typical. Chemical analysis showed that during the first part of the experiments more chlorine was lost than metal; i. e., when, for instance, the metal obtained at the cathode was 70 to 80 per cent of the theoretical amount, the chlorine obtained at the anode was only about 40 to 50 per cent of the theoretical amount. No higher chlorine compounds of lead could be detected in the anode space. It was found that the phenomenon is due to the fact that the carbon is filled gradually with chlorine. The losses of chlorine are therefore due to the absorption of chlorine by the carbon electrode. When it is "saturated" with chlorine, the amounts of chlorine and of metal obtained are the same amounts in per cents of the theoretical amounts. The discharge curve is then the curve 5 in the diagram in which the e. m. f. keeps up the normal voltage 1.2 for the longest time.—*Zeit. f. Elektrochemie,* July 4.

Niblett Traction Cell.—An article on a new British traction accumulator, which has been devised by Niblett and will shortly be placed on the market. As "the result of some months' testing" the following particulars are given: Gross weight of complete cell, including vessel and electrolyte, 24 lbs. 9 ounces, normal discharge rate 16 ampères, current density of positive surface at normal discharge 1 ampere per 7 square inches, capacity 160 ampere-hours, capacity per pound of complete cell 6.55 ampere-hours. These results are obtained with a fall of potential to 1.75 volts per cell. The metallic conductor used is of small dimensions and light weight. "It forms the backbone of a frame wherein the active material is contained, and is so arranged that all those parts immersed in the electrolyte and not covered by the active material are insulated. By this arrangement all the lead salts are brought under direct electrolytic action." The active material "in both the positive and negative plates is not the usual lead oxides, but is a compound of lead salts produced electrolytically and is of a conductive nature. When set and properly seasoned the material is of a stone-like nature," while the necessary porosity is claimed for it. It is claimed that the cells can be formed very rapidly; that 2.2 to 2.3 volts per cell is sufficient to effectually recharge, and that there is no tendency to bending or buckling. With thinner plates the current density on both charge and discharge may be very much increased. "Thus, in the case of the thinnest elements yet tried, rates of discharge of 1 ampere per square

inch of positive surface have been obtained, the e. m. f. remaining practically constant. By working at this current density cells can be constructed which can be fully discharged or charged in less than one hour, without great loss of capacity or efficiency." So far plates varying from 0.1 to 0.75 inch thick have been tested.—*The Elec. Chem. and Met.*, July.

Electrolytic Deposition of Copper.—Sayer and Spiers.—A continuation of their article. They discuss the changes in the constitution of the electrolyte itself. The fundamental change that the current brings about in the electrolyte is the conversion of cupric ions at the cathode into cuprous. Cuprous sulphate is next formed. In neutral solutions hydrolysis occurs and cuprous oxide is therefore deposited. In acid solutions the cuprous sulphate is stable and remains in solution. For the copper deposition to take place at a maximum efficiency, the number of cuprous ions in solution must remain constant. This is the case in strongly acid solutions, where the number of cuprous ions capable of being held in solution is limited, consequently, when this limit is reached further cuprous ions are converted into cupric, and copper is deposited. As mentioned above, the prime action of the current on a solution of cupric sulphate is to convert cupric ions at the cathode into cuprous ions. If, in consequence of stirring, these cuprous ions be brought over to the anode, they are retransformed into cupric ions, and a slime of copper and cuprous oxide is deposited on the anodes. In this case less copper apparently dissolves than is deposited, and the solution becomes poorer in copper. This is particularly the case where the cuprous ions exist above a certain limiting concentration and in neutral solutions. It is highly important to have free acid in the electrolyte; it prevents the deposition of cathodic copper contaminated with cuprous oxide; it prevents the precipitation of an anode slime, and above all, it greatly decreases the resistance of the solutions, and thus enables very low voltages to be used in the commercial refining of copper. They give a curve which shows how, in a particular case, the voltage at the bath terminals decreases with the percentage of free acid in the solution, the curve becomes practically asymptotic at an acidity of about 15 per cent, so that, as far as economical reasons merely are concerned, there is no advantage in increasing the acidity above that amount. They then give a curve for weight of deposit, as depending on the percentage of acid. They also reproduce the corrosion curve, the variations in both curves more or less correspond. The following are the approximate constitutions of some of the solutions used at varius times and at various refineries, mostly in the United States: 9.25 to 9.5 per cent acid and 13 per cent bluestone; 6 per cent acid and 16 per cent bluestone; 5 to 6 per cent acid and 15 to 25 per cent bluestone. In no case is the acidity as high as the 15 per cent referred to above.—*The Elec. Chem. and Met.*, July.

An Iron Cathode in a Solution of Nitrate of Ammonium.—Kaufmann.—A German Electro-Chemical Soc'y paper. He has confirmed the phenomenon found by Haber, that when a solution of nitrate of ammonium, saturated at 0. deg. C., is electrolyzed in a cell with a porous plate, with a carbon anode and an iron cathode, at a low current density at the cathode (0.02 ampere per square decimeter), the iron of the cathode dissolves and the electrolyte at the cathode gets a yellow color. He has investigated this phenomenon and has found that it is due to the fact that during electrolysis at the cathode a solution rich of ammonia and of nitrate of ammonium is formed. He has also found a new ferroso-ferric oxide, which appears to be of practical importance. There are given two prints of a picture of Faraday, the one printed with the old ferroso-ferric oxide, the other with the new one. The former has the chemical formula Fe_3O_4, the latter Fe_8O_{11}. The print obtained with the former is black with a brown shade, that obtained with the latter is deep black. —*Zeit. f. Elektrochemie*, June 27.

Extracting Metals from Ores.—An editorial note calling attention to the well-known fact that at high temperatures calcium carbide has very powerful reducing properties. By igniting mixtures of the chlorides of metals with calcium carbide it is possible to extract the metals in almost a pure state. Working on the same lines, Geelmuyden, over ten years ago, observed that one could readily reduce most of the metallic sulphides (but not that of aluminum) by means of calcium carbide, the resulting calcium sulphide being an exceedingly stable body, even at the temperature of the electric furnace. Bullier has even succeeded in recovering metals directly from mixed sulphide ores, without the usual preliminary roast, and at an efficiency of about 90 per cent. In the case of copper pyrites the metallic ingot obtained consists of two well defined layers, the one of copper and the other of iron saturated with carbon.—*The Elec. Chem. and Met.*, July.

REFERENCES.

Theory of Electro-Chemistry.—Jones.—The first part of a serial on "Selected chapters in electro-chemistry." This deals with the theory of the osmotic pressure.—*Elec. Rev.*, July 20.

Electrolytic Production of Amines.—Chilesotti.—An account of an investigation of the electrolytic reduction of aromatic mononitro-compounds to amines, especially of the methods of Boehringer and of Elbs and Silbermann.—*Zeit. f. Elektrochemie*, July 11.

Copper.—Froment.—An article on the electrolytic method of refining copper and on alloys of copper and magnesium.—*L'Elec.*, June 22.

Units, Measurements and Instruments.

Rectifying Alternating Currents by Means of the Hall Effect.—Des Courdes.—When an alternating current J is supplied to a coil S and a bismuth plate D in series, as shown in the adjoining figure, then a D'Arsonval mirror galvanometer G connected to the lateral electrodes f and g indicates a direct current i. This is due to the fact that the main current J and the magnetic field, produced by it, change the sign simultaneously. When the connections a and b are reversed, the direct current i changes the sign. A more practical arrangement is shown in the second figure, where the alternating current is supplied to the windings of a laminated electromagnet S, while the Hall plate is placed in the air-gap. The direct current i may then be measured by an ordinary commercial instrument. He shows theoretically that this method of changing alternating cur-

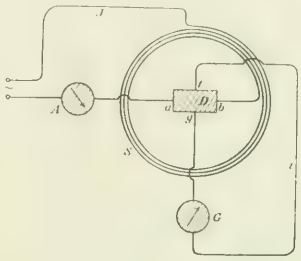


Fig. 1.

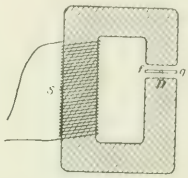


Fig. 2.

rent into direct current is of no commercial use, as the efficiency is very low, certainly below 2 per cent. The arrangement is, however, well adapted to measuring purposes, for the determination of the numerical coefficient of the Hall effect, for devising a dynamometer, and for the direct analysis of the wave form of magnetic fields, i. e., for the determination of the single co-efficients of the Fourier series without having determined before the waveform of the curve.—*Phys. Zeit.*, July 6.

Pyrometers.—Rosenhain.—The conclusion of his illustrated article. The Callendar recorder and the Roberts-Austen pyrometer of the photographic type are described and illustrated. The two methods of pyrometric recording—the Callendar and the photographic—are compared. In favor of the Callendar is the fact that it avoids the trouble and expense of photography. In favor of the Roberts-Austen instrument are the greater simplicity of the photographic recorder, the absence of delicate moving contacts, and the greater sensitiveness and quickness of action. The question how to support the thermocouple in the electric furnace is very briefly discussed. It is admitted that the problem of obtaining continuous records of furnace temperatures much above 1200 degs. C. it not yet satisfactorily solved.—*The Elec. Chem. and Met.*, July.

Silver Voltameter and the Electro-Chemical Equivalent of Silver and Copper.—Richards, Collins and Heimrod.—They use a silver voltameter of the following form. As cathode a platinum pot is used, as anode a silver rod, covered with filtering paper. The anode is placed in a porous cup, the electrolyte at the anode is kept at a lower level than the electrolyte at the cathode. A silver nitrate solution of 10 per cent is used. Comparison with other silver voltameters show that nearly all other types give incorrect values, due to the fact that at the anode a reducing agent is formed which, when it reaches the cathode, causes a deposit of silver independent of the current. By keeping the electrolyte at the anode at a lower level, they

prevent the electrolyte around the anode to diffuse over to the space around the cathode. The value found by them for the equivalent of silver is 0.0011172 (evidently gram per ampere second) that of copper 0.0003292. The electric charge of a monovalent gramion is calculated to be 96,610 coulombs.—*Zeit. f. Elektrochemie,* July 11.

D'Arsonval Galvanometers.—Kuemmell.—He remarks that the weakest point of the D'Arsonval galvanometer is that the damping is generally exaggerated when the resistance of the external circuit is too small. He describes and discusses the types devisd by Carpentier, Elliot Brothers, Edelmann, Hartman & Braun, Siemens & Halske, and describes improvements made by himself. He shows that when the permanent magnet is replaced by an electromagnet the D'Arsonval galvanometer becomes a very practical and very sensitive instrument.—*Zeit. f. Elektrochemie,* July 4.

REFERENCES.

Plotting Alternating-Current Waveforms.—Blondel.—The first part of a long and well illustrated article on instruments for directly plotting down alternating or oscillating current waveforms. After a brief historical introduction, he gives the principle of the oscillograph and describes quite a number of different types of oscillographs, and discusses how to use them and how far they are correct. —*Rev. Gen. des Sc.,* July 15.

Magnetic Measurements.—Montfellier and Aliamet.—The first parts of an illustrated serial on magnetic measurements with the ballistic method.—*L'Elec.,* June 22, July 6.

Measuring Transformers.—Gallus.—An illustrated article on transformers of the French Thomson-Houston Company, to be used in connection with measuring instruments. The ratio of the two voltages is well constant over a wide range.—*L'Elec.,* June 22.

Thermostat.—Young.—An illustrated description of an electrically heated and electrically controlled thermostat.—*Jour. Am. Chem. Soc'y, El'ty,* July 24.

Telegraphy. Telephony and Signals.

Wireless Telegraphy.—Kimura.—An account of an investigation on the influence of the earth on wireless signaling. He used his "sound receiver," which indicates all variations of the current by variations of the intensity, sharpness or duration of the tone. He used five different earth contacts for the mast wire, comprising plates, cylinders and wires of various materials and dimensions. The best results were obtained with a thin cylinder put in a ground saturated with sea water. He believes that the earth connection works by its capacity rather than its conductivity, and a large earthing plate is therefore advantageous.—*Phys. Zeit.,* June 29; abstracted in Lond. *Elec.,* July 19.

REFERENCES.

Simple Time Signal Apparatus.—Kintner.—An illustrated article showing how to arrange a system of electric bells or signals to be actuated at certain specified times by the hands of a clock. The article contains all the necessary information required to enable any one to make such an apparatus.—*Am. Elec.,* Aug.

Improvements in Telephony.—Puluj.—Illustrated descriptions, taken from German patent specifications of some new improvements in telephony. He deals with the protection of telephone stations against currents in lighting, tramway and power circuits, and discusses the use of lighting, tramway and power circuits for transmitting telephone messages without danger.—*Zeit. f. Elek.,* June 9.

MISCELLANEOUS.

Drawing Office.—Knox.—An illustrated outline of the drawing office system of the General Electric Co.—*Am. Mach.,* July 25.

Electric Heating.—Bainville.—An illustrated description of drying stoves built by Adnet for special purposes. They are heated by means of electric incandescent lamps.—*L'Elec.,* June 22.

Glasgow Exhibition.—A continuation of the well illustrated serial in which descriptions of the following exhibits are given: Stirling water-tube boiler, Duff gas producing plant, Davey, Paxman & Co.'s superheated steam plant, and 650-hp steam dynamo set, Willans-Crompton 1200-hp steam dynamo set, the Willans-Schuckert 1200-hp steam dynamo set, and the Robey-Mavor and Coulson 500-hp steam dynamo set (all these dynamos are direct-current machines), also the Berryman feed heater.—Lond. *Elec.,* July 19.

Paris Exposition.—Drouin.—An illustrated description of a 590-kilovolt amperes, three-phase generator, exhibited by Rieter of Winterthur.—*L'Elec.,* June 22.

New Books.

Induction Coils: How to Make, Use and Repair Them. By H. S. Norrie (Normal H. Schneider). Second Edition. New York: Spon & Chamberlain. 269 pages, 79 illustrations. Price, $1.

This book, comprising some 265 pages, describes the construction of numerous varieties of induction coils for disruptive discharge, medical purposes, gas engine sparks and similar matters. The induction coil is an instrument which has been within the last few years very largely improved, at least so far as high voltage disruptive coils are concerned, and with respect to such improved coils the work does not go into great detail. In this connection, therefore, it will be of more value to amateurs than to professionals, as it covers the former field quite fully. It illustrates to good advantage and gives data and dimensions of numerous types of medical coils and methods of regulation.

On the subject of contact breakers, the book is of more amateur than professional value, for it is limited to the description of a number of familiar types, and devotes a few paragraphs to the Wehnelt interrupter. The paragraph on condensers sets forth methods of construction, which have been successfully used. Following are chapters on experiments of different kinds, some of which are ingenious and calculated to display brilliant effects. A chapter on gas lighting, one on batteries for coils, and still another on Tesla and Hertz effects, concluding by one on wireless telegraphy, are among the features. These subjects are covered superficially by the work, but serve to give general ideas in brief and concise form. The work is therefore suitable for those who desire general knowledge on the subjects which it covers, and for amateur experimenters.

Independent Telephony.

At Lafayette, Ind., on July 30, the annual convention of the Indiana Mutual Telephone Association opened. Over 200 delegates were in attendance. W. C. Doolittle, of Lafayette, presided. Judge L. C. Walker, of Indianapolis, read a paper on the subject, "The Late Bell Monopoly—It Lived Unloved and Died Unmourned."

A paper was also read by George W. Beers, of Ft. Wayne, on "Independent Toll Lines." A paper was read on "Our Friends the Enemy," by George P. Haywood, city attorney of Lafayette. He was followed by C. A. Reaves, of Plymouth, who spoke on "The Cooperation of Independent Telephone Companies."

The second day's session of the Indiana Mutual Telephone Association was held on the next morning at 10 o'clock. Many new faces were to be seen among the delegates when Charles A. Zion, of Lebanon, called the meeting to order. A number of new members were admitted to the association. On motion of S. P. Sheerin, of Indianapolis, 2000 copies of the proceedings were ordered printed for general distribution. He said that he believed the organization should advertise its importance, as it was becoming a dreary factor in telephone circles. The election of officers resulted: President, L. A. Frazee, Connersville; vice-president, C. A. Zion, Lebanon (re-elected); secretary-treasurer, H. B. Gates, Indianapolis (re-elected). Mr. Frazee, on being introduced, made a clever speech of acceptance.

The second annual convention of the Independent Telephone Association of Southern Indiana was scheduled for New Albany, Ind., on Aug. 1 and 2.

A special dispatch from New Albany of Aug. 1, says: There is a large attendance at the annual convention of the Southern Indiana Independent Telephone Association, which began here at 2 o'clock this afternoon at Maennerchor Hall. Nearly every independent telephone company in the southern portion of the State is represented. Charles D. Knoefel, president of the Home Telephone Company, of New Albany, delivered the welcoming address, which was responded to by G. A. Kienle, of Huntingburg, president of the association. E. N. Coleman, secretary of the Louisville Telephone Company, delivered an address, and there were a number of papers and other discussions of subjects pertaining to the independent telephone business.

Another special dispatch of Aug. 2, says: The annual convention of the Southern Indiana Independent Telephone Association adjourned to-day, after electing the following officers: President, G. A. Kienle, Huntingburg; vice-president, C. D. Knoefler, New Albany; secretary, E. W. Pickhardt, Huntingburg; treasurer, T. M. Thom, Lamar.

Halsey Direct-Current Meter.

The type of meter illustrated herewith differs radically from those now generally in use. In fact, the only point of similarity is the vertical shaft driving the usual integrating mechanism through the medium of a worm-gear. It does not even have a commutator, but consists of a unipolar motor with mercury contacts. This meter has been developed during the last six years by Mr. Edward S. Halsey, and in the first form, patented in 1899, is shown in partial section in Fig. 1. The armature is a vertical cylinder of copper carried at its upper end by a head or spider on a shaft which holds it centrally in a cylindrical slot in a body of cement into which are molded the long pole pieces 4 and 5. These pole pieces have convex and concave faces corresponding respectively to the two walls of the slot or mercury chamber of which they form a part, defining a field that concentrates the total strength of the surrounding magnet, 1, to a small section of the cylinder or armature, which cuts the lines of force throughout nearly its entire length.

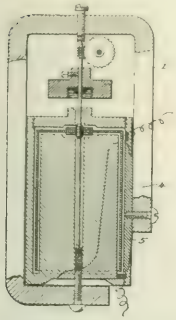


FIG. 1.—SECTION OF METER WITH CYLINDER ARMATURE.

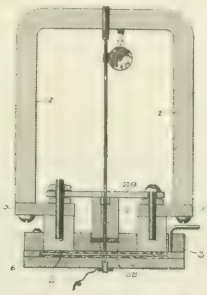


FIG. 2.—DISK ARMATURE TWO FIELDS AND IRON YOKE BASE.

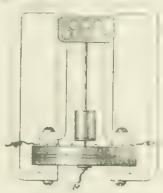


FIG. 3.—TWO MAGNETS AND FIELDS

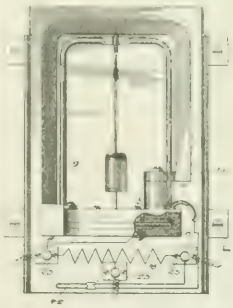


FIG. 4.—THREE-WIRE SINGLE FIELD METER.

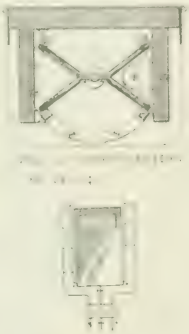


FIG. 6.—MANNER OF CONNECTING THREE-WIRE METER.

The circular or annular slot which forms the interior cavity of the cement body is filled with mercury up and into a neck around the shaft, thus entirely submerging the armature. The current leads at the top and bottom of the slot are molded into the cement body when formed, and conduct the current to and from the armature, through the medium of the mercury, so that the current traverses the armature the entire length of the concentrated field. This construction gives a unipolar motor with a very powerful torque. At the same time, the bearing friction is practically negligible as compared with a jeweled meter on account of the absence of weight or pressure on the bearings; the floated copper armature being considerably lighter than the mercury, and the buoyancy being just compensated for by a circular ballast weight fixed on the shaft. It is stated that a 25-ampere meter will start on considerably less than 1-20 of an ampere; and that it is but 10 per cent slow on ¼ of an ampere, or 1 per cent of its full load; about 5 per cent slow on ½ ampere, 1 per cent slow on 1 ampere, and from this to full load there is not an error of over 1 per cent at any point.

The accompanying illustrations refer to various forms of mercury meters patented by Mr. Halsey. Fig. 2 is a sectional view of a form in which the armature, 2, is a plain flat copper disk enclosed in a receptacle formed of an iron bottom disk, 6, and a fibre top disk, 3, separated by a ring washer of fibre. The two pole pieces, *N* and *S*, are round studs of soft iron pressed through holes punched in the heavy fibre tops and are joined to the two poles of the magnet, 1, by means of the two soft iron stampings, 15. This figure shows the ballast weight, 7, slid down on the shaft so as to compress a soft rubber gasket, 28, cemented to it, thus sealing the meter mercury tight so that it can be inverted and transported in any position. The weight is held down by a stamped yoke, 29, which permits it to swing into place beneath an adjusting thumb nut. The rubber gasket supports the weight upon the shaft. It will be noted that the current is conducted by the leads, 13 (the center step bearing acting as one of them), so that in this case the current does not pass both fields. It might, however, be made to do so, as in Fig. 3, thus developing double the torque.

In Fig. 3 the arrangement and relation of the fields and disk armature are practically the same as in Fig. 2, but the bottom plate [illegible] round iron studs or pole pieces through it, thus making it almost an exact counterpart to the top plate of the receptacle, the upper pole pieces coming exactly above the lower pole pieces. The two independent magnets shown maintain through their *N* and *S* pole pieces, independent fields at opposite edges of the disk armature enclosed in the mercury receptacle, so that current led to it by the positive electrode may pass through both fields in traversing the diameter of the disk and pass through out at the negative lead at the opposite side, or a portion or all of the current may pass out through the center bearing, which constitutes the neutral lead, after having passed through one field only, thereby developing but a fraction or one-half the torque and velocity, and thus being adapted to measurement of current on a three-wire system when connected into circuit as shown on Fig. 6.

Fig. 7 is from a photograph of still a different form of meter, and one which Mr. Halsey has finally adopted as being the simplest,

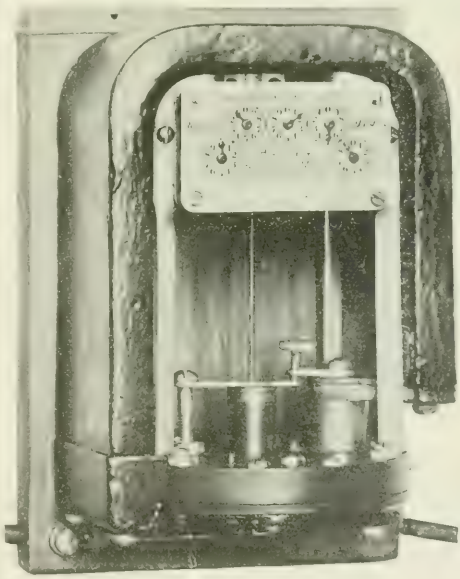


FIG. 7.

cheapest and most practical, and which is about ready for the market. Fig. 4 gives a view of this form with a fraction of the mercury chamber broken away to give an idea of the interior arrangement, and Fig. 5 is a horizontal cross-section through the line *A-A* of Fig. 4 looking down, and exposing the cross hatching of the back-board and magnet and also indicating the position of the re-

movable aluminum cover by the dotted lines. In this form the iron bottom plate, 6, has a lug the width of the magnet cast on the left-hand side and rising above the fibre top disk, 3, so as to join the *S* end of the magnet. This makes the bottom plate the south pole, while there is but one pole piece required through the fibre top, which pole piece is joined to the *N* end of the magnet through the medium of the soft iron stamping, 15.

In this meter the current traverses the disk but little over an inch, entering the bath by the upper lead and out through the bottom lead, through the iron plate. It will be seen that this armature circuit which includes the loop, 42, is shunted by the shunt, 16, so that the total current does not pass through the armature. This shunt has a third central binding post, 23, thus enabling the meter to be connected to a three-wire circuit as shown by Fig. 7. This three-wire feature, though simple, is of considerable value, as without it two motors would be required.

The frame, 9, for supporting the dial and the top bearing for the shaft consists of two aluminum wickets. The cover joints are all double-seamed together, no solder being used. When the cover is pushed back, its edges spring in between the two bead rolls, thus making a thoroughly dust and bug-proof cover without the need of felt or other packing. The lead wire openings are also dust-proof, as they dead end in the backboard.

Either a common pointer dial or a figure-counting mechanism may be used. In one of his patents Mr. Halsey covers a differential driving mechanism for the counting cylinders by which the cylinders are always driven in a forward direction by two reciprocating arms working in alternation, regardless of the direction of the rotation of the motor and worm wheel, so that no care will have to be taken as to the direction of the service to the meter. The meter is being made in sizes of 15, 30, 60 and 100 amperes, and calibrated to read in watt-hours on any constant-potential circuit from 100 to 240 volts, or in ampere-hours for arc lights and for storage battery work. The magnets of the meter consist of a steel casting made to a special formula and treated by a special process. The inventor's confidence in this magnet as well as in the meter altogether is indicated by an offer to guarantee all meter sold for three years' time against deterioration or inaccuracy. An interesting feature of this meter is the fact that the shunting or reduction of the lines of force of the field does not materially change the speed, as the same field which determines the torque acts as the magnetic brake for the meter.

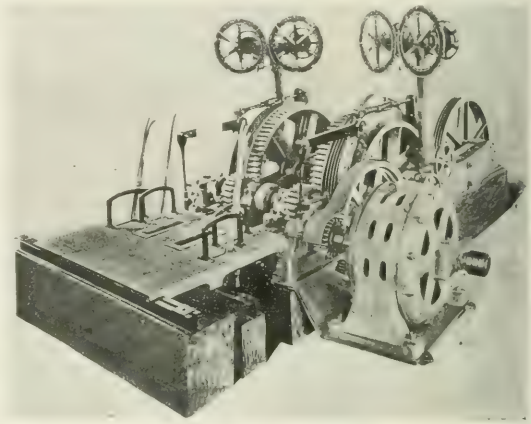
To resume, some of the points claimed for the meter are great accuracy, especially on very small loads; it cannot "run on the pressure"; it has no commutator or brushes, and no jewel, the armature being supported by mercury floatation; short circuits cannot weaken the magnet; there are no coils to burn out, so it will stand large overload; there are no continuous pressure shunt losses. There is practically no drop through the meter at full load; it is thoroughly dust and insect-proof; on account of this and the general construction, wires cannot be introduced by dishonest persons to catch and prevent the rotation of the armature. Simple and convenient means are provided for leveling, but on account of the mercury floatation, being out true does not effect the running appreciably, even on the smallest loads. It has been found that the layer of scum which forms at once on the surface of the mercury, thoroughly protects it against further oxidization or sloughing. The speed of the meter may be regulated by simply turning a lever or index finger on the bottom of the mercury chamber. It is small and compact—a 30-ampere meter being only 8½ inches high by 5½ inches wide and 4¾ inches deep.

Mine Electric Hoists on the Comstock.

About six months ago we printed a description of the Comstock Lode electrical transmission plant, and we now illustrate herewith an induction motor hoisting outfit of which four have been installed at mines on the Lode. The power for operating the mine is purchased from the Truckee River General Electric Company upon a continuous-rate basis, the amount being fixed by a peak load of two minutes' duration. As a consequence of these conditions it is desirable to secure a hoist that will operate at the highest possible efficiency. Another condition to be met was that the regulation of the general system was to be affected to as slight a degree as possible. To meet these requirements the Risdon Iron Works, of San Francisco, Calif., designed the hoist which we illustrate.

In order to secure the necessary variations in speed, the induction motor has a non-inductive resistance in both the primary and the secondary circuits, these resistances being controlled by a modified form of the ordinary street railway controller. In order that the work of the hoist shall be constant at all points in the lift, a continuous rope or balance system of hoist was adopted, the load thus being reduced to the weight of the rock alone. With an equipment of this kind the cage is started slowly and the drop in voltage is comparatively slight, being only about 7 per cent at starting.

The hoist itself consists essentially of a main driving drum and an idler around which the rope is wrapped four times in order to secure the necessary friction for lifting. From this drum the rope is carried over a head sheave, down one compartment, under a movable tail sheave back to the second compartment, over a second head sheaving and on to the driving drum. One cage is inserted between the end of the cable and the other fastened by means of heavy iron clamps, one above and one below the cage in the adjacent compartment. This simple arrangement enables the relative position of the cages to be varied at pleasure, and also permits one cage to be used in single compartment without reference to the other. The hoist



MINE HOIST ON THE COMSTOCK.

is necessarily a geered machine, the motor speed being reduced by the introduction of cut-gearing. To the main drum is attached a brake ring in connection with a heavy post brake which is set automatically by means of a heavy weight and released by hydraulic pressure. In two of the Comstock mines there are two hoists side by side and operated by one motor. One of these is intended for the vertical shaft and the other for the incline leaving the vertical at the point where the vein intersects. Double-deck cages are used in each compartment of the vertical shafts and a two-ton self-dumping cage in each compartment of the incline.

The following are data from the hoist in the Yellow Jacket Mine, which was operated for more than a month with a single cage in a compartment, which is the severest test to which the hoist can be subjected. The weight of the cage is 1200 lbs., of the car 850 lbs., and of the load 1600 lbs., or a total of 3650 lbs. The maximum rope speed was 600 ft. per minute, and the length of the vertical lift 1175 ft. The time of hoisting was 2 minutes and 10 seconds from the moment the load was started until the cage was landed at the surface. The time to accelerate the load was 8 seconds, and the power required 88.4 horse-power by wattmeter readings. The power required to lift the load is, by calculation, 66.4 horse-power, so that the efficiency of the system is about 75 per cent, the loss in the motor, transformers and all friction losses being considered. The voltage before starting was 525 and the running voltage slightly over 500. The maximum current per phase at starting was 180 amperes, the normal running current being 85 amperes. A reading taken when lifting the empty cage at 600 ft. per minute showed 48 horse-power at the wattmeter. Three of the hoists are equipped with General Electric induction motors and one with a Westinghouse motor. All four of the hoists were built by the Risdon Iron Works, of San Francisco, Calif.

Three Rivers Elevator Controller.

The operating frame of a new magnetic rheostat, made by the Three Rivers Electric Company, Three Rivers, Mich., is represented in Fig. 1, the illustration showing everything pertaining to the rheostat except the resistance coils. The diverter at the right has 34 sections, thereby eliminating all tendency to spark, even with large motors, and is very substantially made. The sections are copper insulated with mica and clamped together in a frame easily removable from the rheostat.

The compound coil diverter shown in the upper center is so arranged that the compound coils of the motor can be cut out in any number of sections up to four, and at any period of armature acceleration best suited to the motor and character of elevator it is operating. This is done by connecting to binding blocks directly back of the four small sections shown in the cut, which can be changed to any part of the segment covered by the contact arm. The shaft carrying the contact arms is mounted on ball bearings eliminating all friction, and the face of both diverters are machined perfectly true with it.

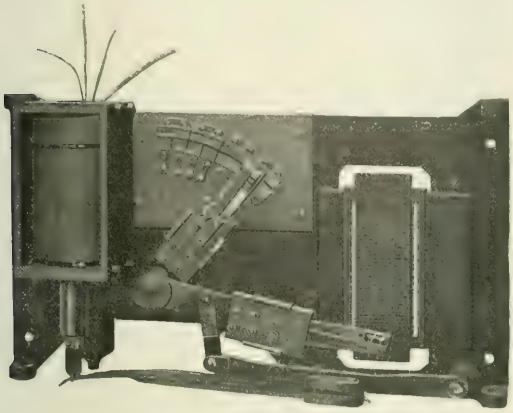


FIG. 1.—ELEVATOR CONTROLLER.

The action of the magnet can be well understood from the cut. When the first rush of current passes on and starts the elevator, the core jumps its full stroke instantly, bending the leaf spring connected with the contact arms, which follow more slowly because of the dashpot on the back of the frame. By having the magnet act in this manner it has a powerful pull, due to the momentarily heavy current, and the core reaches a position before the current can possibly decrease under any condition of load to securely overcome the spring tension during armature acceleration, after which a comparatively weak current is sufficient to hold it up.

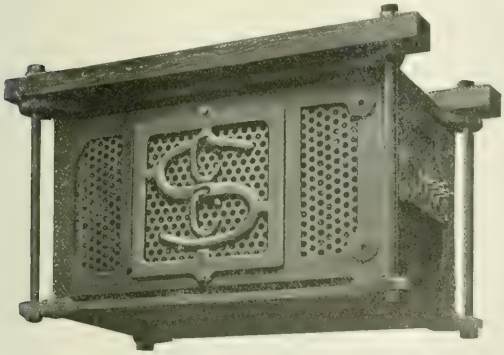


FIG. 2.—ELEVATOR RHEOSTAT.

The release and cutting in of the rheostat is so quick that no rough handling by the operator can reverse the motor on any part of a short circuit. Everything about this frame is made interchangeable and great care is taken to have all parts mechanically correct.

In Fig. 2 is shown the rheostat complete suspended from a ceiling. Since only a few wires are necessary to connect to it, it can be placed anywhere most convenient and without much regard to distance. In Fig. 3 is shown the Three Rivers elevator motor, with the reversing switch mounted on top. This arrangement is particularly suitable for direct-connected elevators, since the operating shaft is favorably located for mechanical connection to the winding machine of the elevator, but may be so placed for belted elevators and the rheostat set on the floor, hung from the ceiling or elsewhere placed to occupy room of no material value. The same company also manufacture a motor starter for double-belted elevators or other uses.

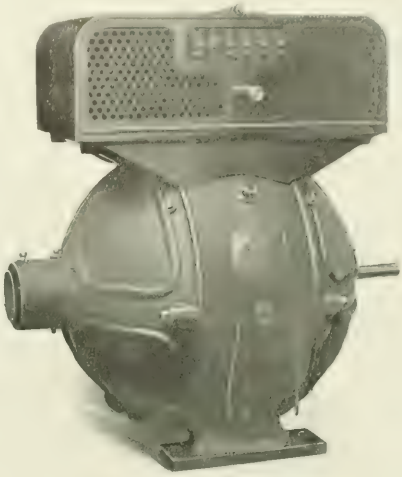


FIG. 3.—ELEVATOR MOTOR.

Improvement in Telephone Receivers.

The Hamilton (Ohio) Metal Pattern Works is introducing a novel telephone device, the invention of Frank J. Baber, of the company. The device does away with the handling of the receiver of the telephone. It is fastened to the wall on the receiver side of the telephone, and a vertical wire which is a part of the device fits over the metal holder of the receiver. It is made of heavy wire and extends from the wall far enough from the mouthpiece to reach the ear of the telephone user. At the outer end of the device is a metal clamp and a frame into which the receiver is laid horizontally, thus enabling the user to adjust it according to his height. It is so constructed that a slight pressure by the ear opens the circuit the same as when one takes the receiver down from the switch. The receiver always remains in the same position, and is ready for use at any time. By placing the ear against the receiver, the signal is imparted to the operator in the exchange in the usual manner, and when through talking the pressure of the ear is withdrawn and the connection cut out. In case one leaves the telephone to secure something or call somebody, an automatic switch keeps the apparatus from closing the circuit and cutting off the party with whom one is talking. This catch is immediately released by placing the ear in position against the receiver. The device is sold direct to telephone subscribers. About 300 of them are in use, nearly all in Cincinnati where the Bell company is reported to have given the device a good indorsement.

Holland for the Dutch.

It is stated by cable that Queen Wilhelmina has appointed a special board of naval officers, headed by Rear Admiral Tadema, to visit the United States to report on the submarine boat "Holland," with a view, it is understood ,of buying some craft of this character.

Combined Pan-American Exhibit of the Bullock and Wagner Companies.

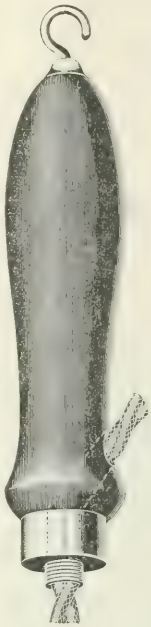
This combined exhibit of the two companies in Electricity Building is surmounted by an electric sign which is a prominent feature in the building. The Bullock shield forms the middle, and the words "Wagner Electric" are flashed by four different colors on each side. In the background are 500 photographs showing Bullock and Wagner apparatus and installations. The Bullock Electric Manufacturing Company's part of the exhibit consists in direct-current motors and controllers, of which there are shown nine types. A 150-kw generator, designed for direct connection, and a 25-kw generator also for direct connection, are shown. The adjustment of the brushes of these two machines is operated simultaneously by a hand wheel, either in a horizontal or vertical plane. Other direct-current machines exhibited are a 30-kw belted generator, a 50-hp motor with sub-base and belt tightener, a 20-hp Bullock motor, with iron sub-base, absolutely dust-proof; a 45-hp Bullock motor, open ends without sub-base; a 10-hp dust-proof motor; a 9-hp motor, with back gear, and a 2-hp dust-proof motor on iron sub-base. All the Bullock type N motors included in the above category are built with either open or closed ends, and are adapted to be placed either on the floor, ceiling or side wall, and may be either belted or geared. The Bullock printing press controller is designed to give with the movement of one wheel all the speeds from full to an inch at a time. All these direct-current machines have brush holders of the Bullock new reaction type, which make it impossible for the brush to fly out of its seat and hit the commutator when the tension is removed.

The Wagner Electric Manufacturing Company shows three self-starting, single-phase, 60-cycle alternating-current motors, one of 30 horse-power, 208 volts; one of 5 horse-power, 104 volts, and one of 2 horse-power, 104 volts. They are automatic as to starting connections, and all that it is necessary to do is to throw in a switch to start them. A centrifugal governor changes the armature connections when a certain speed has been attained.

PAN-AMERICAN EXHIBIT OF THE BULLOCK AND WAGNER COMPANIES.

The largest of the group of Wagner transformers is a 175-kilowatt, with 18,500-volt primary and 1100-volt secondary, oil-filled and water-cooled, one of 25 built for the McCloud River Electric Power Company in Washington, for which the Bullock and Wagner companies have the entire electrical contract. In the 100-kw size a new type is shown having the air blast inlet and exhaust in the base. This is the same as 22 installed at the Castner Electrolyte Alkali Works, already illustrated and described in these pages. It has a primary wound with 14 taps and will give 28 steps in voltage variation on the secondary, from 148 to 181 volts. Transformers from 25 to 1½ kilowatts capacity are shown of the self-cooling type. All are filled with oil, except the 1½ kilowatts, which is filled with a solid insulating compound, which the company finds is a more rapid conductor of heat than an air chamber around the coils.

Four switchboard panels occupy the middle of the background. Two of these were built for the McCloud River Electric Power Company, equipped with the Wagner switchboard instruments and oil switches. The other two panels have Wagner voltmeters, ammeters and wattmeters.



Handle for Lamps.

An illustration is shown herewith of a new electric lamp handle manufactured by the Union Hardware Company, Torrington, Conn.

This handle is made of hardwood, and finished in imitation of hard rubber. As will be seen, it is a handy and convenient appliance, for which use will be found in a great many places and situations where a portable light is required.

Recent Signal Corps Work.

Reports to the War Department from the military authorities in Alaska give assurance that the various projects for greatly extending the telegraphic service in the Territory will be fully carried out during the present season. Captain William R. Abercrombie is engaged with a large force of men in constructing the proposed military road from Valdes on the southern coast to Circle City on the upper Yukon, near the boundary of the British Northwest Territory. At the same time the telegraph line is being extended along that route, and it is expected that even before the completion of the wagon road the telegraph facilities over the entire distance, from the Gulf of Alaska to the Yukon, will be in operation. While this work is going on large detachments of army isgnal corps men are extending the tlegraph along the Yukon, so that the means of communication between all the military posts in Alaska from east to west may be complete before winter sets in.

The work has advanced so far now that there is immediate need of operators for the various stations. The War Department has ordered 30 non-commissioned officers and enlisted men of the Signal Corps to report immediately to Lieutenant William Mitchell, at Seattle, Wash., whence they will join an expedition to sail within a few days for Alaska. The signal corps is also engaged in laying the military ocean cable from Shagway to Juneau, the new Territory capital. When the various projects now in progress are complete, which will be some time during the coming fall, it will be possible to telegraph from the United States by way of Canada to any important place or military post in Alaska, summer or winter.

Connecticut Corporations.

A law has just gone into effect in Connecticut that will interest new electric companies. The main difference between the Connecticut law and the statutes of the States mentioned is that the corporations which go there for their charters will, after paying the first fee for their charter, be forever free from State taxation. New Jersey derives a large annual income from the corporations which have been organized under the very liberal laws of that State, but in Connecticut the requirement is simply that the new corporation shall pay a franchise fee of 50 cents for each $1,000 of capital up to $5,000,000, and for any amount in excess of that sum, 10 cents per $1,000. Thus the cost of a charter for a corporation with a capitalization of $100,000,000 will be $2,500 for the first $5,000,000, and $9,500 for the remainder. All that is required of the organizers of a new corporation is that they shall have a "location" and an agent in some town in the State, and it is not necessary that this agent shall be a stockholder, as is required in Maine. It is not required that the annual meetings shall be held there, or that any stock shall be owned by anybody who lives in Connecticut. The provisions of the law are so minute in regard to the form of organization that it is not necessary for anybody who wants a Connecticut charter to employ a lawyer to do the business for him. All that he needs to do is to send to the Secretary of State in Hartford, for a copy of the law, and then to comply with its provisions, transcribing the by-laws for the corporation from the terms of the act.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was brighter at its opening than at its close, for while crop conditions improved and railroad, trolley, telephone, electric light and other earnings were reported excellent, the renewal of the wrangling in the steel industry threw its gloom over all. Possibly the United States Steel Corporation and its union antagonists are fighting for vital principles, but it does strike the man in the Street—Wall—that there is a splitting of hairs while the industry and prosperity of the country suffer. But there seems to be disunion among the unionists, and from this it may be hoped that the threatened paralysis of industry may be avoided. The general weakening in quotations is indicated by the figures given below. The week was not very active. Only 625 shares of General Electric were dealt in, only 8850 Western Union, 2800 Metropolitan Street Railway, and 8590 Brooklyn Rapid Transit. That is a narrow market, and midsummer dullness could hardly be more pronounced. Below are the market figures for the week:

NEW YORK.

	July 27.	Aug. 3.		July 27.	Aug. 3.
American Tel. & Cable	—	—	General Carriage	—	—
American Dist. Tel.	—	—	Hudson River Tel.	120	—
Brooklyn Rapid Transit	77	75¾	Illinois Elec. Veh. Trans.	—	—
Commercial Cable	—	—	Metropolitan Street Ry.	168	160
Electric Boat	16	17	N. E. Elec. Veh. Tran.	3	—
Electric Boat pfd.	40	44	N. Y. Elec. Veh. Tran.	11½	12
Electric Lead Reduc'n	—	—	N. Y. & N. J. Tele.	—	—
Electric Vehicle	6	7	Tel. & Tel. Co. of Am.	4	6
Electric Vehicle pfd.	16	15	Western Union Tel.	92¼	91½
General Electric	255	253½			

BOSTON.

	July 27.	Aug. 3.		July 27.	Aug. 3.
Am. Tel. & Tel.	161	160	Mexican Telephone	2½	—
Edison Electric Light	255	255	New England Telephone	134	133
Erie Telephone	48	—	Westinghouse Elec.	68	—
General Electric pfd.	263	—	Westinghouse Elec. pfd.	79½	79½
Cumberland Telephone	140	—			

PHILADELPHIA.

	July 27.	Aug. 3.		July 27.	Aug. 3.
American Railways	40	40	Phila. Traction.	96	—
Electric Storage Battery	80	80	Philadelphia Electric	5¼	5⅝
Elec. Storage Batt'y pfd.	80	80	Pa. Electric Vehicle	—	—
Elec. Co. of America	7	7⅜	Pa. Elec. Veh. pfd.	—	—

CHICAGO.

	July 27.	Aug. 3.		July 27.	Aug. 3.
Chicago Edison	176	176	National Carbon pfd.	86½	—
Chicago City Ry.	206	207	Northwest Elev. com.	44	49
Chicago Telep. Co.	275	—	Union Traction	18	15¼
National Carbon	16½	—	Union Traction pfd.	58	58
Central Union Telephone.	45	—			

WESTINGHOUSE ELECTRIC.—The Pittsburg *Press* has the following as to the increase in the Westinghouse dividend: The long-anticipated increase in the dividend on Westinghouse Electric seconds came on Friday, and the Street was caught unawares, the brokers having had no previous knowledge that a meeting of the directors had been scheduled. When first announced from New York there was considerable skepticism, but when it was confirmed the seconds were in demand and were rushed up sharply. The new dividend rate was 1¾ per cent for the current quarter, as against 1½ per cent maintained since May, 1900. At the last call of the local board that afternoon the stock was sent to 71½, the previous record price, and an advance of 3¾ points over the close on Thursday. A reaction to 70⅞ asked followed, but yesterday there was a fair demand, and the result was an appreciation to 71½. The close was at 71⅜, or 3⅝ points higher for the week. The firsts and seconds are now on the same dividend basis and hereafter any increase from 7 per cent will be shared alike. No one doubts the ability of the company to maintain the new rate on the seconds, as earnings have been the heaviest in the history of the company and are estimated as high as 30@35 per cent. Of the other Westinghouse stocks Union Switch & Signal was a shade stronger on the belief that the stockholders will, in Setpember, get the increase in the dividend rate promised for July, but which did not materialize.

PHILADELPHIA TROLLEYS.—Reports are again current that the rapid transit franchises which recently were granted by the city to Congressman Robert H. Foederer, Jr., Contractor John M. Mack, and a number of politicians, have been turned over to the Union Traction Company. According to the rumor, the Union Traction Company pays to the holders of the new franchises $2,250,000. This payment gives the purchasers complete control of the 13 new franchises granted for Philadelphia. The first demand of the owners of the franchise was for $3,250,000, if the Broad and Diamond Street Railway franchises were found to be effective. The Union Traction Company, however, refused to give more than $1,750,000 for the franchises, excluding those for Broad and Diamond Streets. The payment of $2,250,000 would settle the whole matter, as it takes in every franchise, good, bad or indifferent. Under the new charters the Union Traction Company can acquire land by eminent domain, build overhead and underground roads, or partly overhead and partly underground roads, without going to the commission appointed under the Focht and Emery bills. The present company also can acquire a practical monopoly of every street 40 ft. and more in width for a period of seven years without laying a mile of track. There doesn't seem to be much left.

NEW YORK STATE TROLLEY SYSTEM.—An important consolidation of surface railway interests around Troy, N. Y., has been practically consummated. The company will be capitalized at $2,600,000, and will be known as the Hudson Valley Railroad Company. The roads to be merged are the Stillwater & Mechanicsville Street Railway Company, Glens Falls, Sandy Hill & Fort Edward Street Railway Company, Greenwich & Schuylerville Electric Railway, Saratoga Traction Company and Saratoga Northern Railway. The boards of directors of these companies have voted to take part in the consolidation. There are at present about 90 miles of track on the lines of the various companies, and with the completion of the work now in progress in Warren County and between Ballston and Mechanicsville there will be over a hundred miles of track. The lines connect Troy, Waterford, Mechanicsville, Stillwater, Schuylerville, Greenwich, Fort Edward, Sandy Hill, Glens Falls and Caldwell, and by the middle of September Warrensburg will be reached. Saratoga and Ballston are now connected by the Saratoga Traction Company's lines, and by fall these places and Round Lake also will be connected with the main lines. ExState Treasurer A. A. Colvin, of Glens Falls, and Joseph A. Powers, of Troy, are the principal capitalists interested in the new corporation.

WORCESTER, MASS., TROLLEYS.—The Worcester Railways & Investment Company, recently organized by Boston and Worcester men with $6,000,000 capital, to acquire the street railway properties in the vicinity of Worcester, is a voluntary association, somewhat after the manner of the Massachusetts Electric Companies. There is only one class of stock, however, which has no par value, each share representing a fractional interest in the entire assets. The shares are being privately placed at $100 per share, and it is the intention of the management to pay dividends at the rate of 5½ per cent at first, but this rate should be ultimately increased. The old Worcester Consolidated road has shown a larger relative increase in gross receipts from year to year than any other railway in the State. The companies taken over have bonds outstanding to the amount of but $1,300,000. The companies absorbed serve a population of about 250,000. Messrs. Vermilye & Co. have acted as the financial agents.

CHICAGO UNION ELEVATED.—The charter, franchise and all property of the Union Elevated Railroad Company were transferred last week to the Northwestern Elevated Railroad Company for $6,250,000, which will net $125 a share to the holders of the stock of the Union. At a meeting of the stockholders of the Northwestern Company it was voted to issue $15,000,000 of 4 per cent first mortgage convertible bonds for retiring the existing issue of $5,000,000 first mortgage bonds, due Jan. 1, 1902, a certificate of indebtedness of $750,000 and to pay for the Union property.

A LARGE DIVIDEND.—The Sixth Avenue Railroad Company, of New York City, now controlled by the Metropolitan Street Railway Company, has declared a 38 per cent real estate dividend, payable in a few days. The dividend comes from the proceeds of the sale of the company's old stable property, Sixth Avenue, Forty-third and Forty-fourth Streets, to the General Carriage Company for something like $1,000,000. The Central Realty Company has since purchased the property from the carriage company.

THE VAN CHOATE SWINDLE.—About 200 New England shareholders of the Van Choate Electric Company met last week to take measures to recover some of the $500,000 or more which they are said to have paid into the company. About $1,500 was subscribed to defray legal expenses in prosecuting their claims. The stock, which at subscription cost $10 a share, has recently sold at 10 cents a share.

MINNEAPOLIS GENERAL ELECTRIC.—The securities of the Minneapolis General Electric Company will soon be listed on the Boston Stock Exchange. There are $1,600,000 bonds, 5s and 6s; $750,000 6 per cent preferred stock, and $1,500,000 common stock. The 5s are 105 bid, the preferred 102½ and the common 30 at sales. This company has a monopoly of electric lighting in Minneapolis.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent, payable Aug. 15. The directors of the Wilmington (Del.) & New Castle Electric Railway Company have declared a semi-annual dividend of 3 per cent, payable on Aug. 1.

INTERNATIONAL BELL TELEPHONE.—At a special meeting of the stockholders of the International Bell Telephone Company, Limited, it was voted to reduce the capital stock from $750,000, consisting of 10,000 shares of the par value of $75, to $500,000, consisting of 10,000 shares of the par value of $50 a share.

BUYING LIGHTING PLANTS.—The two new lighting plants purchased by the Electric Company of America are at Canton, Ohio, and Auburn, N. Y. The purchase price is understood to represent a cash investment of about $400,000.

Commercial Intelligence.

THE WEEK IN TRADE was, on the whole, encouraging, with good reports from many quarters. Railroad earnings for July increased 10.4 per cent over last year and 23.3 over 1899. Bank clearings at New York gained 48.8 per cent over last year and 11.4 over 1899, while at leading cities outside of New York the gain is 13.3 per cent over last year and 8.5 over 1899. Prices of commodities are firm. There is little or no alarm as to bad crops, wheat being at its best and corn improving all the time. The steel strike was supposed to be off, but is "on agin," with a muttered curse from everybody. That it can last long is not believed in any quarter, and public opinion seems to be dead against it. Greater activity prevails in Western markets in iron and steel than in the East, but nowhere is activity very pronounced. Healthy conditions are indicated by a rather remarkable demand for all kinds of steel entering into implement, vehicle and like work. A rather general marking up of prices on finished material is regarded as a strong probability, for the present week, and the course prices may take will be determined by the amount of ordering for autumn delivery. Electrical trade in all lines is good, and the inquiries for new plants is far in advance of what is usual at this season.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended Aug. 1: Antwerp—4 cases electros, $47; 26 cases electrical material, $1,973; 2 crates auto vehicles, $2,000; 210 packages electrical machinery, $16,568. Argentine Republic—67 cases electrical machinery, $5,307; 58 cases electrical material, $1,755. Azores—1 case electrical material, $25. British Possessions in Africa—135 cases electrical material, $10,511; 5 packages electrical machinery, $172. Brazil—46 cases electrical material, $693. Barcelona—93 packages electrical material, $8,221. British East Indies—12 packages electrical material, $968. British Australia—1 case electrical material, $20; 1 case electric machinery, $35. Berlin—27 packages electrical material, $448. Bordeaux—54 packages electrical material, $2,487. British West Indies—11 packages electrical material $103. Central America—4 cases electrical material, $780. Chili—50 packages electrical material, $1,776. Cuba—82 cases electrical material, $2,113; 8 cases electrical machinery, $265. Ecuador—7 packages electrical material, $170. French West Indies—3 cases electrical material, $11. Gimon—5 packages electrical material, $73. Genoa—12 packages electrical material, $553. Glasgow—3 packages electrical machinery, $918. Hamburg—17 packages electrical material, $298. Havre—5 cases electrical machinery, $199; 13 packages electrical machinery, $337. Hong Kong—3 packages electrical material, $326. Japan—26 packages electrical material, $1,080. London—185 packages electrical machinery, $7,328; 145 packages electrical material, $8,676; 24 packages motor vehicles, $19,800. Liverpool—116 packages electrical machinery, $7,686. Marseilles—20 cases electrical machinery, $706. Mexico—2 packages electrical material, $444; 127 packages electrical material, $2,558. Manchester—1 package electrical material, $200; 4 cases electrical machinery, $2,500. Malta—3 packages electrical machinery, $35. Milan—3 packages electrical material, $169. New Castle—47 cases electrical machinery, $5,900. Newfoundland—13 packages electrical material, $229. Naples—4 packages electrical material, $366. Novia Scotia—2 packages electrical material, $25. Peru—12 packages electrical material, $690. Philippines—3 packages electrical material, $108. San Domingo—30 packages electrical material, $30. St. Petersburg—2 cases electrical machinery, $200. Southampton—8 packages electrical material, $316. Trieste—11 cases electrical material, $754. U. S. Colombia—10 packages electrical material, $81. Vienna—2 cases electrical material, $144. Venezuela—31 packages electrical material, $317.

TELEPHONY IN PENNSYLVANIA.—The change in the name of the Schuylkill Valley Telephone Company to the Consolidated Telephone Companies, and the increase in capital from $400,000 to $4,000,000, and in the debt from $400,000 to $6,000,000, are incident to the combination of the independent local and the long-distance systems of Pennsylvania, announced by us in July. The systems to be included and their capital are as follows: Interstate Telephone & Telegraph, of Pennsylvania, capital $2,000,000; Standard, of Bucks County, $100,000 (bonds), $100,000; Lehigh, or Allentown, $150,000 (bonds), $150,000; Anthracite, of Hazelton, $100,000; People's, of Wilkesbarre, $300,000 (bonds), $300,000; Lackawanna, of Scranton, $450,000 (bonds), $450,000; Carbondale, of Carbondale, $100,000; Overland, of Leheighton, $50,000; total stock, $3,250,000; total bonds, $1,000,000. The Keystone Telephone Company, capital $10,000,000, covering Philadelphia proper, and the Keystone State Telephone Company, having as its territory the outlying towns, such as Chester and Jenkintown, will have a close working agreement with the Consolidated companies. Both the Consolidated and the Keystone companies will have a traffic agreement with the Interstate Company, of New Jersey, and with the Telephone, Telegraph & Cable Company, of New York and Boston.

FIVE HUNDRED-KW GENERATORS DRIVEN BY GAS ENGINES.—The Sprague Electric Company has recently closed an interesting order for three Lundell split-pole 500-kw engine type generators, with speed of 100 r. p. m., and wound for 250 volts, to be direct connected to gas engines. These three generators will be installed in the new works of the Lackawanna Iron & Steel Company, at Buffalo, and are designed for a continuous overload of 25 per cent at a high efficiency. The gas engines will utilize as fuel waste gas from the coke ovens of the Lackawanna Company. These will be among the largest generators in this country ever operated by direct-connected gas engines, and the method of utilizing waste gases for such large amounts of power has never before been attempted, we believe, in the United States. The Sprague Electric Company has been very successful with the split-pole machines.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—The Boston Stock Exchange has listed 62,376 shares of the Cumberland Telephone & Telegraph Company, of an authorized issue of 100,000 shares. The company is a consolidation of the Cumberland Telephone & Telegraph Company, the Great Southern Telephone & Telegraph Company, and the Ohio Valley Telephone Company. The company has regularly paid dividends upon its stock from Sept. 22, 1883, the total amount so paid being $1,853,203, the last three dividends being at the quarterly rate of 1¾ per cent. The directors are the following: James E. Caldwell, Henry Sperry, W. H. Woolverton, E. M. Barton, V. E. Shwab, F. O. Watts, W. W. Berry, William Litterer, George R. Knox, M. J. Smith, A. G. Sharp, Alexander Cochrane.

FURTHER AMERICAN EQUIPMENT FOR SYDNEY TRAMWAYS.—John A. Mead & Co., of 11 Greenwich Street, New York City, whose works are at Rutland, Vt., have just been awarded a contract, through the Babcock & Wilcox Company, for the supply of a complete coal and ash conveying plant, which will be installed in the new central generating station of the Sydney City & Suburban Tramways, Sydney, New South Wales. The machinery, valued at about $15,000, will be capable of handling 45 tons of coal, etc., per hour. Shipment is to be made by Dec. 1. The Babcock & Wilcox Company is to furnish the boiler equipment, aggregating 4500 horsepower, for the Sydney power house. The boilers will be built at the Glasgow (Scotland) plant of the company.

A LARGE SOUTHERN CONTRACT.—The water power on the Catawba River at Rhodhise, N. C., is one of the largest in the United States, and will be utilized for cotton manufacturing and other industries. The S. Morgan Smith Company, of York, Pa., recently shipped to the Rhodhise Manufacturing Company two pairs of 36-inch and one single 30-inch McCormick turbines, mounted in iron cases, with the necessary supply pipes, draught tubes, a complete rope drive, as well as head shafts, couplings, bearings and a 1000-gallon fire-pump.

WESTINGHOUSE GROWTH.—Deeds have been recently recorded in Pittsburg, transferring to the Security Investment Company (a subsidiary Westinghouse concern) 220 acres of land at Cavettsville, North Huntingdon township, Westmoreland County, Pa., and 319 acres in Westmoreland and Allegheny counties. It is reported in Greensburg that the Westinghouse Company will erect buildings.

S. B. CONDIT, JR., & CO., 63 Oliver Street, Boston, have been awarded the contract for a six-panel high-tension switchboard for the power plant at Garvins Falls, Bow, N. H. This board will be equipped with Elden oil-type circuit breakers and switches. Some of the circuit breakers will handle 1300 volts.

TELEPHONE SWITCHBOARD FOR AFRICA.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has shipped to Cape Town, South Africa, for the Cape Government railway service, a 12-point Clark switchboard.

THE SOLAR CARBON COMPANY, of Ravenna, last week shipped a carload of 6000 batteries to a supply house in Wisconsin, completing an order for five carloads for the same people.

THE WORLD'S COPPER PRODUCTION.—The latest statistics show that the copper production of the world during the last century was:

Country.	Tons.
United States	2,725,600
Chili, Bolivia, Peru	1,870,700
Spain and Portugal	1,189,700
England	855,800
Germany, Sweden, Norway	661,600
Australia	443,800
Japan	202,000
Other countries	860,400
Total	8,100,200

During a single year three mines produced about 28 per cent of the total output, viz., Anaconda, 47,830 tons; Calumet and Hecla, 41,101; Rio Tinto, 33,705. If the product of five other mines be added, the output amounts to 50 per cent, a full half of the world's production. These five mines are Boston and Montana, 27,700; United Verde, 18,900; Mansfield, 18,045; Copper Queen, 15,066; Tharsis, 12,000. It would be very interesting to know how much of the 8,000,000 tons went into electrical work. Can any one hazard an approximate guess?

APPARATUS FOR AUSTRALIA.—George McInnes, P. O. box 2127, Marshall Square, Johannesburg, South Africa, mechanical and electrical engineer, writes to the National Association of Manufacturers, Philadelphia, that he has been established since 1892, and he would now like to hear from American firms which would feel interested in quoting him prices and furnishing particulars regarding boilers, 10 to 100 brake, or actual horse-power, from 100 to 150 lbs. working pressure, and suitable for small lighting plants in basements, etc.; engines, 10 to 100 brake horse-power, up to 25 brake horse-power, in single engines of medium speed, from 25 to 100 brake horse-power in compound engines of medium and high speed. Governors must be of best known types. Dynamos, continuous current, 110 and 220 volts, 50 to 500 amperes; generators, three-phase, 2000 and 3000 volts, 10 to 80 horse-power; motors, continuous and three-phase, 1 to 50 horse-power; transformers, three-phase, primary 2000 and 3000 volts, secondary 100 and 200 volts. Prices, including the cost of packing, should be quoted f. o. b., New York. Terms of payment would be cash against shipping documents in New York City.

VARIOUS DOMESTIC ORDERS FOR COAL PLANTS.—John A. Mead & Co., of New York City, have obtained an order for the installation of coal and ash handling machinery in the packing house works of Kingan & Co., Indianapolis. The Kingan power plant is being considerably extended, additional B. & W. boilers being put in, and a contract has been allotted to the American Stoker Company for the supply of a number of automatic stoking equipments. Other contracts secured within the last few days by the Mead people comprise a coal and ash conveying outfit, including scales, etc., for the power station at North Second and Salisbury Streets, St. Louis, of the St. Louis Transit Company. This is the third contract received from the same source, and is valued at upwards of $35,000; an $8,000 coal and ash conveying equipment for the Cleveland City Railway, and machinery of a like description having an hourly capacity for handling 45 tons, for erection in the main plant of the Denver Tramway Power Company. The value of the latter order is said to be nearly $6,000.

MANHATTAN POWER PLANT.—The Manhattan Railway Company has filed with the New York Department of Buildings plans for the electric power house sub-stations for its Sixth and Ninth Avenue elevated lines. There will be three sub-stations and one repair shop, and the combined cost of these will be $133,000. The sub-stations are to be used to transform the electric current generated at the company's main power house at Seventy-fourth Street and the East River. The new buildings will be situated as follows: A four-story brick sub-station at 173 to 175 Spring Street, a four-story brick sub-station at 354 to 356 West Fifty-third Street, a two and three-story brick sub-station on the north side of 110th Street, near Manhattan Avenue, where the Ninth and Sixth Avenue lines make the curve from Columbus into Eighth Avenue, and opposite Morningside Park; a two-story brick repair shop at 118th Street and Lafontaine Avenue. The east side sub-stations are fast nearing completion.

POWER PLANT NEAR MINNEAPOLIS.—The Twin City Rapid Transit Company, which obtained authority from Congress at its last session to dam the Mississippi River at Koon's Rapids above Minneapolis and develop power, has begun work on the actual construction of the dam, the preliminary work of taking soundings having been completed. This franchise is entirely distinct from the franchises owned by the company for operating street railways at Minneapolis and St. Paul. It gives to the Twin City Company control of all available water powers around the two cities, as the company already has control of the Falls of St. Anthony, at Minneapolis. It is estimated that the cost of the new dam will be $600,000, and that a minimum of 10,000 horse-power can be developed at the rapids.

CONTRACT FOR WOODEN CONDUIT.—One of the largest contracts for wood pipe that has ever been let in the Northwest has been closed between the Seattle Automatic Telephone Exchange Company and the J. A. Soderberg Company, 410-411 Washington Building, this city. The pipe will be used for conduits for underground wires for the new telephone system being established in this city. The contract calls for 300,000 ft. (or, approximately, 57 miles) of pipe within 100 days. The pipe will be three inches in diameter, and will be in sections running from 6 to 12 ft. in length. It is to be made from Washington fir, and will be wrapped with 20-gauge galvanized annealed wire.

SHASTA POWER.—The Shasta Electric Light & Power Company, of Redding, Calif., will develop 4750 horse-power on the McCloud River, in Shasta County, Calif. The water will be diverted from the river by suitable headworks and carried for a distance of two miles in a flume having a capacity of 1000 cubic feet per second. The effective head on the wheels is 56 ft. Four turbine and generator units will be installed. The transmission lines will aggregate 110 miles in length. The bulk of the current will be consumed by the mines and smelters now operating in Shasta County. The work is being pushed as rapidly as possible, so that the first delivery of current will be made in December of this year.

BRASS CONSOLIDATION.—The Chicago Brass Works have recently been acquired by the Coe Brass Company, of Torrington, Conn., and the American Brass Company, fast absorbing the successful brass companies of the United States, has now taken in the Holmes, Booth & Haydens Company, of Waterbury, Conn., of which Thomas B. Kent, of New York, is president and general manager, and the ownership of which is practically in the hands of the Kents and Havemeyers and Burnhams, of New York. Holmes, Booth & Haydens were once quite conspicuous in the electrical field, and were the school for several well-known electrical men.

PLANT FOR CASTINGS WORKS.—The Northern Electric Manufacturing Company has a contract for apparatus for a new plant of the American Malleable Casting Company, at Chicago Highlands, Ill. The plant will be operated by electric power throughout, furnished by three 50-hp gasoline engines built by the Maywood Foundry & Machinery Company, of Maywood, Ill. Each engine will be attached directly to a 40-kw Northern Electric generator. Motors will be scattered around the works, which will have a capacity of 20,000 tons a year.

SPOKANE RIVER POWER.—The Northwestern Mammoth Granite & Electric Power Company, C. M. Allen, secretary, intends to develop some 10,000 horse-power on the Spokane River, 9 miles from Spokane, Wash. The power will be used to operate a 16-mile electric road, granite quarries, saw mills, etc. The company have 20,000,000 ft. of standing lumber and 1000 acres of high-grade granite. The capital is $100,000. It is proposed to bond the road for $250,000 in order to build and equip the dam, power house, etc.

PLANT FOR ENGLISH WESTINGHOUSE.—Jones & Laughlins, Limited, of the American Iron & Steel Works, Pittsburg, have received an order from the British Westinghouse Electric Company, for the power transmission for the new shops at Birmingham, England, for which a large amount of American material has already been ordered. The order includes cold rolled shafting, pulleys and hangers, and was secured in keen competition with English and German makers. Additional contracts of this kind will be given out.

BRICK INSTEAD OF STEEL.—As a result of the steel strike the Kansas City Electric Light Company has decided to use brick instead of steel for the stacks of its new $750,000 power-house, ground for which is to be broken in 10 days. There are to be two of these chimneys, each to be 243 ft. high. Brick from Germany will be used. It is also said that some of the railroad companies are going to put up brick bridges instead of steel.

TOKYO STREET RAILWAYS.—Representatives of the Tokyo, Japan, consolidated street railways have been in the United States for some time, making some investigations of electric railway apparatus previous to placing an order for three 1200-kw generators and several hundred motor equipments. The matter is momently expected to reach a decision by cable.

SOUTH AFRICAN TRAMWAYS.—Mr. J. E. Lloyd, manager of the Capetown electric traction system, is said to be at present purchasing quantities of electrical and miscellaneous supplies, etc., in this market. The Morris Electric Company, of New York City, have so far received orders for 5000 incandescent lamps (16 candle-power), 100 dozen oil headlights, 100 chimneys, etc.

ELECTRIC HEATERS.—The Manhattan Elevated, of New York, has awarded a contract to the Consolidated Car Heating Company to equip 1200 cars with apparatus for electric heating. Three hundred cars will be ready by Jan. 1, 1902.

PINIONS FOR BRAZIL.—The New Process Raw Hide Company, Syracuse, N. Y., has just made a shipment of 24 pinions to the Sao Paulo Light & Traction Company, of Sao Paulo, Brazil.

General News.

THE TELEPHONE.

OPELIKA, ALA.—The Opelika telephone exchange is being remodeled and the work is nearing completion. All the wires have been placed in cables.

SAN FRANCISCO, CALIF.—A private exchange system will soon be in operation in the Custom House and Appraiser's building. There will be connections with twenty-eight federal offices.

LOS ANGELES, CALIF.—Improved telegraph communication between the Pacific Coast and the East is a matter of the near future, which has been given official assurance. To meet the demand for better service it is announced that two new copper wires will be in service between San Francisco and Chicago, via the Santa Fe route, by Aug. 15, one to be used exclusively by the Western Union Company and the other by the railroad. The latter, however, will be available for commercial work when business calls for extra service.

WILMINGTON, DEL.—The N. Y. P. & N. Telegraph Company have completed their wires through the entire peninsula, and made connections with the Postal Telegraph Company in Wilmington. Offices in Delaware have been opened as follows: Smyrna, Dover, Harington, Bridgeville, Seaford and Laurel.

TUNBRIDGE WELLS, ENG.—The National Telephone Company, of Tunbridge Wells, England, has announced its intention of giving "an unlimited service for a penny a day" (two cents) to its subscribers in that town.

ROME, GA.—The City Council has passed a resolution instructing the fire committee to make certain improvements in the fire alarm system. New batteries, boxes and wires will, it is stated, be placed in position at once.

BOISE CITY, IDAHO.—Certificate of the increase of the capital stock of the Idaho Independent Telephone Company from $100,000 to $500,000 has been filed, and is made for the purpose of extending the company's lines.

TYNDALL, IA.—The new telephone line between Tyndall and Tabor and Bonhomme is completed. Bonhomme will be much benefited owing to the fact that the town is off the railroad.

MT. PLEASANT, IA.—This city will soon have the new Olds telephone line connections. The line is being built south through Swedesburg and a couple of miles south of Swedesburg a spur is being put up to Trenton.

CANTON, ILL.—The Central Union Telephone Company is engaged in installing a new office at Canton.

BLUFFS, ILL.—The Illinois Telephone Company has had its capital stock increased from $25,000 to $100,000.

ASTORIA, ILL.—The Central Union Telephone Co. will this fall put in cables owing to the increased business requiring so many wires.

LA SALLE, ILL.—The City Council has ordered the Central Union Telephone Company to remove its poles and other belongings within thirty days.

SALINA, ILL.—The telephone company has established toll stations at Salina and Circleville. Construction work is active also on other parts of the system.

CHICAGO, ILL.—The Chicago Telephone Company is now installing slot machine telephones in the twenty police stations supplied with public telephones.

DECATUR, ILL.—The Macon County Telephone Company, instead of using plain galvanized iron wire, has determined to use weatherproof iron wire for its circuits. Copper is better yet.

LAKE FOREST, ILL.—The Telephone Company, are putting in a new switchboard at their office here, and when completed will equip each patron with a long distance metallic circuit set.

OTTAWA, ILL.—From an exchange of a few more than 200 telephones a few months ago, the Ottawa exchange of the Central Union Telephone Company has jumped to over 800 telephones.

MT. CARROLL, ILL.—Frank Zinnel, proprietor of the Independent Telephone Company, has transferred a lot of poles and wire to Sabula and is ready to put in an exchange at that place. Mr. Zinnel has hopes of extending his line to Cedar Rapids.

OAK PARK, ILL.—Work on a $15,000 building to be erected in North Boulevard, near Wisconsin avenue, by the Chicago Telephone Company, has been begun. It will be built of brick and stone, and will be used as an exchange office for Oak Park, Harlem, River Forest and Maywood.

FARMER CITY, ILL.—The Farm & City Telephone Company, of Farmer City, have held their first meeting under the new organization since its incorporation. The new company is incorporated for $50,000. B. F. Wasson was elected president; S. W. Clay, of Atlanta, secretary, and L. B. Wasson treasurer.

POLO, ILL.—Farmers living between Polo and Hazlehurst and in that vicinity will soon have telephone service. The County Telephone Company, of Polo, which last spring organized with a capital stock of $20,000, has been industriously at work. Six hundred feet of cable has been put in the city of Polo to connect with the switchboard at the central office, which is located over the Chaddock store. The new switchboard has a 200 drop capacity.

CHICAGO, ILL.—Corporation Counsel Walker, in an opinion to Freeman K. Blake, chairman of the sub-committee of the judiciary committee of the Council, has held that "improved service" by the addition of a copper metallic circuit would afford no excuse in law to the action of the Chicago Telephone Company for charging $175 a year for a telephone when the maximum rate fixed by ordinance was $125 for business houses and $100 for a residence.

PARKER CITY, IND.—The Parker Telephone Company, Randolph County, has been incorporated with a capital stock of $2,500.

SOUTHPORT, IND.—The Central Union Telephone Company has about completed the putting in of an exchange and thirty private telephones in Southport and the vicinity.

LYNN, IND.—The Lynn Local Telephone Company, with a capital stock of $2,400, has just started. The system is Stromberg-Carlson, with 100 switchboard capacity. The circuits are of Roebling wire. S. C. Bowen is president, D. Hecker treasurer and W. E. Hinshaw secretary.

WABASH, IND.—The telephone line of the Strauss telephone system, which covers all Northern Indiana, was completed from Warsaw to this city on July 25. This fills in a gap that has existed for a year or more, and renders possible long distance communication from Indianapolis to the Northern State line by the independent direct line.

INDIANAPOLIS, IND.—Two new telephone companies have been incorporated by filing articles with the Secretary of State, the Paoli, Unionville & English Telephone Company, and the Clermont Telephone Company. The former is a modest concern with a capital of $1,000. The stockholders are numerous, however. The latter is more pretentious and has a capital of $10,000. B. F. Long heads the board of directors.

TOPEKA, KAN.—A competitive telephone system has been spoken of here, but the idea is not favorably received.

FRANKFORT, KY.—Articles of incorporation have been filed by the Jackson & Hazard Telephone Company, with a capital stock of $2,025.

YAZOO CITY, LA.—A new telephone line running from Yazoo City to Milestone, passing through Eden, Blake and Thornton, has been completed and connection made with the Mutual Company.

WEST PARIS, MAINE.—The Eastern Telephone Company has been granted the right to set its poles in Lewiston, and the line will soon be extended to this village. It will connect with the local wires in Paris, Sumner, Woodstock and Greenwood.

PORTLAND, MAINE.—The following officers have been elected by the New England Automatic Telephone Company. President and general manager, Lewis A. Goudy, of Portland; vice-president, William G. Nash, of Boston; clerk, Oscar H. Hersey, of Portland.

KINEO, MOOSEHEAD LAKE, MAINE.—The Mooschead Telephone & Telegraph Company has closed a contract with the New England Telephone & Telegraph Company, who will extend their line from Monson to Greenville, and the Moosehead company will build to Greenville from Kineo, via Spencer and Lily Bay.

BALTIMORE, MD.—By contract with the War Department the Maryland Telephone & Telegraph Company will shortly begin the construction of a line to establish telephone service between Forts Howard, Armistead and McHenry in the harbor entrance to Baltimore and all points served by the company's lines.

BALTIMORE, MD.—The Enterprise Telephone Company's lines in Montgomery and Prince George's counties are to be extended and to have connection with the Chesapeake & Potomac's long-distance lines. Long-distance transmitters will be placed on all of the former company's stations, including those in private residences.

WALKERVILLE, MICH.—The Lake Erie & Detroit River Railroad is laying a new telegraph line between Walkerville and St. Thomas.

DETROIT, MICH.—The Oakland County Telephone Company has been obliged to substitute cables in the place of bare wires in the alleys in the business portion of the town. Within the past four months 100 subscribers have been added to the list and there is constant demand for more telephones. The list has now almost reached the 500 mark.

LUDINGTON, MICH.—The Pere Marquette Telephone Company has been formed; capital, $30,000.

MANKATO, MINN.—The Mankato Citizens' Telephone Company have the toll line completed to Garden City township.

FLEMING, MO.—Telephone connections now exist between Fleming and Orrick.

PLATTSBURG, MO.—The Plattsburg Telephone Company, of Plattsburg, capital stock $10,000, has been incorporated by J. C. Atchison, F. R. Allen, E. E. Bowlin and others.

KANSAS CITY, MO.—A. H. Stoner, representing the Gamewell Electric Company, of Chicago, has made a proposition to the board of police commissioners to put in a police signal system to become the property of the city at the end of ten years. The proposition requires the payment of $10,000 cash, and a monthly rental of $6.40 per box for 120 months. The system will consist of 130 boxes, embracing all the police stations. The aggregate cost of the system will amount to about $87,000.

PAPILLION, NEB.—A local company has undertaken to supply Papillion with telephone service.

WINSTON, N. C.—The American Bell Telephone Company has about completed a twenty-eight-mile, long distance line, from Winston to Greensboro, N. C., where connection will be made with the main line of the company.

WALHALLA, N. D.—Langdon's local telephone line has been put in operation.

GRAND FORKS, N. D.—Work has commenced on building the underground telephone conduits, and under favorable conditions they may be completed in six months.

SYKESTON, N. D.—M. McConnell has taken a large crew of linemen out on the Bowden extension of the Northern Pacific, out of Sykeston, and will erect the new telegraph lines along the branch.

GRAND FORKS, N. D.—The Northwestern Telephone Company has commenced excavating preparatory to the erection of a two-story building. A crew of men has also been digging a trench for conduits for an underground service. The company will expend upwards of $25,000 before the ground freezes.

WOODSVILLE, N. H.—The Woodsville Telegraph Company has extended its lines to Lisbon.

SILVER CITY, N. M.—The Grant County Telephone Company now has a direct wire to Santa Rita, which greatly facilitates the transaction of business between that camp and Silver City. The company has 115 telephones in use on its system and is daily adding to the number.

TRENTON, N. J.—The Inter-State Telephone Company has filed with the Secretary of State a certificate increasing its capital stock from $100,000 to $5,000,000. The company has already acquired all the important telephone lines in New Jersey not already controlled by the Bell system, with the exception of two. These are the Eastern Company at Camden and the Independent Company at Atlantic City. Negotiations are already under way for the acquisition of these.

KANONA, N. Y.—The South Howard & Kanona Telephone Company, of Kanona, has been formed; capital, $220. Directors: Edward Stewart, Frank Conine and J. C. Barton, Bath.

ROCHESTER, N. Y.—The Rochester Home Telephone Company is at Mendon Center constructing a through line, direct from Rochester to Honeoye Falls. Connections will also be made with Mendon and Mendon Center.

TROY, N. Y.—Workmen have begun laying the conduits for the Troy Telephone & Telegraph Company. Superintendent Nicholson, who is in charge of the work, states that it will probably be a year before wires are run through the conduits.

FAYETTE, O.—The system of the Fayette Telephone Company was thrown entirely out of service by a severe wind and thunder storm a few days ago.

NAPOLEON, O.—The Napoleon Home Telephone Company, of Napoleon, O., is rebuilding its plant, putting in the latest and most modern equipment.

XENIA, O.—The Citizen's Telephone Company, of this place, has secured a good list of subscribers and will install a branch exchange at Yellow Springs.

AKRON, O.—The Akron People's Telephone Company is issuing a new directory, including Barberton and Cuyahoga Falls. The company has 2,400 telephones.

CHESTER, O.—Both the Columbiana County Telephone Company and the Central District & Printing Telegraph Company (Bell) have franchise applications pending before the Council.

BOWLING GREEN, O.—Stockholders of the Bowling Green Telephone Company have elected officers as follows: L. Black, president; J. B. Hickox, secretary; W. R. Brakwell, manager.

FREMONT, O.—The Fremont Home Telephone Company has declared a regular quarterly dividend of 1½ per cent. It has about 600 telephones in operation and the business is growing.

HILLSBORO, O.—The Central Union Telephone Company, of Hillsboro, O., has raised its rates in Clinton County to $1 per month for residences and $1.50 for business telephones with ten on a line.

TOLEDO, O.—Mr. F. M. Wartenbe, who recently resigned the position of manager of the C. U. Telephone Co., will locate in Toledo, where he expects to remain in the employ of the same company.

CINCINNATI, O.—Philip Fitzsimmons, by Probate Court declaration, has announced that he has conveyed to the Fitzsimmons Telephone Manufacturing Company all his rights to use the streets and alleys of the city for telephone purposes.

SPRINGFIELD, O.—Despite the fact the Springfield Home Telephone Company has secured a franchise from the Council, the Springfield Citizens' Telephone Company, which is headed by Philip Hounker, is still endeavoring to secure a franchise from the Probate Court.

ST. PARIS, O.—The St. Paris Telephone Company has declared a semi-annual dividend of 5 per cent. Extensive improvements to the system have been decided upon and will be made in the near future. The company intends to connect Rosewood, Carvesville, Millertown, Christianburg and a number of surrounding towns.

COLUMBUS, O.—The Central Union Telephone Company (Bell) at this point has announced a 20 per cent. increase in the salaries of all its operators and has reduced the working day to nine hours. About 100 girls are affected, and it is said that the same advance will be granted in other places where the company has exchanges.

PIQUA, O.—The right of way has been secured and the work of grading is now going on between Piqua and Minster by the Miami Valley Electric Railway Company. After this branch of road is completed they will secure the right of way west of Minster to Maria Stein and St. Roas, then back along the bank of the St. Mary's reservoir to Celina.

MILLERSBURG, O.—The Killbuck Telephone Company is making a second attempt to secure a local franchise despite the fact the Millersburg, Wooster & Orrville Telephone Company, an independent company, is giving satisfactory service. It offers lower rates than the latter company, and it is claimed that it is attempting to secure a franchise which will be turned over to the Bell company, which has no local exchange.

CINCINNATI, O.—The City & Suburban Telegraph Association of Cincinnati, which controls all the telephone properties in that city and the cities of Hamilton, O., and those across the river in Kenton and Campbell counties, Ky., has arranged to establish a complete branch exchange in the Exposition buildings at the Second Fall Festival, which opens at Cincinnati Sept. 16. The idea will be to demonstrate to the public the workings of a complete exchange of the common battery system. It will be connected up with the city and all long distance instruments.

FINDLAY, O.—The plant of the Findlay Home Telephone Company, which has just been completed, was formally turned over to the company a few days ago by the North Electric Company, who installed it. The plant was inspected by C. H. Ledlie, of St. Louis, who pronounced it to be one of the finest plants of the size in the country. The company has appointed as general manager of its business Mr. A. C. Morse, formerly with the Federal Telephone Company as a district superintendent. The new system is controlled by the Federal Telephone Company.

GUTHRIE, OKLA.—The Topeka & El Reno Telephone Company was chartered July 27. The capital stock is $10,000. Directors: W. F. Evans, Topeka, Kan; H. B. Low, Fort Worth, Tex.; F. H. Wright, G. W. Bellamy and O. O. Blake, of El Reno.

OSAGE, OKLA.—The Osage & Eastern Oklahoma Telephone Company, with County Treasurer J. H. Clapp president, has just been notified by the Interior Department at Washington that it has been granted a permit to erect, establish and maintain a telephone system in the Osage reservation.

[illegible] to try an experiment with the Marconi system of wireless telegraphy in the city of Kingston, Ont. One of the instruments will be placed on Garden Island and the other in Kingston.

FLORENCE, ORE.—A contract has been awarded to H. H. Fish to build a telephone line from Florence to Acme. The line may soon be extended to Mapleton and Eugene.

MARK CITY, PA.—The Bell Telephone Company has established communication with Gettysburg. The new line is now open for business.

SILVERDALE, PA.—The Borough Council has granted the Standard Telephone Company the privilege of erecting poles through the town.

YORK, PA.—The Highland Telephone Company, which system embraces the Delta franchises, has declared a dividend of 3 per cent for the past six months.

WILLIAMSPORT, PA.—The directors of the Central Pennsylvania Telephone & Supply Company, of this city, have decided to consolidate with the Bell Telephone Company, of Harrisburg.

LIONVILLE, PA.—The Bell Telephone Company has now been rebuilt from Whitford to Lionville, with new poles and new copper wire, and is in first-class condition. It has been extended to Upper Uwchlan, where an exchange has been put in.

READING, PA.—The work of extending the Valley telephone system to Reading has been completed to a point near the city limits. This is a part of the Consolidated Telephone Company system, which is to embrace many counties in Eastern Pennsylvania.

COLUMBIA, S. C.—Practically all the telephone lines in this sections have been bought by the South Carolina Telephone Company, with headquarters at Columbia. This gives Batesburg, Leesville, Lexington, Johnston, Ridge Spring, Saluda and Edgefield telephone communication with the Capital City.

ALEXANDRIA, S. D.—The North telephone line, as now completed, has sixteen miles of wire up and accommodates seven subscribers, but many more are expected.

MITCHELL, S. D.—Poles have arrived for the construction of a telephone line from Mitchell to Woonsocket. The contractors agree to have the line completed by Sept. 1.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company has completed the laying of its conduits on Commerce Avenue and the connecting alleys. The experiment has proved so satisfactory that the company has decided to considerably extend its conduit system.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company has issued statement of its business for the month of June, 1901. The total number of subscribers June 1, 1901, was 65,691, and the net increase during June of 1,069, making 66,760 June 30.

SAN ANTONIO, TEX.—B. S. Bailey, of Wauseon, O., has just completed putting in new telephone systems at San Antonio, Tex.

EL PASO, TEX.—A $50,000 company has been organized in Cleveland, O., to install the telephone system for which franchise was granted recently to Mrs. Britt, of Chicago.

VERNON, TEX.—A company has been organized here to build a telephone line from this place to Quanah and Crowell, Tex., and Altus and Enid, Okla. Work will be begun at once.

FORT WORTH, TEX.—Representatives of seventeen independent telephone companies and exchanges in Texas, Indian Territory and Oklahoma have formed a permanent organization, with Ed Nims, of Roff, I. T., as president, and O. C. Betz, of Corsicana, as secretary. The telephone situation in Texas, Oklahoma and Indian Territory and extensions to the stock ranch region were fully discussed.

LEXINGTON, VA.—The Mutual Telephone system has been much damaged by storms.

SPOTTSYLVANIA, VA.—The work of stringing the wire and putting in the telephones on the line of the Spottsylvania Telephone Company from this point to Belmont and Lewiston has begun, all the poles now being in place.

SCOTTSVILLE, VA.—Mr. J. W. Gulley, of Staunton, is getting rights of way for the Virginia Long-Distance Telephone Company, with a view to putting in a line from Staunton to this place, then on to Richmond, taking in the most important points between.

LA CROSSE, WIS.—The new underground fire alarm system has been completed.

MONTELLO, WIS.—The telephone company has placed a new 100-drop switchboard at the central office in this village.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company has let contract for the distribution of the telephone poles to be used in the construction of the new line between Cheyenne and Casper.

LA CROSSE, WIS.—The Wisconsin Telephone Company is figuring on an exchange at West Salem, Wis. The present service on the toll board is said to be very poor, and the patrons there are desirous of having something better.

EAU CLAIRE, WIS.—The Osseo Telephone Company has been granted a franchise to construct a telephone system in Eau Claire. The plant is to be in operation in a year's time. A clause in the franchise prohibits it combining with any existing company.

BILLINGS, WYO.—The Wyoming extension of the Rocky Mountain Bell Telephone Company's lines is now being built between Billings and Big Timber. It will be built to Laurel, Red Lodge and Bridger this year and the remainder of the work will be left until next year.

SHEBOYGAN, WIS.—Alderman Teenies has prepared a series of rules and regulations for the granting of telephone franchises which will be adopted by the Council. The maximum rate of a rental for business houses must not exceed $2.50 and for private residences $1.50 a month.

ELECTRIC LIGHT AND POWER.

MOBILE, ALA.—The consolidation of the Mobile Light & Railroad Company, the Electric Lighting Company of Mobile and the Mobile Gas Light & Coke Company will take place Sept. 1. The consolidated company will adopt the name and charter of the Mobile Light & Railroad Company. The amount of capital stock and of the bonds to be issued by the consolidated company will be fixed at the time of consolidation—Sept. 1.

CAPE NOME, ALASKA.—A complete electric light plant is to be installed at Nome by Capt. F. N. Selberg, who is now purchasing the machinery for the plant. Equipped and in operation the plant will cost about $25,000. It will be owned and operated by the Nome Electric Light & Power Company, with Capt. Selberg as superintendent. Associated with him are some of the richest men in Nome. Every dollar of the stock is owned by Nome men. The company secured the necessary municipal franchise this spring, and last fall, before the granting of the light privileges, the poles were erected. It is expected to have the plant in operation by Sept. 1.

LOS ANGELES, CALIF.—The Equitable Gas & Electric Company was recently incorporated, with Los Angeles, Calif., as the principal place of business. Directors: S. A. W. Carver, A. Kinney, W. J. Washburn, J. D. Pope, W. F. Botsford, J. A Winans and W. L. Gillenen, all of Los Angeles. Capital stock, $1,000,000; subscribed, $8,000.

KESWICK, CALIF.—When the Keswick Power Company switches on its current its largest customer will be the Mountain Copper Company, of this place, which is the largest consumer of stationary power in Northern California. A large brick power station will be built at the smelter. Electricity will largely supersede the use of petroleum, which for the past year has been the chief fuel used by the smelter company.

BERKELEY, CALIF.—The Bay Counties Power Company, recently filed an application for a permanent franchise allowing it the right of running wires through Berkeley, Calif. The company has already run its pole line through the town under temporary franchise. The privilege is asked of maintaining wires in several streets for 99 years, the town to receive 2 per cent. of the gross receipts after five years. It is said that the Berkeley Electric Light Company has secured an agreement from the Bay Counties Company not to compete for local lighting for the first five years.

GEORGETOWN, COLO.—The new 50-ton concentrating mill of the Red Oak Company has started up and is operated by electric motors. Mrs. Teagarden, of Denver, turned on the electric current to start the machinery. The ore steadily improves in quantity and values, and a production of 100 tons per day will be an easy matter. The streak of solid lead ore is six feet wide, and there is an immense body of concentrating ore in connection with it. It is one of the biggest mines ever opened in Clear Creek County, and electric power has proved invaluable in developing it.

PARIS, FRANCE.—A $90,000 electric-lighting system is to be installed in the Church of Notre Dame in Paris.

GAINESVILLE, GA.—The Gainesville Power & Light Company has been chartered with a capital stock of $100,000. The stockholders are: F. L. Murray, Chicago; J. Spaulding, Atlanta; S. C. Dunlap, Z. T. Castleberry, H. H. Dean, Howard Thompson and C. E. Kimbrough.

INDIANAPOLIS, IND.—The Board of Public Works is advertising for bids for public electric lighting. The amended specifications, free from discrimination and with the confiscation clause stricken out, has been submitted to the local companies. No further resort to the court will be had.

JEFFERSONVILLE, IND.—The question who exactly owns the local light plant is doubtful. J. J. Walsh, who was the nominal president, is acting as receiver. The plant was built to sell to the city on the municipal ownership plan. Charges of bribery were made against members of the Council and the people repudiated the deal.

RICHMOND, IND.—An injunction suit has been brought in Richmond, Ind., by the Richmond Heat, Light & Power Company against the city of Richmond to enjoin the muicipality from erecting its own light plant. In the petition of the plaintiff it is averred that the municipality entered into a contract with it for it to furnish light for the city for a term of years.

CLINTON, ILL.—The electric light company of Clinton will furnish about 600 incandescent and twenty arc lights for the street fair.

COVINGTON, LA.—The St. Tammany Ice & Manufacturing Company, Limited, has its electric light plant in operation, and it gives perfect satisfaction.

MINNEAPOLIS, MINN.—The light committee of the Council is preparing to take up the matter of granting a franchise to the Black River Falls company to run wires into the city for the purpose of furnishing power for running small plants.

GLOSTER, MISS.—Work will soon begin on the electric light plant and water works.

BROOKFIELD, MO.—The Brookfield Gas, Electric & Heating Company, of Illinois, has filed evidence of incorporation, with a capital stock of $25,000, the capital to be employed in Missouri.

ST. LOUIS, MO.—A lighting contract was awarded by the Board of Public Improvements July 30. The Laclede Gas Company was awarded the lighting contract for one district for $8,000 and the Missouri Edison the other for $30,000. There was but one bid for each district and the contracts were awarded to the companies at their bids, which are lower than last year's prices.

ST. LOUIS, MO.—James Campbell, vice-president of the Laclede Gas Light Company, who has been engineering the deal for the sale of a controlling interest in the company to an Eastern syndicate, has announced that the deal is off. He stated that he had received a telegram July 31 from the president of the company, Emerson McMillin, to the effect that the syndicate which contemplated purchasing the Laclede Gas Light Company will be unable to pay certain money which was due Aug. 1, and asked for an extension. This Mr. Campbell was unwilling to grant, so wired that the deal was off.

NASHUA, N. H.—The annual meeting of the stockholders of the Nashua Light, Heat & Power Company was held recently. The following officers were elected by the directors: F. W. Estabrook, president; J. H. Tolles, clerk; Elbert Wheeler, treasurer; Walter F. Norton, superintendent of gas department; George L. Sadler, superintendent of electrical department.

PLYMOUTH, N. H.—The Plymouth Electric Light Company has held its annual meeting and some changes in the board have been made. James M. McCoy and Fred P. Weeks have come into control by buying up recently a majority of the stock, so that better results may be looked forward to in the near future. James N. McCoy was elected president, George H. Adams, clerk; Frank C. Calley, treasurer. It was voted that after Sept. 1 all users of electric lights would pay for their lights by meter.

POINT PLEASANT, N. J.—The Point Pleasant Light Company has won its fight to string wires in the borough of Bay Head, its right to do so having been questioned by the borough authorities.

TRENTON, N. J.—The Citizens' Light & Power Company has been incorporated at Trenton with an authorized capital of $1,500,000. Incorporators: William A. Jones, Melville A. Carpenter and Joseph B. Short, all of Newark.

POUGHKEEPSIE, N. Y.—The Consolidated Electric Light, Heat & Power Company, of Poughkeepsie, has been formed; capital, $200,000. Directors: James W. Hinkley, P. Frost Spaulding, Silas Hinkley and John Doheny, Poughkeepsie; William K. Roy, Wappingers Falls.

WARREN, O.—T. W. and E. W. Gilmer have been granted a franchise to erect and operate a steam heating and electric lighting plant.

COLUMBUS, O.—Judge Bigger, of the Common Pleas Court, has refused to issue an order restraining the Department of Public Work from issuing bonds in the sum of $110,000 for the purpose of building a city lighting plant.

YOUNGSTOWN, O.—Park & Hamilton, acting for the Penhale-De Vitt syndicate, which controls extensive lighting and railway properties in this vicinity, have secured options on the properties of the Greenville Electric Light & Steam Company, the Greenville Gas Company and the Greenville Water Works. The options are for sixty days and the price asked for the properties is said to aggregate $250,000.

TIFFIN, O.—The Tiffin, O., Light & Fuel Company, the Tiffin Electric Light Company and the Tiffin Gas Light Company have been consolidated. The new company will be known as the Consolidated Gas & Light Company. Besides the Tiffin concern the new company owns plants at Delphos, New Bremen and Minster, O. The incorporators are M. B. Dailey and C. F. M. Niles, of Toledo; D. M. Kirtley and J. H. Barr, of Detroit, and W. H. Dore, of Tiffin.

CINCINNATI, O.—The Business Men's Club, of this city, has begun the agitation of a question concerning an improvement of the local manufacturing situation as regards power facilities. New concerns locating here find their greatest difficulty in securing power. It has been suggested to the Cincinnati Gas & Electric Company that they fit up their smaller electric light plants, now being abandoned, and lease them to the medium and smaller manufacturing concerns that need power. The suggestion will probably be adopted.

BOWLING GREEN, O.—The Bowling Green Light & Power Company has secured a ten years extension of its franchise from Nov. 27, 1901. It has also renewed its contract with the city to furnish fifty-eight arc lamps at the rate of $7 per month and incandescents to be furnished private consumers at a rate of not more than ten cents per 1000 watts and $1 per month to be the minimum price. The company agrees to maintain a separate plant for lighting service so that the electric railway service will not interfere with the lighting circuit. New equipment will be installed at once.

CANTON, O.—A syndicate of capitalists supposed to be Detroit people are quietly working in Ohio to secure control of the lighting plants in a number of the leading centers. It is said that the company is to be known as the Electric Company of America, and it has been announced that it has secured a controlling interest in the property of the Canton Light, Heat & Power Company. Particulars of the deal have not been given out. At Fremont it is claimed the same people have secured control of the Northwestern Ohio Natural Gas Company, the Fremont Gas Company and the Fremont Electric Light & Power Company. It is stated that the new company will erect an extensive gas and power plant. The Fremont Electric Light & Power Company has recently closed a city contract to furnish light for ten years at $70 per year. It is said that the same people are negotiating for plants at Marion, Bellevue, Bowling Green, Massillon and other places.

LEBANON, ORE.—The town of Lebanon, Ore., recently closed a contract for lighting the streets with 1200-cp arc lamps, at the rate of $6.75 per light per month, on a twilight to daylight schedule.

KLAMATH FALLS, ORE.—The Klamath River Irrigation & Electric Company has completed its plans for taking water from the Klamath River for irrigating and generating electric power. The company, which was organized by J. F. Goeller, C. C. Maltey and E. J. Boyd, will install an electric light and power plant, with headquarters in Klamath Falls, Ore. The capital stock is $350,000.

PITTSBURG, PA.—The Edgewood Light, Heat & Power Company has been formed; capital, $1,000.

MERCHANTVILLE, PA.—The electric light system is now installed, and the streets are lighted by electricity for the first time by the arc system.

RED LION, PA.—At a recent election the stockholders of the Electric Light Company voted to increase their capital stock from $8,000 to $20,000. Work on the new plant is being pushed along vigorously.

SCRANTON, PA.—The charter for an electric light company has been applied for by a company, at the head of which is Mr. Allen, secretary of the International Correspondence Schools Company. The new concern will secure franchises from the boroughs of Dalton, Clark's Summitt, Clark's Green, Waverly, Glenburn and Factoryville. It is intended by the concern to provide all of the towns north of the mountain with electric light accommodations. The plant to generate the power will be located at Dalton and the lights will be incandescent.

RENOVO, PA.—The Pennsylvania Railroad Company will erect an immense new electric light plant on a site north of the blacksmith shop at Renovo in the near future. Besides furnishing electricity for lighting purposes throughout the shops, yards and Renovo passenger station, power will also be obtained to run some of the machinery in the machine and blacksmith shops.

LAKEWOOD, R. I.—Within a comparatively short time Lakewood will have electric lights. Locations have already been selected, and so soon as the poles can be fitted with arms the lights will be installed.

WAVERLY, TENN.—A charter has been granted an electric light company, which will put in a plant at an early date.

MT. PLEASANT, TEX.—The electric light plant has been destroyed by fire and all of the machinery ruined, which leaves the town in darkness for an indefinite period. The loss is estimated at $6,000, with only partial insurance.

RICHMOND, VA.—The new electric light plant for the city is nearing completion and will be ready for operation by Aug. 5. It will be an up-to-date plant in every respect.

CEDARBURG, WIS., will soon be lighted by electricity.

GRANTSBURG, WIS.—A $15,000 electric light plant will be established here.

JANESVILLE, WIS.—The Janesville Electric Company has let contracts for entirely duplicating its plant.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—It is announced that the proposed sale of the Huntsville Electric Railway & Power Company to Baltimore parties has been confirmed. The system may be extended.

ATTALLA, ALA.—The Gadsden & Attalla Union Railway, an electric line between the above-named towns, has been sold. The purchasers were W. H. Weller and C. D. Ward, of Gadsden.

BIRMINGHAM, ALA.—George H. Davis, of New York, has reached Birmingham, and is ready to proceed with the $1,000,000 improvements contemplated by the Birmingham Railway, Light & Power Company, this company having recently absorbed the Consolidated Electric Light Company and the Birmingham Gas Company.

OAKLAND, CALIF.—It is reported on good authority that the Oakland, San Leandro & Haywards Electric Railway has passed into the control of W. G. Henshaw, president of the Union Savings Bank, Oakland, Calif.

SAN MATEO, CALIF.—The San Mateo Electric Railway Company, with headquarters in San Francisco, recently gave a statement to the State Board of Equalization, George E. Starr, secretary and treasurer, to the effect that $125,000 had been spent during the past year in improving the system. It is contemplated during the present year to extend the line from the present terminus to San Mateo, via Baden, and within a month cars will be put on to run to the end of the line at forty miles an hour, competing with the Southern Pacific Railroad.

ATLANTA, GA.—The Atlanta Railway & Power Company will file applications for extensive improvements in its tracks. Improvements in eight localities are projected.

GREENFIELD, IND.—A new depot is being erected here, and the electric line running into Spring Lake Park is being lengthened.

MUNCIE, IND.—The City Council has granted a franchise to the Newcastle & Greenfield Electric Company to enter the city with its line.

WABASH, IND.—The first cars of the Wabash River Traction Company have been run over the line. The cost of the road is somewhat in excess of $300,000.

MUNCIE, IND.—A mass meeting of farmers of Delaware and Henry counties has been called by the stockholders of the Muncie & Greenfield Electric Railway. The object is to impress the farmers with the importance of the road and to secure rights of way.

INDIANAPOLIS, IND.—A project is on foot by local capitalists for buying about two hundred acres of land in the northwestern corner of Hancock County and the northeastern corner of Marion County and converting it into a beautiful park. Either the Citizen's Electric line or the Indianapolis-Anderson Interurban line will build a road.

FT. WAYNE, IND.—General Manager Nelson, of the Ft. Wayne & Southwestern Traction Company, announces that cars will be running regularly between this city and Huntington soon; that the entire twenty-five miles of rail will be done by the 1st of August. He has been over the proposed extension from Huntington to Marion, via Wabash, Laro and Andrews.

INDIANAPOLIS, IND.—General Superintendent Ralph Peters, of the Pennsylvania lines, has been consulting with traffic officials in Indianapolis concerning an electric line to Martinsville. The Indianapolis & Vincennes track will be used. The constitution of the electric cars is to anticipate the Martinsville & Indianapolis electric line now being built. Arrangements are also under way to equip the Springfield and Xenia (Ohio) branch with electricity.

INDIANAPOLIS, IND.—The long talked of deal is finally closed and contracts have been made for the construction of the Indianapolis & Logansport interurban road, a New York capitalist having agreed to take the $2,000,000 of the bonds for $1,500,000, and to begin construction Aug. 1. A private right of way is secured for the most part. The road will be sixty-seven miles long and will connect a score of good towns and cities and pass through six of the best farming counties of the State.

LEXINGTON, KY.—A novel sight witnessed here July 26 was furnished by women acting as street car conductors. Fares were collected by girls of the various society sets. The affair was in the interest of Christ Church Guild, and street car parties were the particularly swell thing.

[illegible] granted permission by the State Railroad Commissioners in Boston to run its tracks over private land in Lanesboro.

NILES, MICH.—Charles Chapin is preparing to utilize the power to be derived from his Buchanan dam for electric street railway purposes. The contract has been let for the enlargement of the race and the building of a new power house. The contract for a new electrical apparatus and water wheel was let a few days since.

JEFFERSON CITY, MO.—Secretary of State Cook has chartered the Inter-States & Leavenworth Railway Company, of Kansas City, with a capital of $500,000. The company is to operate a street railway in Kansas City and Jackson County, Mo., in Kansas City and Wyandotte County, Kan., and in Leavenworth and Leavenworth County, Kan.

RUTHERFORDTON, N. C.—Decatur Morrow is interested in a proposition to build an electric line to Chimney Rock, N. C., so that Asheville, N. C., can extend its electric line to that point, twenty-five miles, giving a railway from Asheville to Rutherfordton, connecting with the Seaboard Air Line. The estimated cost of the line is $400,000.

WILMINGTON, N. C.—It is reported that the Wilmington Seacoast Railroad to Wrightesville Beach has been sold to a syndicate and will be electrified. It is also thought that this is the first move in consolidating the line with the Wilmington Street Railway and the Wilmington Gas Light Company under a company headed by Hugh MacRae. Such a consolidation was authorized by the Legislature two years ago.

SYDNEY, N. S.—A Boston, Mass., syndicate has recently bought the ferries running between Sydney and North Sydney, in Cape Breton, Nova Scotia, as well as the Sydney electric light plant. The syndicate will at once commence the construction of an electric railway between Sydney and Glace Bay at a cost of $750,000.

PAINESVILLE, O.—The Fairport branch of the Cleveland, Painesville & Eastern Railway has been opened for business.

COLUMBUS, O.—The Newark, Zanesville & Coshocton Railway Company has applied to the State for lease of canal property.

GIBSONBURG, O.—Work has been started on a four-mile spur line from this place to the main line of the Toledo, Fremont & Norwalk Railway.

COLUMBUS, O.—The Columbus Railway Company is building at its shops here several large double truck cars for the Columbus and Westerville line.

WAUSEON, O.—The Fulton County Commissioners have granted a franchise through the county to the Toledo & Bryan Air Line Railway Company.

MT. GILEAD, O.—James Berry, a prominent business man of this place, is organizing a company and is securing right of way to build a line from Marion to Mt. Gilead.

STEUBENVILLE, O.—The Steubenville Traction & Light Company has awarded contracts for the erection of a new car barn and a new power house and repair shop.

DAYTON, O.—The Dayton & Northern Traction Company has completed the work of laying rails between Dayton & Greenville, and wires are being strung. The road will be in full operation before Aug. 15.

TIFFIN, O.—The Tiffin & Port Clinton Railway Company has won an important case where it brought suit to condemn land for electric railway purposes. It will have the effect of settling other similar cases.

HAMILTON, O.—Peter Schwab and others who are interested in the Southern Ohio Traction Company have organized the Eastern Indiana Traction Company to build a road from Richmond to Portland, Ind.

CINCINNATI, O.—The Traction Company is arranging to abandon one of the oldest lines in the city, the old Sycamore Street cable. Electric power will be substituted and the Sycamore Street Hill part abandoned.

RAVENNA, O.—The extension of the Northern Ohio Traction Company between this place and Kent is nearly completed and the line will be placed in operation the latter part of August in time for the annual county fair.

CLEVELAND, O.—R. Rosenstock & Company, engineers for the Findlay & Southern Railway Company, are completing plans and specifications for the equipment of the road and power house. Bids will be called for shortly.

CHILLICOTHE, O.—Grading has commenced on the Chillicothe & Hillsboro Traction Company's line. The contract for grading the Scioto Valley Traction Company's road to connect Chillicothe and Columbus has been let.

TOLEDO, O.—President Detwiler, of the Toledo & Maumee Valley Electric Railway Company, has announced that both lines operated by the company are to be double tracked, and that there is now no intention of selling the road.

THE CINCINNATI, O., ORPHAN ASYLUMS are to benefit at the hands of the Cincinnati Traction Company. The company furnishes special cars free and pays all expenses, including refreshments, on certain days of the week.

SPRINGFIELD, O.—H. W. Frey, of Springfield, and M. H. Collins, of South Charleston, are securing right of way for a road to extend from Springfield to Washington C. H., by way of South Charleston, Sedalia and Bloomingburg.

COLUMBUS, O.—The Columbus, Newark & Eastern Railway Company and the Columbus & Granville Traction Company have applied to the County Commissioners for a franchise over practically the same route between Columbus and Granville.

BRIDGEPORT, O.—S. White, of Mt. Pleasant, who has been promoting a line from Cadiz to Bridgeport, is reported to have consolidated his project with the Ohio Rapid Transit Company, which proposes to build from Martin's Ferry into Wheeling.

AKRON, O.—The Northern Ohio Traction Company has commenced construction work on its line to Massillon and Canton. The company has been unable to secure a franchise in Canton, but it has gained an important point in this direction.

VERSAILLES, O.—The people of this place are agitating in favor of an electric road. Right of way has already been secured through Bradford to Webster, nearby towns.

MARIETTA, O.—The Parkersburg & Marietta Electric Railway Company is advertising for bids for the construction work on twelve miles of line. C. H. Shattuck is president and J. M. Jackson, Parkersburg, W. Va., chief engineer for the company.

LEESBURG, O.—T. H. Hogsett, H. M. Huggins, A. Z. Blair and James McDermott have incorporated the Hillsboro & Ohio River Traction Company. They will build a line from Xenia to the Ohio River by way of Wilmington, New Vienna and Hillsboro.

DAYTON, O.—Col. George B. Kerper has resigned as general manager of the People's Railway Company, of this city, to devote his entire attention to the work of the Toledo, Bowling Green & Southern Railway, of which he has recently become chief owner.

NORWALK, O.—The City Council has granted a franchise to the Norwalk, Ashland & Southern Railway Company, enabling its line to enter the center of the city. The road will extend from Norwalk to Ashland, passing through North Fairfield, Fitchville and New London.

PIQUA, O.—Both the Western Ohio Railway Company and the Miami Valley Railway Company are pushing construction work on their lines north of this place. The roads will parallel each other for some distance, the former extending to Sidney and the latter to Minister.

CLEVELAND, OHIO.—The Hillsboro & Ohio River Traction Company has been incorporated by Henry M. Huggins, of Cincinnati; Thomas H. Hogsett and Charles Orr, of Cleveland, and Monroe Warner, James E. McDermot and O. Z. Blair, of Hillsboro. Capital stock, $10,000.

MARTIN'S FERRY, O.—The Steubenville, Mingoe & Ohio Valley Traction Company, the Wheeling Traction Company and the Ohio Valley Rapid Transit Company have applied for franchises in this place. It is probable that franchise will be granted giving all three joint use of the desired track.

COLUMBUS, O., is to have another electric railway, the Findlay & Southern, connecting Mt. Victory, Sommersville, Broadway, Marysville, Plain City and Columbus. Twenty-five-year franchise has been secured in Marysville and right of way through Union County. The road is to be completed by July 1, 1902.

COLUMBUS, O.—The contract for building the first section of the Scioto Valley Traction Company, between Columbus and Circleville, has been let to W. H. Luchtenburg, of Columbus, and F. B. McKinnon, of Toledo. A contract for the line between Ashville and Circleville was awarded to Row & Mowery.

HAMILTON, O.—The Hamilton, Glendale & Cincinnati Traction Company, a part of the Millcreek Valley Company, operating through lower Ohio towns into Cincinnati, will operate through the city of Hamilton. When completed the road will give a through schedule from Fountain Square, Cincinnati, to the Butler County seat.

COLUMBUS, O.—After waiting months for rails, the Columbus Railway Company has secured a large shipment and is pushing construction work with a large force on the Mt. Vernon Avenue line extension, which will connect at the city limits with the Columbus, New Albany & Johnstown Railway, now in process of construction.

TOLEDO, O.—The Michigan & Ohio Electric Railway Company, of which W. I. Robinson, of Detroit, is president, has placed conrtacts for grading; work to start within thirty days. The road will extend from Toledo to Maybee, Belleville, Romulus, Taylor and Encorse, Mich., with a branch to Detroit, and will have sixty-one miles of track.

TOLEDO, O.—The Everett-Moore syndicate, which now controls the properties of the Toledo Traction Company, has just purchased a tract of land 340 ft. on Beach Street and 100 ft. on Superior and Huron streets, on which will be erected an office building, freight and passenger station. It will be utilized by all the roads entering Toledo. Plans for the building are under way.

CLEVELAND, O.—Officials of the Cleveland & Eastern Railway Company, which is now dominated by the Everett-Moore syndicate, have incorporated the Chagrin Falls & Lake Erie Railroad Company, capital stock $100,000, for the purpose of building a line from Chagrin Falls to Willoughby, following the beautiful Chagrin River valley. It will connect three of the lines already in operation.

CINCINNATI, O.—Expert engineers and electricians of the traction company are planning to put all city lines underground. The cost, as estimated, will be about $1,000,000. The subject has been agitated by the street car people considerably of late years; the many steep grades which surround the city on all sides offering obstacles that have been believed by experts to be insurmountable.

COLUMBUS, O.—The Columbus, Buckeye Lake & Newark Traction Company has applied for further leases along the canal between Hebron and Newark. It has been found that for nearly two miles the road is on State canal property, whereas is has been supposed to be highway. The company has erected poles and strung wires for 7742 ft. on the road and wants the privilege of letting them remain where they are.

CINCINNATI, O.—The Cincinnati Traction Company will erect a magnificent fifteen-story home in that city, at the southeast corner of Fifth and Walnut streets, a commanding site. The building is to be patterned after that of the Widener-Elkins structure in Philadelphia, will cost $1,000,000 and be of steel frame construction, granite base and pressed brick and stone. The selected site is just across the way from the present offices, where the occupants are greatly cramped for room. The company gets a perpetual lease, with privilege of purchase at the end of twenty years, standing the company an annual rental of over $20,000.

LEGAL.

COMMON CARRIERS.—It has been decided by the Supreme Court of North Carolina that telephone companies are common carriers. They cannot discriminate by refusing to put their facilities at the disposal of any person who may offer to pay the usual charge for such service.

SUIT AS TO PATENT POLES.—Mr. John Mayer has filed suit in St. Louis for an injunction and accounting against the Imperial Electric, Heat, Light & Power Company and Lee G. Bruckman, general manager of the company, in the United States Circuit Court July 31. Mr. Mayer claims that he is the patentee of the poles used by the company for the suspension of their arc lights at street corners. Mr. Mayer charges that the Imperial is manufacturing and using these poles unlawfully.

THE AUTOMOBILE.

NEW YORK STATE.—The law enacted at the last session of the Legislature regarding automobiles has gone into effect. It limits the speed of all power vehicles to twelve miles an hour in cities and fifteen miles on the country roads. If the driver of a horse holds up his hand when meeting an automobile the chauffeur must stop instantly. A penalty of not more than $200 is attached to the statute.

TRIP TO TEXAS.—Mrs. Sarah Elizabeth Clark Decker and her husband have started from New York on a 2,000-mile trip to Beaumont, Tex., in a gasoline automobile. The route announced is to Jersey City, and through Asbury Park, Philadelphia, Washington, Richmond, Charleston, Macon, Pensacola, Mobile and New Orleans. The couple expect to complete their long ride in about seven weeks, making no effort to establish a speed record.

PERSONAL.

MR. H. BEVES, of the General Electric Company, Limited, of England, has returned to that country after a short stay on this side.

MR. J. E. Townsend, formerly manager of the Lima Electric Light & Power Company, has been appointed general manager of the lighting department of the Northern Ohio Traction Company.

PROF. GUSTAVE GILLON, of the University of Louvain, Belgium, has arrived in this country on a mission from the Belgian Government, and will make a study of electric railway development and electrical transmission of power.

MR. J. F. COLEMAN has resigned his connection with the City Engineer's Department of New Orleans in order to devote his entire time and energies to the business of the firm of Coleman & Malochée, consulting engineers of that place.

MR. J. E. WILSON, for nine years with the Pettingill-Andrews Company, and more recently with the Stuart-Howland Company, has organized the Electric Supply & Maintenance Company, 476 Eight Street, Troy, N. Y., of which company he is president.

GEN. EUGENE GRIFFIN, vice-president of the General Electric Company, has just made a flying trip to this country from England, where for some time to come he will find his most active occupation in connection with the British Thomson-Houston Company.

TRACY—TANNER.—The marriage of Mr. A. R. Tracy, electrical engineer to the State schools, at Faribault, Minn., to Miss Emily R. Tanner, took place last month at Minneapolis. The happy pair then left by way of the Great Lakes to spend a week at the Pan-American.

MR. L. TRUDEAU.—A cablegram has been received by Mr. L. Trudeau, of the Montreal Electric Street Railway, from Mr. Duncan McDonald, manager of the Paris street railway system, and formerly of Montreal, offering Mr. Trudeau the position of superintendent of tramways at Bordeaux.

SENOR ANGEL OLAZAGASTI, superintendent of the city electric lighting plant at Ponce, Porto Rico, was in Columbus, O., recently. He is making an inspection of the latest improvements in American electrical machinery and expects to make some purchases of new equipment for his plant.

MR. EPES RANDOLPH has been appointed general manager of the Los Angeles & Pasadena Electric Railway, which operates the Pacific Electric Railway and the Pasadena & Mt. Lowe Railway. Mr. Randolph's management will extend over all these roads. This appointment took effect Aug. 1.

MR. F. W. CH. JANISCH, engineer of works, etc., of the Siemens & Halske Company, of Berlin, is now visiting this country and hopes to spend a few months here inspecting and studying American methods and machinery. The company are in process of greatly extending their plant despite the generally dull times in Germany.

MR. S. C. THAYER, formerly president and general manager of the Columbiana County Telephone Company, Ohio, and until recently prominently identified with the Century Telephone Construction Company in its work in New York, has become general manager of the Bradford County Telephone Company at Tonawanda, N. Y.

MR. NELSON P. HUTCH, of Milwaukee, Wis., recently inspected the power possibilities of the Chats Rapids, near Ottawa, with a view to development. This magnificent, undeveloped power has been attracting great attention of late, and it will probably be all utilized before very long. It is one of the finest powers on the Ottawa River.

MISS HATTIE H. BEALS, telephone operator at Wichita, Kan., has won a homestead worth $25,000 in the Government distribution of land grants by lottery in Oklahoma, and she is going to mary C. V. Akerland, a trolley car conductor, at Wichita. Thus the good gifts of fortune will all remain in the electrical family, and neither of the happy pair will say "hello!" or "step lively!" hereafter.

MR. W. S. STROWGER, of Rochester, N. Y., who recently heralded a new storage battery, is now very enthusiastic about his "new liquid gas." It is

stated that he "has succeeded in liquefying it at pressure and in producing it by cold chemical process. He can also compress it so that a quantity can be placed in a bottle, and by placing a pipe, with a gas burner on top, the tap may be turned and a brilliant light will result, just as though the regular gas of commerce were being used."

MR. FRED BATHURST returned to England last Wednesday, as noted, on the steamship *Teutonic*, after a professional tour of some weeks, during which he informed himself concerning the more recent developments in American electrical engineering. Upon going aboard the steamer Mr. and Mrs. Bathurst were pleasantly surprised by the many evidences of thoughtfulness on the part of American friends in the way of flowers and fruits.

MISS ANNA GETTINS, at present chief operator of the Youngstown, O., exchange of the Central Union Telephone Company (Bell), has been offered the position of traveling supervisor of exchanges throughout the entire State of Ohio. Miss Gettins has been with the Youngstown exchange for twelve years, and besides being an expert chief operator, she has an extensive mechanical knowledge of all the working of a system, both inside and out.

OBITUARY.

PROF. C. A. SCHOTT.—Washington dispatches announce the death there on July 31 of Prof. Charles A. Schott, for more than half a century an assistant in the United States Coast and Geodetic Survey, aged seventy-five years. Several years ago the French Academy conferred on him its highest honor—a medal for his researches in terrestrial magnetism. He was born at Manheim, Baden, Germany, Aug. 7, 1826. In 1847 he was graduated from the Polytechnic School at Carlsruhe. The following year he came to America and entered the Coast and Geodetic Survey. In 1856 he was promoted to the grade of an assistant in the service. Mr. Schott was a member of the Government parties that observed the total eclipse of the sun in August, 1869, at Springfield, Ill., and at Catania, Sicily, in December, 1870. In 1898 he was a delegate to the International Conference on Terrestrial Magnetism, which was held at Bristol, England. Mr. Schott was a member of many scientific societies, among them the National Academy of Sciences, Washington Academy of Sciences and the American Association for the Advancement of Science. He was also the author of many papers on hydrography, geodesy, tides and meteorology, and physics of the globe in Smithsonian Institute publications.

MR. W. H. JOHNSON.—We regret exceedingly to note the death at Louisville, Ky., of Mr. W. H. Johnson, a well-known electrician of the old school. He was born in Williamston, Mass., May 6, 1834. His father was a member of the State Legislature. The family moved to Troy, N. Y., where young Johnson was apprenticed to a firm of instrument makers. In 1855, at Cleveland, Mr. Johnson began his long connection with the telegraph service. He was at first in the manufacturing department of the Western Union, where he invented, it is said, the switchboard, which, in improved form, is now used in every Western Union office in the country. In 1859 Mr. Johnson was appointed superintendent of manufacture of the Southern Telegraph Company, with headquarters at Louisville. When the Southern was absorbed by the Western Union he was given a corresponding position at Louisville. He continued in the service of the Western Union for twenty-six years, until the department of manufacture was abolished. In 1882 Mr. Johnson organized the Louisville Electric Light Company and was its first secretary and manager. A year later he organized the Louisville Electrical Supply Company. He was chosen expert electrician for the Louisville Board of Fire Underwriters, and was the first inspector of electric lights and wires for the city. In 1889 he was appointed Deputy Collector of Internal Revenue for the district. He was one of the original stockholders and directors of the Ohio Valley Telephone Company, and retained his interests until the company sold out to the Cumberland Telephone & Telegraph Company. Mr. Johnson married Miss Anna Guyles, of Cleveland, who survives with one son, Mr. Shirley Everton Johnson, a well-known journalist. Mr. Johnson was a life member of Preston Lodge, No. 284, F. and A. M.; a K. of H., and a charter member of the Old Time Telegraphers' Association.

NEW INDUSTRIAL COMPANIES.

ROCHESTER, N. Y.—The Rochester Engineering & Supply Company has been formed to manufacture electrical machinery, etc. Capital, $5,000.

ONEIDA, N. Y.—The Oneida Automobile Company has been formed with a capital of $5,000, the directors being Theo. Coles, H. M. Reynolds and S. Allen Clark.

ROCHESTER, N. Y.—The Pullman Railroad Supply Company has been formed to manufacture and sell trolley catchers, electrical appliances, etc.; capital, appliances; capital, $20,000.

CHICAGO, ILL.—The La Salle Electric Company has been formed; capital, $9,000; manufacturing and deal in electrical supplies. Incorporators: P. L. Biggins, L. J. Gamwell, E. M. Hanes.

MODERN STREET LIGHTING COMPANY, of New York City, has been incorporated under the laws of Delaware to make and deal in articles for supplying light, heat and power. The capital stock is $100,000.

JERSEY CITY, N. J.—The Nathans Electrical Manufacturing Company has been formed to manufacture electrical machinery; capital, $125,000. Incorporators: Thos. A. Nathans, Frank L. Zabriskie, Edwin C. Ranney.

SOLVAY, N. Y.—The Pass & Seymour (Incorporated), of Solvay, Onondaga County, has been formed to manufacture electrical appliances; capital, $100,000. Directors: James Pass, A. P. Seymour and B. E. Salisbury, of Syracuse.

CAMDEN, N. J.—The Keystone Electric & Manufacturing Company has been formed. Principal office, New Jersey Corporation Guarantee & Trust Company Building, 419 Market Street, Camden, N. J. Objects, general electric and manufacturing business; capital, $250,000. Incorporators: Albert Schweitzer, A. Hausold, Samuel Brown.

STANDARD SIGNAL COMPANY, of Troy, N. Y., has been formed to manufacture and install systems of interlocking block signals and safety appliances of every description for railoads; capital, $300,000. Directors: Alfred H. Renshaw and Palmer C. Rickett, Troy; Henry Burden, Jr., Cazenovia; John T. Cade, Ridgefield, N. J.; Harvey N. Loomis, New York.

BUTLER, PA.—The United States Electrical Supply Company has been organized at this place to manufacture telephones and telephone plants under patents of Dr. John W. Byers, of Butler. Under the new system thirty-five telephones will be operated by two wires and absolute secrecy is said to be possible. John W. Brown is president, M. A. Berkheimer, vice-president; W. H. Miller, secretary; Charles Bailey, treasurer, and Frederick E. Freers, general superintendent.

Trade Notes.

REMOVAL.—The Eck Dynamo & Motor Works has removed from Newark to Belleville, N. J.

ARMOUR & CO. have just entered their third order for Cross oil filters, furnished by the Burt Manufacturing Company, of Akron, O.

ARC LAMPS.—Ordinarily the summer months are the dullest in the arc lamp business, but the Electric Appliance Company, Chicago, state that they have sold more A. B. arc lamps during the past two months than ever before.

ELECTRIC VEHICLE COMPANY have just issued a special bulletin, No. 12, showing what excellent service their electric automobiles rendered as ambulances, etc., in various places during the recent extremely hot weather. It makes most interesting trade literature.

THE CENTRAL ELECTRIC COMPANY, of Chicago, which has recently become Western sales agent for the Pittsburg Transformer Company's products, has issued a descriptive bulletin relating to the same. The Pittsburg Company's type "K" transformer, made for both high and low frequencies, is well known by central station managers for its efficiency and superior workmanship.

PARAGON FAN & MOTOR COMPANY, 572-578 First Avenue, New York City, are actively distributing their recent circular relative to the Paragon enclosed multipolar apparatus in generators and motors. The circular is a pamphlet of 20 pages and gives a large amount of useful technical data as to this power machinery.

LAHMEYER APPARATUS.—The Elektrizitats-Actien-Gesellschaft, formerly W. Lahmeyer & Company, Frankfort-on-the-Main, Germany, send us a pamphlet which apparently was prepared in anticipation of the recent visit to its works by the English Institution of Electrical Engineers. The Catalogue is printed in English, and gives descriptions of all the more important types of apparatus made by this company, and views of some large electric railway and lighting plants which it has installed.

UNIVERSAL ELECTRICALLY DRIVEN GRINDERS.—The Anderson Tool Company, Anderson, Ind., has issued a 32-page catalogue devoted to its line of electrically-driven grinders. Nineteen excellent half-tone engravings show the Lea universal grinder applied to various uses. The Anderson Company makes three sizes of the universal type of grinder and three of a plain type. The final page of the catalogue illustrates the "L. H." enclosed arc lamp, which is manufactured by this company.

CORLISS ENGINES.—The Vilter Manufacturing Company, Milwaukee, Wis., in a new catalogue shows illustrations of the various types of Corliss engines of its manufacture. Views are also given of the large plant of the Vilter Company at Milwaukee, and an interior view of the main shop. About one-half of the catalogue is devoted to a list of plants using Corliss engines built by the Vilter Manufacturing Company, from which it appears that many are in service abroad, and particularly in Mexico.

VILTER MACHINERY.—The Vilter Manufacturing Company, Milwaukee, Wis., has recently closed a number of important contracts for Corliss steam engines and refrigerating and ice machines. Among the latter are 30 and 50-ton ice plants, and 25, 35 and 125-ton refrigerating plants. Among the engines are two 24x48x48, one 22x40x42 and one 14x28x36 cross compounds; three 18x42, two 22x42, and one 20x42 Corliss engines. The customers cover the States of Wisconsin, Kansas, Nebraska, Washington, D. C., Ohio, Illinois, Louisiana and Texas.

MECHANICAL DRAFT.—With the title, "Who Uses Mechanical Draft?" a 32-page pamphlet issued by the B. F. Sturtevant Company gives a partial list of those who use Sturtevant fans for induced draft. With the exception of a few words of explanation on the second cover page, the text consists entirely of names and addresses. The list of foreign boiler plants fitted with induced draft alone has more than 300 entries. The names of more than 200 vessels are given in which Sturtevant fans are used for mechanical draft, among which are over fifty United States war vessels.

STURTEVANT ENGINES.—The B. F. Sturtevant Company has issued the fourth edition of its illustrated catalogue of Sturtevant engines for electric light plants and general high-grade work. All the various types of Sturtevant engines are shown in excellent engravings, a number being represented direct-connected to electrical generators. The final pages give a useful table of horse power constants per revolution for different mean effective pressures; for single engines the range is from 2½x2-in. stroke to 18x16-in. stroke, and for double engines from 3½x2½-in. stroke to 9x5½-in. stroke.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently issued an electric fixture and supply catalogue, which covers the most complete and up-to-date line of fixtures shown for some time. The fixtures are all illustrated by very large half-tones and the catalogue is very handsomely gotten up. The company states it has recently enlarged its facilities for handling the electric fixture business, and that its factory is now in position to guarantee prompt shipments of anything illustrated in their catalogue. Another recent publication of the same company is a small pamphlet devoted to lamp sockets and receptacles.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 30, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

679,[illegible]. POWER FACTOR METER; Paul M. Lincoln, of Niagara Falls, N. Y. App. filed Mar. 27, 1901. (See Current News and Notes.)

679,175. FREQUENCY OR SPEED INDICATING AND REGULATING DEVICE; Paul M. Lincoln, of Niagara Falls, N. Y. App. filed Mar. 27, 1901. ((See Current News and Notes.)

679,304. ELECTRIC METER; Walter C. Fish, of Lynn, Mass. App. filed May 21, 1901. (See Current News and Notes.)

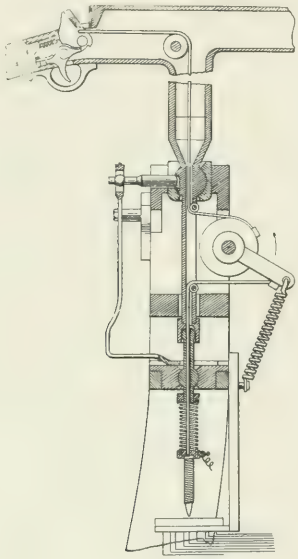
679,308. INSULATOR; H. Geisenhoner, Schenectady, N. Y. App. filed May 1, 1901. From the insulator is suspended a loop having overlapping parts similar to a key ring, between which the wire is passed to enter the loop.

679,310. SIGNAL SYSTEM; J. L. Hall, Schenectady, N. Y. App. filed Feb. 16, 1899. A marine signalling device consisting of a switch-controlled keyboard adapted to be moved bodily from one stand to another at different places on the ship, and readily make the necessary connections when put into position on any stand.

679,314. ELECTRIC RAILWAY; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 19, 1897. Means for reducing the amount of current which flows through the electromotive device actuating the switch controlling the working section.

679,316. ELECTRIC SWITCH SHELL; H. Hubbell, Bridgeport, Conn. App. filed Jan. 28, 1901. Details.

679,321. AUTOMATIC SWITCH; F. Mackintosh, Schenectady, N. Y. App. filed May 1, 1899. An arrangement of springs co-operating with a magnet in acting upon an armature to open the charging circuit of a battery as



679,325.—Target Apparatus.

soon as the counter electromotive force of the battery has reached a certain alue

679,325. TARGET APPARATUS; J. L. McCullough, Brooklyn, N. Y. App. filed March 15, 1900. Circuits between a gun and a target are so controlled by the movements of the gun in aiming that the accuracy of the aim is electrically indicated when the trigger is pulled, without actually firing a projectile against the target. This provides for gun practice without wasting ammunition.

679,331. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed Feb. 26, 1901. The aim of the invention is to provide a system having switches which are certain to open and close when required.

679,332. SURFACE CONTACT RAILWAY; W. B. Potter, Schenectady, N. Y. App. filed Jan. 9, 1899. The switch mechanism between the feeder and the working section comprises two or more switches adapted to be operated simultaneously.

679,[illegible]. ELECTRIC METER; W. H. Pratt, of Lynn, Mass. App. filed Apr. 22, 1901. (See Current News and Notes.)

679,357. APPARATUS FOR TREATING METALS BY ELECTROLYSIS; A. G. Betts, Upper Troy, N. Y. App. filed May 18, 1901. Apparatus for conveniently compressing, from time to time, the metallic electro deposit

679,362. ELECTRIC BRAKE; F. E. Case, Schenectady, N. Y. App. filed July 17, 1897. The brake system is so arranged and connected that whenever a brake shoe sticks a reverse current can be sent through the same to thereby demagnetize and release it.

679,405. MICROTELEPHONE; Emil Volkers, of Berlin, Germany. App. filed Mar. 22, 1901. A telephone receiver and transmitter are secured to the same standard or support; in each case the mechanism is embedded in an open box in a mass of liquable material, the diaphragms of both receiver and transmitter being located in practically the same plane. The object of the invention is to produce an apparatus of simple and economical construction, which, when once the parts are assembled, will not again require adjustment or regulation.

679,446. AUTOMATIC CIRCUIT CLOSER; G. A. Wall, Providence, R. I. App. filed Dec. 7, 1900. Details.

679,472. MULTI-RATE METER; Frank P. Cox and Charles E. Holmes, of Lynn, Mass. App. filed Dec. 4, 1899. (See Current News and Notes.)

679,476. ELECTROLYZING AND WASHING APPARATUS; J. F. Kelly, Pittsfield, Mass. App. filed Sept 14, 1900. The cell is forcibly reciprocated in order to carry the body of mercury from the electrolyzing chamber to the washing chamber without intimately mixing the amalgam.

679,477. ELECTROLYTIC DECOMPOSING CELL; J. W. Kynaston, Liverpool, England. App. filed Feb. 1, 1899. The cell comprises a series of superposed horizontal trays along which a stream of mercury flows to serve as a cathode of large surface.

679,700.—Arc. Lamp

679,492. TROLLEY FOR ELECTRIC CARS; J. H. Beckert, St. Louis, Mo. App. filed Sept. 28, 1900. Apparatus is provided whereby the trolley is upwardly supported only when it is in contact with the wire.

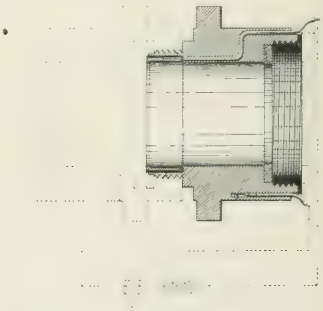
679,518. ELECTRICAL STOP FOR ENGINES; J. F. Skirrow, East Orange, N. J. App. filed Dec. 14, 1900. Details.

679,544. INSULATOR FOR ELECTRIC WIRES; J. E. Sharpe, Oneida, N. Y. App. filed May 17, 1901. The wire is held between the insulator and a plate, being clamped by a ring passing over the insulator.

679,546. SECONDARY ELECTRIC CLOCK; T. H. Wurmb and R. Bauman, St. Louis, Mo. App. filed Jan. 26, 1900. Details.

679,580. MEANS FOR ACTUATING INDICATORS UPON MOVING TRAINS; E. Vilpou, Blois, France. App. filed Feb. 23, 1900. Knives are arranged along the roadway in position to cut a cord stretched along the train when desired; cutting the cord operates an indicator at the locomotive.

679,615. UNDERGROUND ELECTRIC CONDUCTOR FOR STREET RAILWAYS; J. Floyd, Philadelphia, Pa. App. filed Nov. 21, 1900. An arrangement for maintaining a continuous circuit in passing over crossings.



11,924.—Hose Signal.

679,638. CIGAR CUTTER AND LIGHTER; C. A. Rosenholz, Wardner, Idaho. App. filed Feb. 14, 1901. Details.

679,654. BURGLAR ALARM; W. J. Wernette, Remus, Mich. App. filed Jan. 25, 1901. Details.

679,700. ELECTRIC ARC LAMP; S. M. Meyer, Brooklyn, N. Y. App. filed Oct. 10, 1900. The core of the solenoid is laminated both axially and transversely for the purpose of obtaining an increased traverse of a given size of core.

11,924. ELECTRIC HOSE SIGNAL SYSTEM; H. Sargent, Boston, Mass. App. filed Jan. 7, 1901. Relates to the construction of the connection at the hose coupling.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, AUGUST 17, 1901. No. 7.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager

CHICAGO OFFICE, - - - - - - - - - - - 1130 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 17, 1901.

CONTENTS

PAGE
Editorial 245
Annual Convention of the American Institute of Electrical Engineers..... 248
Electrical Engineers of the Day VII Ralph D. Mershon 248
A Large Polyphase Workshop Distribution Plant..... 249
Coherers—The Development, Construction, Operation and Function of Electric Wave Detectors, by A. Frederick Collins..... 251
German Electric Railway Experiments..... 253
Storage Batteries in Central Stations, by R. F. Schuchardt..... 254
Lighting an Antarctic Ship..... 255
Unprofitableness of Cheap Telephony..... 256
American Street Railway Association Entertainment Committee..... 256
Generating Units for the Boston Elevated..... 257
The Bremer Arc Light..... 259
The Development of Trolley Freight Systems..... 259
Electrolytic Refining of Lead..... 260
Current News and Notes..... 260
LETTER TO THE EDITORS:
Popular Science and Corpuscles, by Lucius K. Noll..... 262
Digest of Current Electrical Literature..... 263
New Books..... 267
Electric Rock Drills, by Geo. H. Waltman..... 268
Improvement in Socket Construction..... 269
Self-Starter for Large Motors..... 269
Electrically-Driven Drill..... 269
Improvement in Hot Wire Instruments..... 270
Pan-American Exhibit of the Buffalo Forge Company..... 270
Storage Battery Exhibit at the Pan-American..... 271
DEPARTMENTS:
Financial Intelligence..... 272
Commercial Intelligence..... 273
General News..... 274
Trade Notes..... 279
Record of Electrical Patents..... 280

ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

We notice that the annual meeting of this society is to be held at Denver during the last week in August. It is devoutly to be wished and sincerely to be hoped that the officers of this association will abandon the policy of mediæval mysticism which has characterized the association in years past. It has been the custom to deny facilities—or, at least, to render no aid—to the representatives of the technological press in attendance at the annual conventions. To such an extent has this been carried that the association has in some quarters received the soubriquet of "The American Association for the Suppression of Science." In our judgment such a policy is unworthy of science and of those who devote themselves to its advancement. The great characteristic of scientific knowledge, as distinguished from merely industrial knowledge, is that it is free to all who will receive it. It is quite reasonable that a scientific body should desire to maintain the copyright upon its papers, but after due restrictions have been imposed upon republication, the more fully and freely its papers are reprinted in the periodicals and discussed by outside persons, the greater the estimation of the society, the greater its prestige, and the greater the good which it effects. The community at large wants to have disseminated, and to acquire access to, every atom of scientific information that may be offered. We feel sure from the standing of the officers in the scientific world that this proposition to lend aid in securing wide publicity of the transactions of the association has only to be properly introduced to their attention to receive their acquiescence. Some excellent papers are already scheduled for presentation at Denver, if one may judge from their titles.

THE NEW YORK CENTRAL TUNNEL.

We have already referred in these columns to the New York Central Tunnel situation and the vociferated need for a change of motive power in that home of noxious fumes, but the recent vigorous action of the Grand Jury calls for renewed comment. We cannot be surprised that the railway officials are not eager for change, for improvements cost money, and so long as the traveling public confines itself to grumbling and irate letters to garnish the official waste-basket, nothing comes of its discontent. But there are civil powers to which all corporations may occasionally be subject, and eventually a "day of wrath" arrives in which the smouldering indignation of the public, reasonable or unreasonable, bursts into a flame. That point seems to have been about reached in the case of the tunnel nuisance, and there is every indication that the railroad authorities may be urged into movement.

Their reply to protests and imprecations is that their engineers have not been able to find any feasible scheme for ventilating the tunnel, and that a change to electric motive power is equally impracticable. We can cast no aspersions upon the engineers concerned so far as the matter of ventilation is involved, but will merely inquire, purely for information, how long an engineer would usually be likely to hold his job if he openly advised a course which would involve the expenditure of a million dollars with no direct opportunity for return. As to the difficulty of adopting electric traction for the tunnel and the suburban lines connecting with it, we venture to intimate that if the present engineering staff of the railroad cannot or will not solve the problem, it is high time to enrich it with engineers who can and will. We are well aware that the

task is of no trivial magnitude; that it involves heavy electric traction on a scale that is somewhat greater than any existing work; that the installation of the third-rail system in a complicated railway yard is a difficult matter, and, above all, that it cannot be done in a day nor for $10. But, on the other hand, its size does not predicate either unusual difficulties or the failure of present methods. There is no law of the Medes and Persians compelling the use of the third rail there or anywhere else, and, finally, if it were to take 10 years and $20,000,000, it must still be done, and the sooner the work is started the sooner it will be finished. Every month of delay makes the task more serious and costly, and the public more impatient.

As to the electrical side of the matter, we must frankly say that the difficulties are existent, but entirely manageable with proper skill in engineering the work. So far as methods of traction are concerned, there is not the least trouble. Electric locomotives alone or used in connection with the multiple-unit system for suburban work are entirely competent to replace the present motive power. The traffic of a busy electric elevated road is quite as heavy and at least as difficult to manage as the tunnel system need be. In many respects it is far more difficult, by reason of the very frequent stops and the need of very rapid acceleration, neither of which would be severely felt in the tunnel. Moreover, the elevatd road has far less track room and a less substantial roadbed. The supply of motive power over the system seems to be the bugbear at which the railroad men shy. Because the third-rail system has been vigorously heralded in the newspapers, and indorsed by some outside of their own circle, the railway officials seem to be laboring under the delusion that if they attempt electric traction they must bow down and burn joss sticks before that particular idol.

Now, within certain limitations the third-rail system is most admirable and facile of adoption on steam railroads, but we do not hesitate to say that electric traction would not be seriously affected by its complete suppression, at least in the form now familiar. Because an absolutely unguarded third rail carried within three or four inches of the roadbed is obviously dangerous and troublesome in the intricacies of a big railway yard, there is no reason for railway officials to throw up both hands and wail that electric traction is impracticable. Because their particular method of switching and train dispatching would be inconvenienced by a particular system of electrical distribution, they are not justified for sinking down in despair. Did they forever refrain from burning anthracite coal because the locomotive required proper fire boxes for the new fuel? There will be no serious impediments in the way of electric traction in and beyond the tunnel as soon as the railway authorities get to work with the earnest intention of making the change. There are plenty of electrical engineers entirely capable of directing the work, and if they are not now investigating the conditions they ought to be. We have nothing whatever against the New York Central Railroad save the apparent *laissez-faire* policy. The time has now come when there must be a change. When the officials make excuse by denying the power of electricity to do their work properly, we cannot but protest that they blind only themselves, but not the engineering profession, and not even the unprofessional public, who have seen year by year the growth of the art.

THE BREMER ARC LIGHT.

At the Paris Exposition, one of the "clous" in the electrical department was to have been a revolutionary arc light. The space reserved for its exhibition remained persistently vacant, however, and those who followed the indication of a notice there displayed and visited an office in the city received no enlightenment as to the mysterious invention. We refer to the Bremer arc light, the details of which have finally been disclosed in two United States patents issued last week and abstracted elsewhere in this issue. It appears that the kernel of the invention is the use of a flux in "doctored" carbons, whereby the salts used to color the arc are rendered quite liquid and thus enabled to drip off instead of remaining in the form of scoria to interfere with normal operation. To facilitate dripping, the carbons are given an odd shape in cross-section, and for the same reason it is necessary to incline the electrodes at an angle to the horizontal. Moreover, the stability of the arc under these conditions calls for the use of a pair of carbons per electrode and also an electromagnet to deflect the arc. Finally, proper distribution of the light adds the further requirement of a downward light deflector. Verily, great oaks from little acorns grow!

CORPUSCLES AND COSMIC PHENOMENA.

In our comment last week on Professor J. J. Thomson's recent paper on the corpuscular theory, mention was omitted of an interesting application to the explanation of cosmic phenomena, which illustrates the possible influence of the infinitesimally small upon the behavior of the infinitesimally great. He shows that although a corpuscle, in spite of its 60-miles-an-hour gait, cannot ordinarily shake itself free from the solid substance in which it moves and has its being, unless the substance is very strongly heated, so as to increase both the jostle energy of its molecules and that of its corpuscles. Under these circumstances, as, for example, at the bounding surface of an incandescent lamp filament, corpuscles may be discharged, and produce what is commonly called the Edison effect of the incandescent lamp. Since highly heated bodies discharge corpuscles and negative electricity, it is reasonable to expect that the sun shoots off a great number into space, and some of these—a large number in the aggregate—must hit the atmosphere surrounding our world. If not driven off again by electrostatic repulsion, they sink into the atmosphere and fall under the influence of the earth's magnetic field, which twists their line of motion into spirals, even as a magnet in a Geissler tube rotates a continuous arc of discharge. In the earth's equatorial regions where the bulk of the corpuscles must fall, the magnetic field will tend to keep them moving parallel to the earth's surface, but near the poles where the fewest fall the magnetic field pulls them spirally down to the earth, in which passage they are capable of producing the luminous effects known as the aurora.

The consequences of this ingenious theory seem to agree satisfactorily with the records of observations of auroræ, which, on this view are the glows produced by the celestial rain of the corpuscles from the sun. The same hypothesis has also been elsewhere shown as capable of accounting, at least in part, for the sun's corona. The high temperature of the sun must tend to develop powerful discharges of negatively electrified particles which must also tend to increase the positive electrification of the sun's mass. This will establish a very powerful reactive electrostatic force tending to pull back the corpuscular shower, and when for any reason the corpuscles diminish in velocity below a critical value, they tend to fall back again upon the sun.

Whatever difficulties and doubts may lie before the corpuscular theory there can be no doubt that it has come to abide. The only danger is in driving a willing horse to death, and in trying to explain too many of the difficulties of the great, by the capabilities of these infinitesimals. The article referred to is, however, the first publication, we believe, that has been authoritatively given in ordinary language of the new theory by the author, and it must now stand or fall by the experimental results of the next hundred years.

Electro-Chemical Industry.

The address of the president of the Society of Chemical Industry (England), Mr. J. W. Swan, F. R. S., recently delivered in Glasgow University, and printed in a pamphlet amusingly marked "Private and Confidential Until Read," contains some very interesting information upon the technics of industrial electro-chemistry. The data it gives for the industry in Europe are much more complete than the data for the United States. Summing up the statistics for Europe, it appears that during 1900 there were 50 electro-chemical works in operation, utilizing roughly 125,000 kilowatts, of which 10 per cent was worked by steam, and nearly 90 per cent by water power. The countries using steam were Great Britain, Germany and Russia. In these countries the steam power used exceeded the water power. The power employed in these steam-using countries is, however, only about 16 per cent of the total power in Europe.

It is evident, therefore, from these figures, that electro-chemical industry is mainly confined to locations where water power is available, and that England, Germany and Russia being countries in which but little water power is available are compelled to use steam for special electrolytic purposes. It seems that sodium and its salts are obtained economically from steam power, and electrolytic metal refining is also carried on by steam power, but aluminum chlorate, calcium carbide and ferro-chrome are prepared by power that is almost exclusively obtained from falling water. It seems, in fact, that the latter industries can only thrive where cheap water power is obtainable, since the cost of power enters into their production to a greater degree than in the case of metal refining. This is also illustrated by the fact that electro-plating is the oldest electrolytic industry in existence, and one in which the cost of power assumes, by comparison, the least importance. For a long period, in fact, the source of electric current in electro-plating was the voltaic battery. Some electro-refining industries also require but a relatively very feeble electric current. For example, the Siemens & Halske process for extracting gold from the tailings and slimes of the Rand goldfield, employs but a very small current density, and the gold is deposited upon thin lead cathodes. The South African war seems to have so far crippled the gold-mining industry in the Rand during the past two years that no statistics concerning this process during that time are available. But that will probably soon be changed.

Mr. Swan points out that great progress is being made in subsidiary uses of electro-chemistry. That is to say, electro-chemical operations are finding considerable application as one step in a series of otherwise purely chemical operations, indicating that electro-chemistry is being fully appreciated by men who are not considered as electrical specialists in the line of industrial chemistry, or that industrial chemistry is now regarding electro-chemistry as a necessarily included branch. An instance of this is found in the fact that ozone electrically generated is occasionally used in the refining of sugar. It is also stated that the city of Lille in France has adopted electrically generated ozone as the sterilizing agent in connection with the water supply. Electrolytically generated hydrogen is now commonly used for the inflation of military balloons. This process, when coal is available, obviates the necessity of transporting acids and zinc in considerable quantities. It is pointed out that in the fixation of atmospheric nitrogen and the production of nitric acid from the nitrogen of the air by electric methods, if the output per kilowatt-hour can be somewhat increased beyond that now recognized as possible, nitrate of soda would be capable of manufacture by electrical methods on a large scale.

The Mechanical Equivalent of Light.

An article by Mr. C. J. Reed on this subject appeared on page 170 of the 3d inst. Although we agree in the main with Mr. Reed's remarks to the effect that light cannot be measured in terms of energy, yet we think that the case is not so hopeless as the article seems to suggest. Thus we know approximately the range of frequencies to which the human eye responds. It is also possible to measure the amount of radiant energy which a source of light emits within this range of frequency. The ratio of this energy that is in visual limits to the total energy of emission may then be called, and is usually called, the luminous efficiency of the source. For example, if between the frequencies of, say, 390,000,000,000,000 and 760,000,000,000,000 of cycles per second, the luminous source emits 5 per cent of all its radiation, then we may say that the luminous efficiency of that source is 5 per cent. This is, however, only the first rough step towards scientifically measuring light as a sensation in terms of energy of radiation. The next step is to determine, for the average eye, the relative physiological values of the different frequencies within the visible spectrum.

For example, we know that a given amount of radiant energy produces more light, judged as a sensation, when developed as green light than as light of any other color. If then we call unity the sensation value of the most effective frequency, the physiological value of any other frequency is capable of being expressed as a certain measurable positive fraction. This done, we can, after having mapped out a radiant-energy distribution-curve in terms of frequency, prepare a new curve between the limits of the visible spectrum, which new curve shall express the corresponding physiological sensation values in arbitrary units. The summation of the area bounded by the new curve will then give a theoretical light value of the source in arbitrary physiological units. This sum or integral, divided by the total power radiated by the source, would give the physiological value of the light per unit of power radiated. Although all this can be done at the present time with a greater or less degree of accuracy, it is doubtful how far the process can be relied upon for representing real sensation, because we know that in the presence of powerful stimuli the eye loses a part of its sensibility.

It is, however, quite important, from various points of view, that the physiological coefficient of luminosity for different colors of light or frequencies of radiant energy should be determined in as many cases as possible. Some work has already been accomplished in this direction, but it is desirable that much more should be undertaken. It is important to know how the coefficients vary with age in the same individual, and how they vary between different individuals of the same race or different races. We have at the present time no knowledge as to the sensibility of the present normal human eye compared with the eye of an ancient Greek or Roman citizen, and it is quite possible that the human eye is undergoing a steady gradual variation in sensibility, under the influence of civilization, without our being in any way rendered cognizant of the fact. We cannot measure absolute sensation, but we can measure and compare relative sensations by purely optical means, so that all measurements of this kind are interesting from a historical as well as from a physical standpoint. Each year makes the subjects of optics more nearly akin to that of electromagnetics. Small Hertzian apparatus can now be made which will emit waves of light about a decimeter in length, and with which the ordinary phenomena of refraction and reflection can be not only demonstrated but also actually measured with some approach to accuracy. Professor Fleming in a series of lectures recently delivered produces an interesting series of such electro-optical experiments.

Annual Convention of the American Institute of Electrical Engineers.

The first meeting in connection with the annual convention of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street, New York, Wednesday, Aug. 14, at which foreign guests of the Institute were welcomed and the final programme announced for the trip to Buffalo and the session to be held there. Though the meeting was but a preliminary one, about 100 members were in attendance. Among the foreign engineers present were the following:

Professor Paul Janet, director of the Laboratoire Central, and of L'Ecole Superieur de l'Electricité, Paris, official delegate of the Société Internationale des Electriciens; M. Courbier, Laboratoire Central de l'Electricité; M. Boy de la Tour, chief engineer of Société Fives-Lille; M. Debauve, standards department, Maison Breguet, Paris; M. Marcel Aubert, Ingenieur, Licencié es Sciences; M. Maurice Aubert, Ingenieur, Licencié es Sciences; M. Roux, Ingenieur civil. All of the above gentlemen are members of the Société Internationale des Electriciens.

F. W. Ch. Janisch, chief engineer Siemens & Halske Company, Berlin; Professor Gustave Gillon, University of Louvain, Belgium; Berlin; Professor Gustave Gillon, University de Louvain, Belgium; Mr. D. McNaught, Silvertown, England; Mr. Norman C. Sawers, Silvertown, England; Mr. Arthur H. Pott, London, England.

In addition to the above, quite a number of other engineers from abroad will join the party starting for Buffalo on Sunday morning, and the foreign contingent will probably number above two score.

President Steinmetz in welcoming the guests referred to the fact that science knows no country, and that between those devoted to science there is a community of feeling and interest not affected by nationality. The International meetings of engineers at Paris last year marked a desirable condition which he hoped would become more firmly established each year until finally in some part of the world there would be an annual gathering of engineers from all countries. Following Mr. Steinmetz, Mr. C. O. Mailloux delivered an address of welcome in French to the delegation of members of the Société Internationale des Electriciens, to which Professor Paul Janet responded in graceful terms. In the course of his remarks, Professor Janet spoke of the extreme regret of Professor Hilliaret, of the Société Internationale des Electriciens at being prevented at the last moment from joining the party of French visitors. After a response by President Steinmetz to the remarks of Professor Janet, Mr. C. O. Mailloux, as chairman of committee, announced the final programme as to entertainments, the trip to Buffalo, etc.

After the adjournment of the meeting a luncheon was served, the termination of which was enlivened by a witty post-prandial speech by President Steinmetz, which was received with a continuous roar of laughter.

Electrical Engineers of the Day—VII.

RALPH D. MERSHON.

Ralph Davenport Mershon was born at Zanesville, Ohio. After leaving the Zanesville High School he had a year's experience in railroad location and construction before entering college. In 1890 he was graduated from the Ohio State University with the degree of Mechanical Engineer. During his senior year he was assistant in physics, and remained at the University for a year after graduation as assistant in electrical engineering.

In the fall of 1891 Mr. Mershon entered the laboratory of the Westinghouse Electric & Manufacturing Company, at Pittsburg, where he was occupied in experimental work, designing and in general engineering. As the result of some of his work on the induction motor he, in 1893, made a report to the Westinghouse Company in which the induction motor was treated both from the standpoint of the rotary field and from that of the transformer, the latter treatment being graphic and employing Fleming's transformer diagram, all the theoretical results arrived at being verified by measurements on an operating motor. In the summer of 1893 he represented the Westinghouse Company at the Chicago World's Fair in the tests of Westinghouse apparatus for awards. After the World's Fair much of his time was spent in the West, especially in Colorado, installing apparatus and doing general engineering work for the Westinghouse Company. In 1896 he spent more than a year in the vicinity of Telluride, Colo., making high-voltage experiments and measurements on a transmission line erected for the purpose, which resulted in some valuable contributions to engineering knowledge, particularly with respect to the limitations of high-voltage on transmission lines and the nature of the discharges from such lines when subjected to abnormal voltages.

After being for several years connected with the New York office of the Westinghouse Company, Mr. Mershon in the fall of 1900 severed his connection with the company to take up consulting engineering work. At the present time he is acting as consulting engineer for some important electrical enterprises in Canada, among which are the Montreal & St. Lawrence Light & Power Company and the Montreal Street Railway Company. The former concern, which was formerly known as the Chambly Manufacturing Company, owns the well-known "Chambly" power plant on the Richelieu River in the Province of Quebec. This plant is being re-constructed and enlarged after Mr. Mershon's plans and under his supervision. When completed it will deliver something over 20,000 horse-power to the city of Montreal.

During his connection with the Westinghouse Company Mr. Mershon had experience in all branches of electrical work, including experimenting and research, designing, factory engineering, outside engineering, patent work and commercial work. The patent work was mostly in connection with the litigation over the famous Tesla patents, and involved amongst other things a considerable amount of

experimental work. Amongst his contributions to engineering literature is a paper in 1894 on the output of polyphase machinery as affected by the number of leads from the armature, showing how the output of such machinery increases as the number of phases is increased. This paper contains perhaps the first mathematical investigation of the rotary converter, and includes an analysis of the copper losses in the closed coil armature of this apparatus and of the alternating-current generator. Another paper, published in 1897, is on the drop of voltage in alternating-current lines, in which was given for the first time a simple method for accurately calculating the drop of alternating-current lines, taking into account power factor, reactance and resistance. He was the first to publish a method which unites convenience with accuracy in plotting waveforms, a paper published in 1891, giving in detail the use of the potentiometer as applied to instantaneous contact work, including the employment of a telephone to indicate a balance.

Among the inventions of Mr. Mershon are the six-phase rotary converter with three simple transformers, the introduction of artificial reactance into the local circuit of a rotary converter that it may be compounded without affecting the remainder of the system, and the beautiful device known as the "Mershon Compensator," by means of which, and without the use of pressure wires, the voltage at a sub-station, or any point on the line, may at all times be indicated at the generating station under all conditions of power factor, reactance and resistance drop. This device formed the subject of an award to Mr. Mershon, of the Franklin Institute John Scott medal. Mr. Mershon is a manager of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers.

A Large Polyphase Workshop Distribution Plant.

ONE of the largest workshop power distribution plants in the world is now nearing completion at the New York Navy Yard. The plant, which will serve the new shops of the steam engineering department of that yard, has a generating capacity of 1200 kilowatts, and will supply power to more than 200 two-phase induction motors, and to 9 traveling cranes. In a future issue a description in detail of the installation will appear, the present account being confined to a general outline of the plant, and including the guarantees as to economy, etc.

The accompanying illustrations show a plan and a cross section of the power house. There are three two-phase alternators supplied from the same number of boilers. The boilers, which are of the water-tube type, are each of 400 horse-power, on the basis of 30 lbs. of water evaporated per hour from 100 degs. F. at 70 lbs. pressure. Each boiler has a total of 4000 square feet of heating surface and 80 square feet of grate surface. Two of the boilers are in one battery, and the third is set singly. The boilers deliver steam at 160 lbs. pressure, and are designed for a maximum pressure of 200 lbs. Each boiler is fitted with an inclined grate mechanical stoker, operated by a variable-speed, two-phase induction motor. For the handling of coal and ashes there is installed a complete coal and ash conveyor system operated by two-phase motors. Over the fireroom is a continuous bunker of 100-ton capacity.

In the fireroom is installed a vertical steam-driven feed-pump of the single cylinder plunger type, constructed for a water pressure of 300 lbs. per square inch, and of a capacity sufficient to provide feed-water for two of the boilers working at their rated power. There is also a triplex plunger pump direct connected to a two-phase, variable-speed motor, and of the same capacity as the steam-driven feed-pump. The requirements are that the motor shall have an efficiency of at least 82 per cent, and a load factor not below 80 per cent when the pump is supplying feed to but one of the three boilers.

Two surface Wheeler condensers are installed, each of which is capable of condensing 16,000 lbs. of steam per hour, a vacuum of 26 inches being maintained. The condensers are so arranged that either or both may be used for any one of the three generating sets. Each condenser has an electrically driven centrifugal circulating pump and an electrically driven air pump operated by two-phase, constant-speed motors. The specifications require that the rise in temperature at the motor shall not exceed 40 degs. C. after 10 hours' work at full load.

There are three direct-connected generating sets, each rated at 400 kilowatts, but capable of carrying an overload of 50 per cent for a period of one hour. The engines are of the vertical cross-compound condensing type, and run at a speed of 136 r. p. m. As will be seen in the cross-sectional view of the power house, the generator and flywheel are fitted on the shaft between the engine frames. The requirements are that the engines shall regulate from no-load to full-load within 2 per cent variation in speed, and that the variation in phase angle during one revolution shall not exceed one-tenth of one degree. The receiver is fitted with reheater coils containing steam at boiler pressure. The high-pressure cylinder is jacketed and the reheater coils are in series with this jacket. The flywheel has a diameter of 14 ft., and weighs 35,000 lbs.

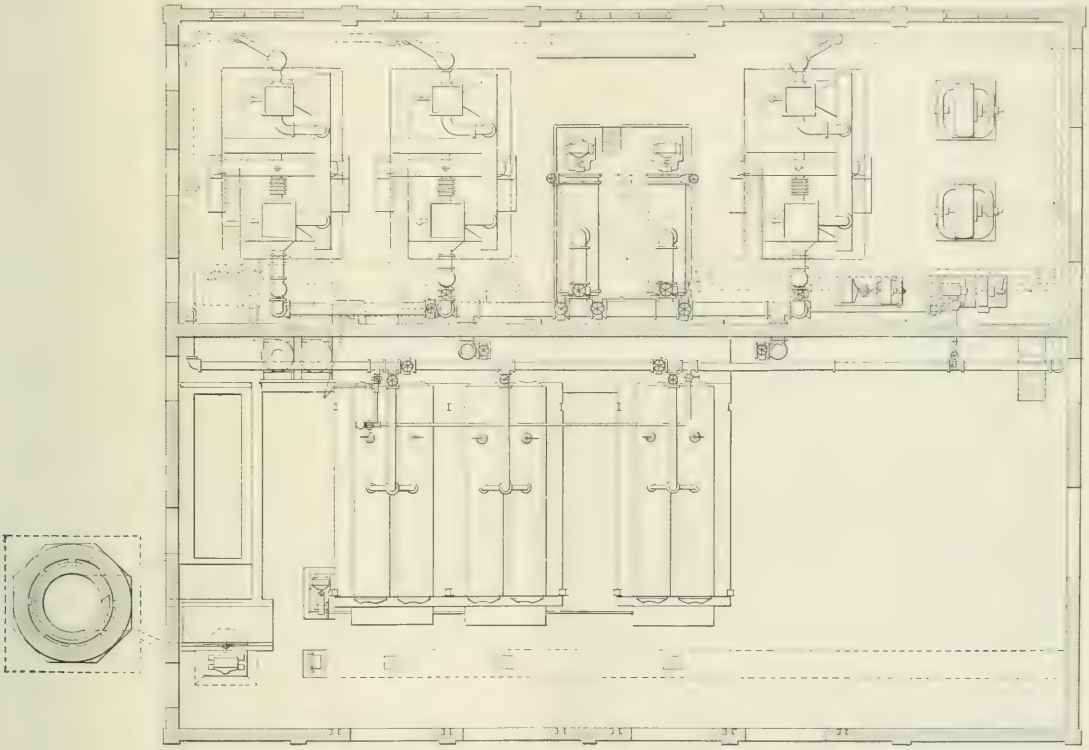


Fig. 1.—Plan of Power House, New York Navy Yard.

The guarantees as to economy are that 400 kilowatts (actual) shall be generated and delivered to the switchboard with a coal consumption not greater than 2.1 lbs. per kilowatt-hour, with any one generator and any one boiler in use. This economy is to be determined by three tests of 10 hours each, the fuel burned to be Pocahontas coal of good quality, not hand picked, and the working of the plant throughout, including stoking, to be entirely by means of accessories furnished with the plant. It is, moreover, provided that the consumption of dry steam at 160 lbs. pressure shall not exceed 20 lbs. per kilowatt-hour with the engines and generators working at their rated capacity of 400 kilowatts. In the economy tests all steam used will be included, not only that supplied to the cylinders of the engines, but also the steam in the jackets, reheaters and in a feed-water heater supplied by the steam from the first receiver, which heater will be operated during the test with a sufficient amount of

steam to raise the temperature of the feedwater through 80 degs. F. The fuel entering into the guarantee will include all the coal fed to the grate, with no reduction for moisture in the coal nor for ash or unburned coal falling from the grate.

To operate the cranes, which are fitted with direct-current motors, there are two Westinghouse 75-kw rotary converters, shown to the right of the engine-room in Fig. 1.

The generators will deliver two-phase alternating currents at 220 volts and a frequency of 25. They are of the standard Westinghouse type, and so constructed that the field and armature may be exposed for repair or inspected, by moving the field frame in a horizontal direction parallel with the shaft. The commercial efficiency of each generator is required to be not less than 84, 90.5, 93 and 94.5 per cent, respectively, when operated at one-fourth, one-half, three-fourths and full non-inductive loads. At full load the temperature rise is not to exceed 40 degs. C., or 50 degs. at 25 per cent overload for 12 hours, or 60 degs. at 50 per cent overload for one hour, the power factor in these temperature tests not exceeding 90 per cent.

There are two independent 20-kw exciters, one steam and the other motor-driven, each of which is capable of exciting the fields of two generators when carrying their full rated load with an 80 per cent power factor. Provision is made for the supply of current to the exciter circuit from the Navy Yard direct-current mains.

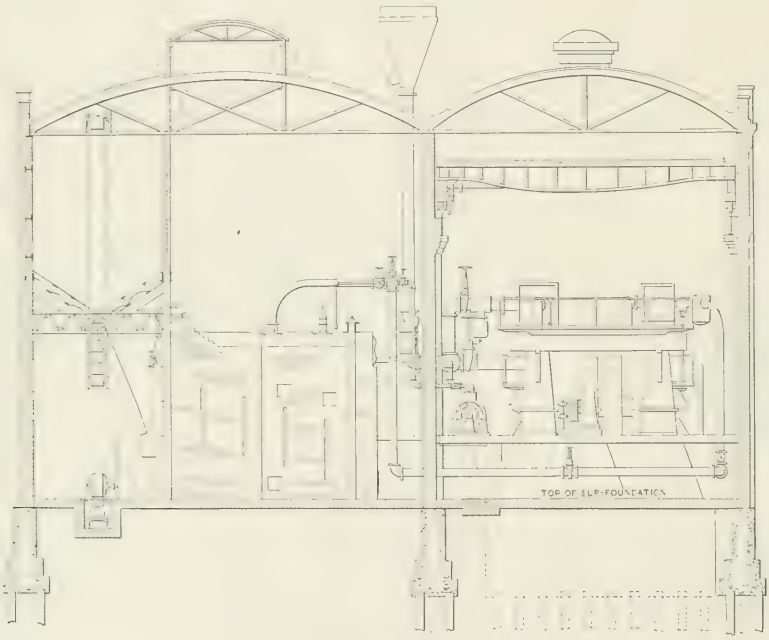


FIG. 2—CROSS SECTION OF POWER HOUSE.

The switchboard, which is of the Westinghouse standard pattern, consists of 14 white marble panels 65 inches by 24 inches by 2 inches. Additional panels may be added at future time without disturbing the present installation. As stated above, provision is made for connecting the exciter circuit with the direct-current lines of the Yards and Docks Department in case of need. For distribution there are seven two-phase circuits and three direct-current circuits. The feeders are carried underground in American vitrified-tile conduits from the power house to the center of distribution in the different buildings. The two-phase feeders consist each of four 500,000 circ. mils rubber and lead-covered cables. The direct-current feeders consist of two 300,000 circ. mils rubber and lead-covered cables.

Two two-phase circuits lead to a switchboard in the machine shop, one circuit each to the boiler-shop and blacksmith shop, one to a 200-hp induction motor driving a Rand air compressor, one to the pattern shop, one to the foundry, and one is in the power house. The direct-current feeders lead to the machine shop, boiler shop and foundry, and are of sufficient carrying capacity to supply power for the electric cranes and lights for the buildings.

The two two-phase feeders in the machine shop are connected to a switchboard (supplied by the H. Krantz Manufacturing Company), on which are mounted two 500-ampere main switches, and eight 200-ampere branch switches. Each main switch connects one of the two two-phase circuits to a separate set of bus-bars. The branch switches controlling the different motor circuits are of the double-throw, four-blade, quick-break type. Any circuit can thus be connected to either of the two sets of bus-bars and in this way the load can be evenly balanced between the two feeders; while in case of accident to the cables of one feeder, power can be drawn from the other feeder exclusively. Each branch circuit is protected by four enclosed type fuses.

Next to the above described board in the machine shop is placed a switchboard for direct-current power for cranes and lights. Each crane is controlled from this point by a double-pole, quick-break knife-switch. The sub-feeders leaving these boards are run underground in iron conduits, up the main structural columns and along the girders, an outlet being left at each column for the motor connections. Each motor is provided with a controlling board of white Italian marble 32 inches by 24 inches by 1½ inches, on which are mounted a main switch, fuses, an auto-starter switch and, where necessary, a two-pole double-throw reversing switch.

The aggregate capacity of the motors installed is about 1900 horse-power, distributed as follows: In the power-house, for pumps, air compressors, coal conveyors, etc., 200 horse-power; in the pattern shop for the operation of tools, blowers, etc., 180 horse-power; in the machine shop for the operation of tools, cranes, conveyors, etc., 620 horse-power; in the erecting shop for the same purposes, 500 horse-power; in the boiler shop for the same purpose, 200 horse-power; and in the foundry, 200 horse-power.

The specifications require that the rotor or secondary of the motors shall be entirely free from all moving contacts, and that each motor above 3 horse-power shall be controlled by a suitable starting device in the primary. This device must be so arranged that the motors can be stopped, started and the starting torque adjusted. All motors below 40 horse-power are required to stand 100 per cent overload for two hours without any injury whatever, and to be capable of "looking" for one minute without injury. All motors of 40, 50 and 100 horse-power must be capable of standing 100 per cent overload one minute, and it must be possible to bring these motors to a standstill and "lock" them for a short time without injury. The allowable rise in temperature is 40 degs. C. at full load for 12 hours, 50 degs. for 25 per cent overload for the same time, and 60 degs. for a 50 per cent overload for one hour, measured by thermometer. The maximum running torque is required to be not less than 2½ times full-load torque with 200 volts at the motor terminals; and the maximum starting torque not less than twice the full running torque with 200 volts at the motor terminals.

Following is a schedule of the induction motors being installed: Six-pole motors: One of 200 horse-power, two of 100 horse-power, six of 50 horse-power, fourteen of 40 horse-power, and fifteen of 30 horse-power. Four-pole motors: twelve of 20 horse-power, twenty-four of 15 horse-power, sixty of 7½ horse-power, and thirty of 5 horse-power. Twelve-pole motors: eighteen of 10 horse-power, twenty of 7½ horse-power, and eighteen of 5 horse-power. The 250-revolution motors will be direct-connected to line shafting, and a number of large machine tools will be direct connected to motors.

The requirements as to the commercial efficiency of the motors are as follows: For 100-hp, 50-hp, 40-hp and 30-hp motors, 89 per cent at full load, 88 per cent at three-quarter load, and 87 per cent at half load; for 20-hp and 15-hp motors, 87 per cent at full load and three-quarter load, and 86 per cent at half load; for 10-hp, 7½ and 5-hp,

four-pole motors, 84 per cent at full load and three-quarter load, and 82 per cent at half load; for 10-hp 12-pole motors, 83 per cent at full load and three-quarter load, and 82 per cent at half load; for 7½ and 5-hp motors, full load and three-quarter load, 82 per cent, and half load, 81 per cent. The power factor for the 100-hp, 50-hp and 40-hp motors is required to be above 90 per cent at above three-quarter load, and at least as much as 84 per cent at half load. The power factor of all four-pole motors must be not less than 84 per cent for loads above half load. The power factor for 12-pole motor are required to be above 80 per cent for loads above three-quarter load, and above 70 per cent for loads above half load.

The original proposal called for induction motors to operate the cranes, but this requirement having been found commercially impracticable, the cranes are fitted with direct-current motors. There are nine electric cranes, three in the erecting shop, three in the main machine shop, two in the foundry, and one in the boiler shop. The largest of these is a 40-ton crane for the erecting shop, and has a span of 70 ft. and a travel of 347 ft., the maximum hoist being 50 ft. The crane is also fitted with a 5-ton auxiliary hoist. The traversing speed ranges from 150 to 20 ft. per minute, and the traveling speed from 250 to 40 ft. per minute; the speed of the hoist under full load varies from 8 to 3 ft. per minute, and under light load from 16 to 5 ft. per minute. The lifting speed of the auxiliary hoist under full load varies from 30 to 5 ft. per minute, and under light load is as high as 50 ft. per minute. The crane has three independent motors, not including the motor for the auxiliary hoist. One motor is for hoisting and lowering the load, another for moving the trolley backward and forward on the bridge, and the third for moving the entire crane up and down the shop.

In the machine shop there is a 25-ton electric traveling crane having a span of 70 ft., a travel of 338 ft. and a lift of 50 ft. In the same shop and below the 25-ton crane, there are two 10-ton cranes having a span of 67 ft., a travel of 347 ft. and a hoist of 30 ft. There are also two 10-ton cranes in the erecting shop, each having a span of 67 ft. 4 inches, a travel of 338 ft. and a hoist of 30 ft. In the case of the 25-ton crane the traversing speed varies from 150 to 20 ft. per minute, the speed of the bridge from 250 to 40 ft. per minute, and the speed of the hoists for full load from 10 to 3 ft. per minute, and for light load from 20 to 3 ft. per minute. The maximum hoist is 50 ft. In the case of the 10-ton cranes the maximum hoist is 30 ft., the traversing speed from 200 to 30 ft. per minute, and the speed of the hoists under full load from 30 to 6 ft. per minute, and under light load, from 50 to 10 ft. per minute.

The contract for the generating plant and the polyphase motors was awarded to the Westinghouse Electric & Manufacturing Company. The mechanical equipment of the power house was furnished by Westinghouse, Church, Kerr & Co., as sub-contractors. The 40-ton crane was supplied by the Niles Tool Works, the 25-ton crane by the Morgan Engineering Works, the four 10-ton cranes by Pawling & Harnischfeger, and the two 15-ton cranes by the Shaw Crane Company. The distributing system and the motors are being installed according to the plans, and under the direction, of Commander J. A. B. Smith, U. S. Navy, and his electrical assistant, Mr. Ant. J. Fromholz, E. E.

The Automobile Endurance Contest.

Secretary Butler, of the Automobile Club of America, has issued the entry blanks and itinerary for the 500-mile endurance contest, from New York to Buffalo, Sept. 9 to 15, the entries for which will close on Aug. 31. A change has been made in the regulations for light delivery wagons, Class E, in which the minimum load has been reduced from 500 to 300 lbs., exclusive of operator or fuel and water. All entries must be accompanied by the following information in full: Weight of the motor vehicle, including fuel, supplies and equipment; capacity of water and capacity of gasoline; number of miles with the number of passengers the vehicle is able to run on ordinary roads without any replenishing of fuel or water; maximum and minimum rate of speed for each vehicle; full name of manufacturer; place of manufacture; rated horse-power of the motor, number of cylinders, bore, length of stroke and normal speed of engine. Entries must be made to the secretary at the clubhouse, 753 Fifth Avenue, New York. The itinerary divides the route into six daily stages, as follows: New York to Poughkeepsie, 84.4 miles; Poughkeepsie to Albany, 75.4 miles; Albany to Herkimer, 82.2 miles; Herkimer to Syracuse, 65.1 miles; Syracuse to Rochester, 87.2 miles; Rochester to Buffalo, 69.9 miles. Total, 464.2 miles.

Coherers—The Development, Construction, Operation and Function of Electric Wave Detectors.

By A. Frederick Collins.

THE development of detectors for Hertzian waves follows coincidently the mills of the gods, in that, however, slow their progress, it is withal exceeding well. When Heinrich Hertz studied the problem of electric waves with a view to establishing ultimately the proof of their relation to light, he builded better than he knew, for though the phenomenon of coherence had been observed, it was not associated with the waves that bear his name, and thus it was that his classical deductions made with a micrometer spark-gap detector were the forerunner of wireless telegraphy.

The sum of the knowledge at this time was briefly this: If a cut convolution of wire, whose cross-section is 2 mm in diameter and the convolution itself is 20 cm in diameter, the terminals being fitted with polished brass balls (Fig. 1A) allowing a gap between them of, say, 1-10 mm, is connected with one terminal of the secondary of a Ruhmkorff or other high-tension apparatus, it will give forth a miniature duplication of the spark given by the coil. According to the law governing high-tension currents, the passing of the micrometer spark in the detector or resonator, as Hertz termed the circle of wire, was inexplicable, and he therefore concluded that the spark

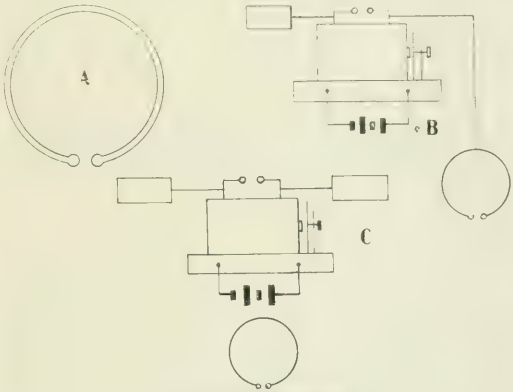


Fig. 1. Hertz's Resonator.

depended on electric waves for its propagation and not upon the conductivity of the secondary discharge.

This being the case, the connecting wire was not absolutely essential. Removing the resonator to a room from which all light was excluded, Hertz found he could still see the spark pass, and he now knew that it was not due to the secondary current, but to the disruptive discharge across the air-gap. (Fig. 1, *B* and *C*.) This discovery lead to tests for interference, reflection and refraction, which seemingly verified Helmholz's theory, namely, that light and electricity are identical, although the waves may vary in length from a millionth of a millimeter to several hundreds of miles. While Hertz's resonator does not depend on the coherence of divided particles of metal, yet messages could have been received by it and thus physically as well as theoretically it was the real beginning of the etheric wave form of telegraphy.

The action of selenium under light waves is well known, and it was but natural that this metal should have been tried immediately upon the announcement of Hertz's discovery. (Fig. 2.) That the electric waves did change its electrical conductivity like light, was offered as additional proof for Hertz's claim to the discovery of new waves. The electric waves were much too long to produce any great change, and when Righi, the preceptor of Marconi, attacked the problem he devised a new detector depending for its sensitiveness on a finely divided film of mercury on a glass. (Fig. 5.) Evidently coherence took place between the minute segregated particles of the quicksilver, but its maximum and minimum resistivity were not sufficiently divergent to allow any great distance to intervene between the emmission of the waves and the detection of them.

In the wire detectors of Hertz there were no local batteries or other devices intended to increase the size or intensity of the microscopic spark, but in the Righi detector, in the selenium cell and all

forms of coherers utilize a battery together with some form of receiving device. The receiver may be a galvanometer, a telephone, or telegraph sounder or relay, all of which should be wound with many turns of fine wire since the flow of current through the system should not be more than 1-10 ampere. A coherer with a normally high resistance and operating with a large current is much less sensitive than one with a low resistance employing a current of a fractional ampere.

Professor Calzecchi-Onesti seems to have been the first to observe the coherence of metal particles. It was in 1884 he demon-

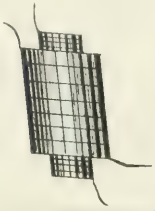


FIG. 2.—SELENIUM CELL.

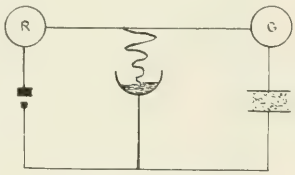


FIG. 3.—LODGE'S COHERER.

strated that copper filings were conductors or non-conductors of the electric current when placed between two plates of metal, but he attributed this property to induction and not electric waves, and so his researches were of but little value. Fig. 7 shows the arrangement of his device. By means of the galvanometer *G*, and the receiver *R*, he detected, upon "making" the circuit through the mercurial contact, that the metal filings cohered. This was due to the

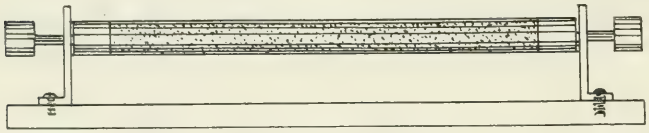


FIG. 4.—BRANLY'S COHERER (½ SIZE).

emission of electric waves created by the spark and not the current as Calzecchi supposed.

The detector invented by Professor Oliver Lodge seems to be a matter of history repeating itself. In construction it is not unlike the Reis telephone and similar to those first made by Blake; in fact, the evolution of the coherer itself is not unlike the transmitter of the telephone, and a further point of similarity lies in both depending upon an imperfect electrical contact. Fig. 3 shows the Lodge detector. In operation it is essentially a coherer. A metal point rests lightly on a metal plate, and when the waves are allowed to fall upon it the point coheres to the disk of the detector and its resistivity is considerably lowered. Platinum was employed by Lodge for the point and plate as it does not oxidize. Nickel could have been employed advantageously, as it is slow to oxidize and more susceptible to the Hertzian waves than platinum. Yet a better combination would be to employ a point of nickel and a plate of silver and enclose the whole in a vacuum.

But the first real coherer was made by Professor Branly, and to him must be given the greatest credit. In size and appearance it was the climax of crudity when compared to those beautiful little devices which are now employed to detect the emission of electric waves over 200 miles away. Branly's tube, which he preferred to designate a radio-conductor (Fig. 4), was made of glass tubing, six or seven inches in length, and with nearly half an inch bore, into

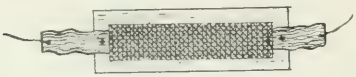


FIG. 5.—RIGHI'S DETECTOR.

which were forced copper plugs or pistons arranged to compress the filings to obtain the proper resistance. This coherer of Branly's was made by him in 1891, and is the keystone to the arch of wireless telegraphy. After the publication of his now famous experiments, all that remained was to improve and to improve does not always mean to invent. Then the workers tried many, I might say all the metals, including aluminum, cadmium, antimony, bismuth, tellurium, etc.; other substances as manganese, plumbago, carbon, sulphur, etc., singly and in combination with the metals, and then the proper size of the grains of metal, precise quantity and the exact position, all were considered, for once the secret was wrested from the occult, everything seemed to be more or less dependent as well as susceptible to these newly discovered waves.

But now a new difficulty presented itself. It was noted that when the waves had manifested their presence by coherence, the tendency of the metallic particles were to remain cohered. Neither the application of primary or secondary, direct or alternating, interrupted or continuous currents would effect decoherence, and until the particles were decohered no further manifestations of the waves could be obtained. Some metals showed a tendency to remain in a state of cohesion for as long a period as 24 hours; others varied in the time limit, although iron and carbon was found to return to their normal states of resistivity almost instantly the cause was removed. But the metals most suitable, by virtue of sensitiveness and accuracy, required a physical method to decohere them, and it was found that a very slight tap with the finger or pencil was sufficient to cause the particles to again return to a receptive state to register the waves. Professor Lodge was the first, I believe, to apply the electro-mechanical tapper, so arranged that when a current passed through the coherer it would also pass through the magnets of the tapping device and the hammer striking the blow, decoherence was accomplished automatically. (Fig. 8.) This was a very great advance over the method of tapping by hand, and the arrangement is generally employed in wireless telegraphy at the present time. Its three principle defects are, first, the blow of the tapper is liable to disrupt the glass tube containing the filings; second, the noise oc-

FIG. 6.—MARCONI'S COHERER (FULL SIZE).

casioned by the concussion is objectionable where a Morse sounder is in use; third, its action is not practically instantaneous, but requires a specific time to become operative. To overcome some of these objections, Dr. Rupp suggested that the coherer be made to revolve at right angles to its axis, and that decoherence would result by virtue of centrifugal action. It has also been suggested to revolve the coherer in a plane to its axis leaving a space between the terminal plugs for the filings to fall as the tube revolved. The additional appliances necessary for the fulfillment of either of these schemes has prevented their use for the remedy they offer is a greater evil than the ills they seek to cure.

In the combination of the metallic filings, coupled with extreme care in construction lay Mr. Marconi's secret to long-distance transmission without wires. The form he employs is shown in Fig. 6, being full size. The combination of filings between the conductor plugs, which are made to fit into the glass tube tightly, is composed of 90 per cent of nickel, a fraction less than 10 per cent of silver, the remaining fraction being added in the form of metallic mercury. The silver and nickel filings are not amalgamated with the mercury,

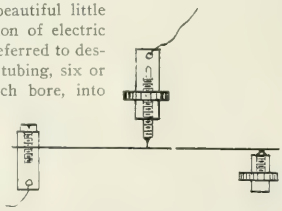


FIG. 7.—CALZECCHI-ONESTI'S EXPERIMENT.

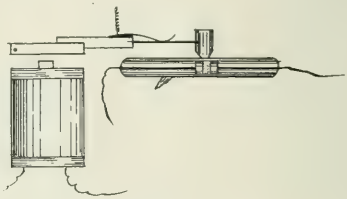


FIG. 8.—LODGE'S DECOHERING DEVICE.

but the latter is rubbed over the ends of the plugs. In tests I have made I found that the mercury produced no appreciable difference, and may be safely omitted without any untoward effects, either as regards sensitiveness or accuracy. Too great a percentage of mercury is fatal to the proper working of the coherer. After the filings (which should be made with a medium coarse cut file), have been placed in the tube and the plugs inserted, the next step is to test it

for sensitiveness. There are several methods, but the most expedient is to weigh the filings to a nicety and then adjust the plugs until the proper resistance is obtained, which again depends upon the purity of the metals and the combination employed. Experience is not unnecessary in this delicate process and to obtain exacting results, a series of tests should be made and all carefully noted for future reference. The tube, after adjusting, is exhausted, and then hermetically sealed. Such a coherer does not become easily deranged, and while extremely sensitive for marine work, it answers well for terrestrial and meteriological observations, it is not delicate and may be generally depended on.

It may be well to show the construction of a simple coherer, for purely experimental purposes. Fig. 9 illustrates its construction. Two brass conductor plugs slide freely through the brass standards mounted on a piece of hard rubber. The terminals of the plugs are of brass or silver 1 mm in diameter, sliding nicely into a piece of glass tubing. The plugs are fitted with a screw adjustment, to obtain an inward pressure, and the springs drawing the plugs outward when a higher resistance is wished. Set screws are provided on top of the standards to hold the plugs when adjustment is obtained. The filings should occupy a space about 1 mm between the terminals, though the amount is largely a question of the metal employed. In this coherer the ends are not sealed nor the air exhausted. The adjustment may be made whenever necessary, and altogether it is the most suitable form of coherer for experimental work, lecture purposes, class instruction or short distance telegraphy. If carefully adjusted, assuming that the tapper, relay and sounder are properly balanced, distances of two or three miles should be easily covered with a coil giving a spark 20 mm in length.

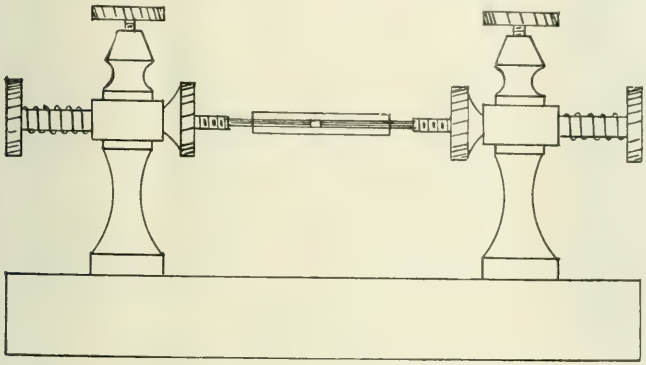


FIG. 9.—EXPERIMENTAL COHERER (FULL SIZE).

Another device to take the place of the electro-mechanical tapper is the Collins decoherer (Fig. 10). In this the coherer is a little different from the forms described in that the conductor plugs are beveled, forming a V-shaped pocket. Into this are placed some fine Norway iron filings, carefully annealed to prevent the retention of magnetism. Over the tube is an electro-magnet, the terminals of which are connected in shunt or series with the coherer plugs. It is evident that at the moment coherence is effected the filings will be attracted by the magnet and the circuit broken, by the attraction of the iron particles upward through the gradually widening gap formed by the plugs. With nickel filings the efficacy of the detector is greatly increased and the signaling distance being very much greater than when iron filings are used.

Coherers can be constructed that are self-decohering. Iron possesses this property to a considerable extent, though a lag occurs which renders the working of the instruments as slow as when equipped with a mechanical decoherer. Carbon decoheres without tapping, but the amplitude between the limits of conductivity and non-conductivity is so small that only the most sensitive receiving devices are affected by it. Silver is the most sensitive of metals, whereas nickel is the most reliable under the action of the Hertzian waves. The Ducretet system employs hardened steel particles. In some recent lectures I used a telephone transmitter as a coherer with fairly good results. Many other devices than those mentioned show the manifestations of the Hertzian waves, and theoretically the bolometer of Professor Langley should be able to detect them. I am informed, however, by him that it has never been tested in relation to the electric waves. Likewise, I am unable to give the details of Professor Fessenden's coherer which was announced by some of the daily papers to be one or two thousand times as sensitive as the best Marconi coherers. His work for the Government, so far as reported, has failed to reveal the ultra-sensitiveness thus far.

The limit of sensitiveness in detectors, I believe, has been reached, and future advances in space telegraphy will be due—not so much to the perfection of the electro-mechanical apparatus—but to the better understanding and application of that vague law we talk so glibly of as electrical resonance.

Helmholtz once said that the human eye was the worst constructed optical instrument he knew of. Mathematically, this is undoubtely true, but if man could only construct an electric eye—as the coherer has been termed sentimentally—with a small fraction of the sensibility for electric waves that the eye possesses in the discernment of light waves, he would be elevated on a very high pedestal—in his own estimation—for ingenuity and Godlike learning.

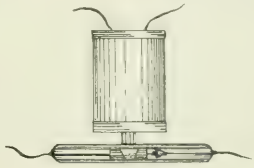


FIG. 10.—COLLINS' COHERER AND MAGNETIC DECOHERER.

German Electric Railway Experiments.

Consul-General Mason, of Berlin, Germany, reports as follows concerning the high-speed experiments in Germany, which from time to time have been referred to in these columns. There was organized at Berlin, on Oct. 10, 1899, a so-called "Studien Gesellschaft," or "company for experiments," in high-speed traction. This company—which has for its president Dr. Schulz, chief of the imperial railway administration—includes as members the General Electric Company, of Berlin, Messrs. Siemens & Halske, the great machine builders Börsig, Krupp, Halzmann, and Van der Zuypen & Charlier, besides several banks, which undertook to supply the capital of 750,000 marks ($178,500), for the necessary expenses of construction. The mere mention of the foregoing names will show that the Studien Gesellschaft represents the foremost scientific and mechanical ability of Germany. After more than a year of study and experiment with motors, conductors, and especially the task of taking up an electrical circuit by a motor moving at high speed, Director Rathenau, of the General Electric Company, in January of this year, had a formal interview with the German Emperor, in which he submitted a plan for using as an experimental electric line the military railway leading southward from Berlin to Zossen, a distance of 30 kilometers (18.6 miles).

This proposition was promptly and fully approved, and from that moment the whole scheme has had the active support of the Imperial Government. The line to Zossen is now in process of preparation for the trials which, it is expected, will begin in August or September. For these experiments two motor cars will be, or have been built—one by the General Electric Company, the other by Messrs. Siemens & Halske. Each will carry about 50 passengers, and efforts will be made to attain a speed of from 125 to 150 miles an hour. Meanwhile, Messrs. Siemens & Halske have been making some preliminary tests on a short provisional line, which was built for experimental purposes a year or two ago, at their works at Lichterfelde, near Berlin. The motive of these preliminary trials has been to test the important, but hitherto undemonstrated, point whether a motor moving at a speed of 100 miles an hour or more will take the current readily from a three-wire line. The experiments will be undertaken when the line to Zossen is specially prepared and the two motor cars now being built for that purpose are ready. That these preparations are not yet complete is shown by the fact that the Society of British Engineers, which visited Berlin a few days ago as guests of Messrs. Siemens & Halske, saw the provisional three-wire testing installation at Lichterfelde, as well as the motor car built

for the coming experiments by the General Electric Company, but were not taken to see the railway to Zossen.

Storage Batteries in Central Stations.

By R. F. Schuchardt.

An excellent illustration of the value of a storage battery in connection with an electric lighting system was shown in Chicago on Monday, June 24, when an accident in the Harrison Street station of the Chicago Edison Company caused the complete shut down of that station for about 40 minutes.

The accident in question occurred in the boiler room, and because of its peculiar nature most of the steam had to escape before the seat of the trouble could be gotten at. The steam gauge in the office of the chief engineer gave the warning and the chief operating engineer's office on Adams Street was immediately notified of the trouble by telephone. Orders were telephoned to Washington Street station to put on all low-tension generators, and the battery operator at the Adams Street sub-station was asked to prepare for full load.

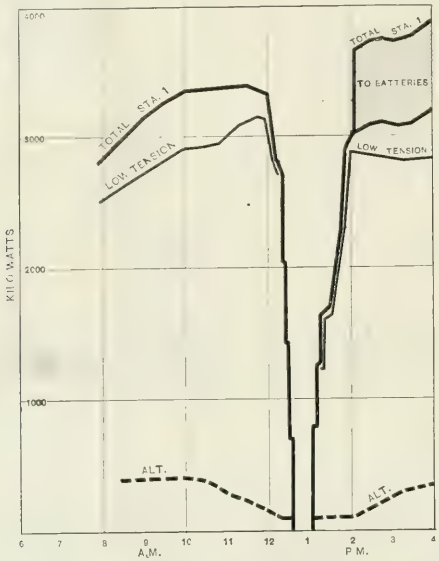


FIG. 1.—LOAD CURVE, STATION NO. 1.

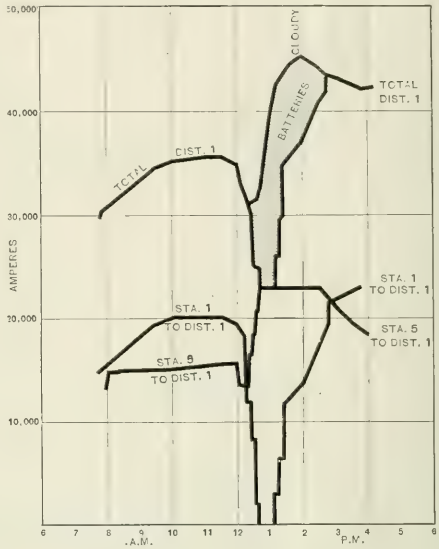


FIG. 2.—LOAD CURVE, STATION NO. 5.

The accident occurred at 12.25 p. m., and 15 minutes later not a wheel was turning at Harrison Street station, the generators having been taken off as the steam pressure dropped. The load carried by the stations at the time of the accident was as follows:

Harrison Street Station (Station No. 1).—Low-tension to District No. 1, 18,000 amperes; low-tension to District No. 3, 2000 amperes; three-phase to sub-stations, about 100 kilowatts. Washington Street Station (Station No. 5).—Low-tension to District No. 1, 11,000 amperes; low-tension to District No. 3, 400 amperes; high-tension (various), about 300 kilowatts. The Adams Street sub-station batteries were "floating" on the system.

In a remarkably short time after the orders were received Station No. 5 was carrying its full capacity, delivering 23,000 amperes to District No. 1, and some 400 amperes to District No. 3 (West Side), in addition to the high-tension load. Sub-station No. 2, on the South Side, shut down its rotary converters, and carried the District No. 2 load of about 1000 amperes on the battery of that sub-station. Of the North Side three-phase transmission lines, that to Station No. 4 was shut down, while the North Avenue sub-station rotary converters were kept running on the converse rotary converters at Sta-

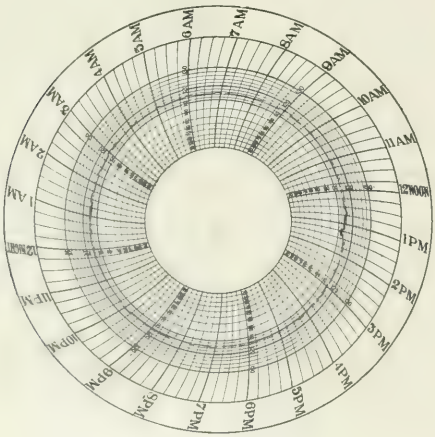


FIG. 3.—PRESSURE CHART.

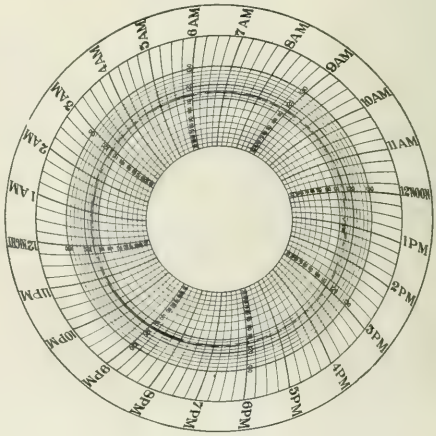


FIG. 4.—PRESSURE CHART.

tion No. 1, which latter received current from the Adams Street sub-station batteries fed *back* over the trunk lines. The steam engines of Station No. 4 were pressed into service, and by raising the voltage of the long north-runnig feeders much of the load was taken off from the North Avenue rotary converters, thus relieving the battery feeding into Station No. 1.

Station No. 1 load to District No. 3 was carried on bus No. 2 of the station by the Adams Street batteries through the charging switchboard over trunk line tubes switched to this board. All of District No. 1 load not taken care of by Station No. 5 was carried by the batteries, amounting to about 21,000 amperes average, with 23,000 amperes maximum. This load continued for about 40 minutes. The batteries had been "floating" on the system since the charge of the night before, and thus both of them—each with a capacity at a one-hour rate of discharge of 11,200 amperes—were "full." On the first signal from Station No. 1 each battery picked up 3000 amperes, and then increased this as the Station No. 1 dynamos were taken off, until each carried about 11,000 amperes.

At five minutes past 1 o'clock sufficient steam had been generated at Station No. 1 to begin to take back the load, and after normal conditions again obtained the batteries were charged so as to be prepared for a possible peak later in the afternoon, as the day was cloudy. There was, however, still about 20 per cent of the battery capacity left at the end of the heavy discharge.

The load curves, Figs. 1 and 2, give a good idea of how the load was dropped by Station No. 1, and picked up by Station No. 5 and the batteries. The pressure charts, Figs. 3 and 4, show clearly how quickly the changes were made, for, as shown, the voltage of the system never fell below three volts under standard pressure and, outside of the company's engineers, no one even suspected the occurrence of an accident.

Lighting an Antarctic Ship.

The British steamer "Discovery," which has just started for the South Polar regions, has some special lighting features. The most singular and conspicuous object on the upper deck is the great windmill, which is the driving agency in the novel lighting arrangements. Oil in sufficient quantities would take up more room than could be spared after the storage of food and scientific instruments had been provided for. The ship is therefore to be lighted throughout by electricity. The current is generated by a dynamo driven by this great windmill on deck, both being portable, so that they can be set up on the ice and connected with the accumulators by means of a flexible cable.

To wind-power the great drawback lies in the fact that, while at one moment the mill may make 200 r. p. m., a strong gust will the next instant raise the speed to 2000, the rate falling with equal rapidity upon the disappearance of the wind. With a dynamo working so irregularly it is impossible to charge accumulating cells. This difficulty has been overcome by Mr. Bergtheil, of the firm of Bergtheil & Young, who are responsible for the lighting. The mill drives two dynamos, to one of which is fitted an arrangement which equal-

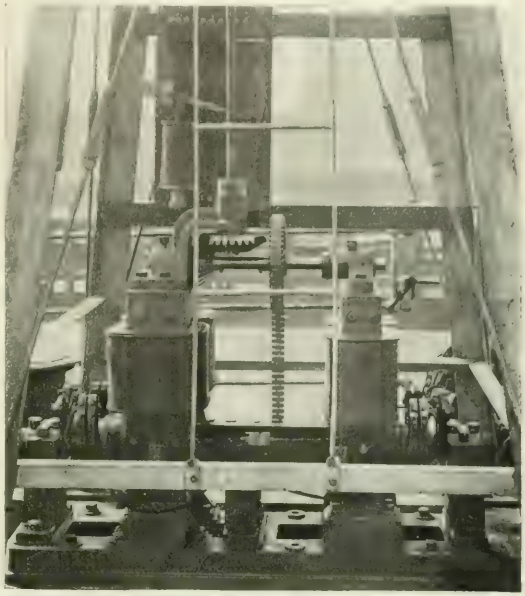


FIG. 2.—DETAILS OF WINDMILL PLANT.

FIG. 1.—STEAMER "DISCOVERY" WITH WINDMILL ON DECK.

izes the current, offering greater resistance when the wind is high and less when it falls. Thus the number of revolutions of the mill can vary from 500 to 2000 per minute without causing any appreciable difference in the current, which, when the mill stops, is automatically cut off, and when it restarts is switched on to the accumulators, evenly supplying the 50 or more lamps in the ship. A simple contrivance is fitted to the accumulators, causing a bell to ring when too much current is being taken from them. To prevent the accumulators freezing they are placed low down in the vessel, next the engine-room, and as the acid will not freeze till —29 degs. F. is reached the contingency is unlikely to happen.

Unprofitableness of Cheap Telephony.

One of the papers read at the recent meeting of the Independent Telephone Association of Southern Indiana was by Mr. J. W. Ladd, on "Is It Profitable to Furnish Telephone Service at 50 Cents per Month?" He pointed out that cheap apparatus at first was dearest in the long run, and that the best instruments and material yielded the most satisfactory results.

The continual annoyance of disturbed service, or more properly a bad service, which must necessarily result from the use of poor material, is sure to bring about a heavy tax in the way of expense, to say nothing of a reduced rental consequent upon a loss of patronage, whereas on the opposite hand a properly constituted and a properly equipped system insures a prompt and satisfactory service and increases rather than decreases the returns; not only in the way of increased business, but in a large saving in the way of expense. Then the life of the system is a matter of material consideration. It is not to be supposed that any material will last indefinitely. Accidents, breakage and the wear and tear of the natural elements will in time necessitate the reproduction of the entire system. This may be done, in fact, is done, at forced interims, and by piecemeal, but the expense is there and proves a very disagreeable factor in making up the profit and loss account. The life of a telephone equipment cannot be definitely known, but it is safe to say that 12 to 15 years, under the most favorable conditions, and with the use of the best material, would mark the period of its usefulness and require reproducing or duplicating. This would call for a reinvestment or doubling of the original investment, and the returns must justify this procedure.

Then the character of the subscribers brings up the consideration of the question in another phase. More instruments can be placed upon a single wire line in the rural districts, than in town, or even in a more diversified or thickly populated locality of mixed interests. Farmers will converse with one another over their lines and cause less disturbance to the exchange or to through service than subscribers in towns and cities. On the other hand, in towns and cities the instruments are distributed over a smaller amount of territory and the time and expense of keeping the lines and instruments in good working conditon is consequently reduced. If the wire becomes grounded or a lightning arrester fails to do its duty, and an instrument burns out or is wrecked 20 miles from the home office, the cost of repair is largely increased in the way of time in getting to and from the seat of trouble, and time means money. But in towns and cities there must be more wires to the number of instruments in use, more and better poles, more accidents, and to overcome electrical disturbances, metallic circuits and better insulation in every way, so that one section cannot possess any great advantage over another section.

Telephone patrons are, as a rule, very exacting, and ofttimes unreasonable in their demands, and should be made to pay a fair, if not a liberal price for a good service. This they will do, and willingly, but if a call bell refuses to respond or if the wires break or become grounded, or for any reason fails to conduct the subtle fluid to the point wanted, distance is an unknown quantity in the consideration. It is time, or rather opportunity, to kick, and the defect must be remedied instanter, and sooner if possible, or the system suffers in reputation for effectiveness. The numerous minor incidental accidents and petty trouble connected with the business and not mentioned especially pile up the expense account of intolerable proportions, sufficiently even at the maximum rate of $100 per month, to take the business entirely out of the catalogue of sinecures. The original cost per mile for constructing a single line, by using the best native poles, may be reduced to a minimum of, say, $60, with an average of two boxes to the mile, is probably not far from correct. This, at 50 cents per month, would yield a return of 20 per cent upon the investment, but when they came to consider the item of expense which will run to 15 per cent of the original cost, and the cost of operating exchanges, the profits vanish into thin air and the balance appears on the wrong side of the profit and loss account.

American Street Railway Association Entertainment Committee.

The entertainment committee of the American Street Railway Association met pursuant to call at Cafe Martin, 7 p. m., Aug. 8, 1901. The following gentlemen were present: Messrs. Cooke, Reed, Evans, Barr, Webster, Littell, Fairchild, Sanderson, Martin, McGraw, Meneeley, Wakeman, Robinson, Vreeland and Pennington.

Mr. Robinson called the meeting to order, and the following matters were discussed, and it was decided, that owing to the fact that this was to be a three-day convention, and that there were to be two business sessions on Wednesday, Oct. 9, 1901, and on Friday, Oct. 11, 1901, and owing to the fact that Thursday, Oct. 10, 1901, was to be Exhibitors' Day, the committee would provide no special entertainment whatever for the gentlemen in attendance upon the convention, and would limit its efforts to the entertainment of the ladies, providing such entertainment for three days. It was decided also that the committee would not give a theater party or a general reception.

It was decided to open the Madison Square Garden to the public on Wednesday morning, afternoon and evening, Oct. 9, 1901, on Thursday evening, Oct. 10, 1901, and on Friday morning, afternoon and evening, Oct. 11, 1901, and that a charge of 50 cents be made to the general public for admission to the Garden at such times. A band will play in the Garden.

It was decided that a sub-committee of the general entertainment committee be appointed by the chairman, to be composed of the chairman and five members of the committee, to carry out the work laid down at this meeting, and the chairman appointed the following gentlemen: Messrs. Sanderson, McGraw, Cooke, Meneeley and Martin.

A concert will be held at the hotel on the morning of Oct. 9, 1901, for the ladies, to be followed by a reception to the ladies. A local entertainment committee of ladies will be appointed to hold the foregoing reception, and to act generally in the capacity of such committee. Information bureaus will be established at the hotel and Madison Square Garden.

It was also decided to provide automobiles for the general use and entertainment of the ladies attendant upon the convention for one day.

The following matters were discussed and referred to sub-committee. Provision of carriages for the ladies' entertainment for a second day; a trolley ride over Brooklyn Bridge, and to some point of interest in Brooklyn; a large electric sign on Madison Square Garden during the continuance of the convention; an itinerary and general guide to the points of interest in and about the city of New York for free distribution; a trolley ride to Fort George; a visit to the Metropolitan Museum of Art, Riverside Drive and Central Park for the ladies.

Electrical Activity in Montreal.

The Montreal electrical companies have furnished the people a good deal of excitement during the past two months, and now promise some more. There appears to be something new moving in electrical circles in Montreal, to judge from the extensive preparations now being made by the Lachine Rapids Hydraulic Company to provide for contingencies. A meeting of the shareholders of this company has been called to authorize the issue of a million a half dollars' worth of bonds. The marketing of such a heavy amount of securities indicates that something unusual is about to happen among the electrical companies. Mr. Walbank, the manager of the Lachine Hydraulic Company, states that his company was issuing the bonds to prepare for any emergency whatever. The new bonds are to be issued to meet any contingency whatever, whether it be the entrance of the St. Lawrence Power Company into competition, an order from the city to place the wires underground, or anything else. The improvements the company proposes to make this summer will absorb about $500,000 of the bond issue, leaving a million in reserve. The company is completing a 4000-volt transmission line from the power house to the city, and installing four more generators, which will make an aggregate generating capacity of about 15,000 horse-power.

Generating Units for the Boston Elevated Railway.

The steadily increasing number of large generating units for electric traction will shortly be further augmented by two 4000-hp sets, the compound parts of which are rapidly approaching completion in the shops of The Westinghouse Company at East Pittsburg, Pa. These units are for the extension of the power plant of the Boston Elevated Railway Company (described in the Electrical World and Engineer of June 15 and Aug. 10), and are to be installed in the Lincoln Wharf and Cherlestown generating stations, respectively.

The engine is of the vertical inverted cross compound type, having the generator and flywheel mounted on the shaft between the

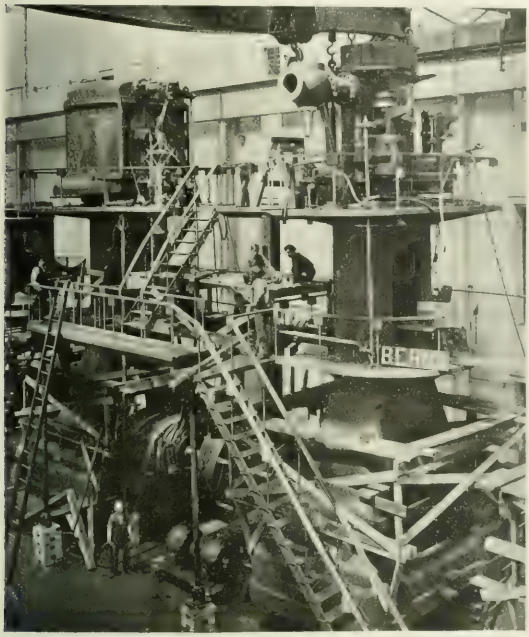


FIG. 1.—ONE OF 4000-HP ENGINES IN COURSE OF BUILDING.

high-pressure and low-pressure cylinders. The high-pressure and low-pressure cylinders are respectively 44 and 87 inches in diameter, with a stroke of 60 inches. The engines are to run at 75 r. p. m., and with superheated steam at 160 lbs. gauge pressure. Under these conditions, and with 26 inches vacuum, the economical load is about 4000 horse-power, but as the high-pressure cut-off has a range up to 75 per cent of the stroke, the overload capacity is over 7000 horse-power, and the engines are sufficient strong in all their parts to carry this ultimate load without risk.

Neither cylinder is steam jacketed, and a tubular reheating receiver is placed horizontally between the cylinders and containing about 1400 square feet of reheating surface.

The valves on the low-pressure cylinder are of the well-known Corliss type, multiported, and placed in the cylinder heads to reduce clearance to a minimum. On the high-pressure cylinder, a radical departure from the usual American design has been made in the adoption of balanced poppet valves. The ordinary Corliss valve, while giving excellent results with saturated steam, is not suitable for engines using highly superheated steam, on account of the impossibility of getting the necessary lubrication at the increased temperatures.

The shaft is made of open hearth steel, hollow forged in a hydraulic forging machine. It is 37 inches in diameter at the flywheel and armature fits, and 34 inches in diameter in the bearings. It is 27 ft. 6 inches long from center to center of cranks, and has a hole 16 inches in diameter throughout its length.

The flywheel is 28 ft. in diameter, and is built up on a hub or center of air furnace iron, heavily flanged on one side for bolting to the armature of the generator. Five steel castings, each comprising two radial arms and [illegible] degrees of rim, 12 inches wide, are fitted to the center with ream bolts, and the rim joints secured by shrink links. Ten more cast steel rim segments 3¾ inches thick are fitted, five on either side of this 12-inch section in such a way as to break joints, and are secured by reamed pins riveted in place by a hydraulic press. The radial joints in the side segments are also further secured by shrink links. The total weight of the wheel is about 125 tons.

The emergency stop valve is actuated by a steam cylinder piston. This valve closes automatically when the speed of the engine passes a fixed limit, or may be manually controlled from several points on the engine by means of valves which admit steam above or below the piston in the actuating cylinder. The automatic control is effected by a small weight pivoted in one crank check, and balanced against centrifugal force at normal speed by a coiled spring. When normal speed is exceeded, the weight flies outward by reason of the excess of centrifugal force, and strikes a conveniently located spring lever that opens a three-way cock, admitting steam to the actuating cylinder which immediately closes the valve.

The over-all dimensions are as follows: Height, 38 ft; length, 40 ft.; width (which is fixed by the diameter of the flywheel), 28 ft.

The generator, which will supply power for both elevated and surface lines, has a nominal capacity of 2700 kilowatts, and under full load will deliver a direct current of 4500 amperes at 600 volts. Like the other machines in the power houses of the Boston Elevated Railway Company, it is compound wound, and has the series field shunted so as to give practically constant potential at all loads.

Although this machine is of exceptional size, it has not been found necessary to depart from the standard type of construction, and except in size and the number of poles, looks exactly like any

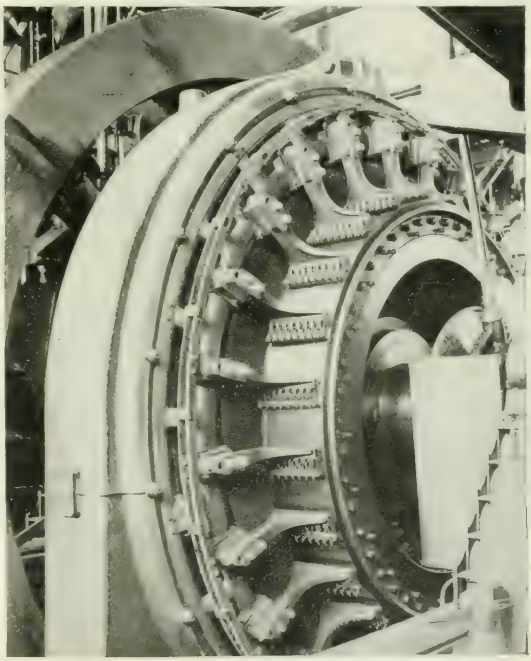


FIG. 2.—2700-KW GENERATOR, LINCOLN POWER STATION.

other Westinghouse railway generator of the engine type. The field is, as usual, divided in a vertical plane, the laminated pole pieces are cast into the frame, the shunt and series coils are wound and insulated separately, and separated from each other by a wide air space; and the brush holders are supported by a massive ring, which is hung from the yoke of the machine. The commutator is of particularly generous proportions, and with its whole surface open and unobstructed by the brush-holder ring. The armature has a bar winding made of continuous coils, and held in the slots of the armature

core by fiber wedges, a construction that dispenses with the use of bands of any kind.

The method of balancing the circuits in the armature so as to prevent the interchange of current and sparking at the brushes is interesting. A number of points in the armature winding which are nominally of equal potential, are connected by leads through which current may pass from one section to the others with which this section is connected in parallel. These currents, alternating in character, lead or lag with reference to their respective e. m. f.'s, thus magnetizing or demagnetizing the field magnets, and automatically produce the necessary balance between them. This method of balancing is of great advantage in eliminating the sparking at the brushes and the wasteful heating that occur when an armature becomes decentralized. When, with an armature out of center, the air-gap on one side is greater than that on the opposite side, the potential generated in the coils, if the armature has the ordinary multiple winding, will be greater on the side having the smaller air-gap than that generated in the coils under the poles of the same polarity on the opposite side. Consequently, a current corresponding to this difference of potential flows from one section of the winding to another through the brushes. This flow of current will act the same as if two generators were coupled rigidly to a single shaft and the potential of the one was raised above that of the other, in which case the machine having the higher potential would act as a generator and the other would run as a motor. This, of course, results in bad sparking and the burning of the brushes.

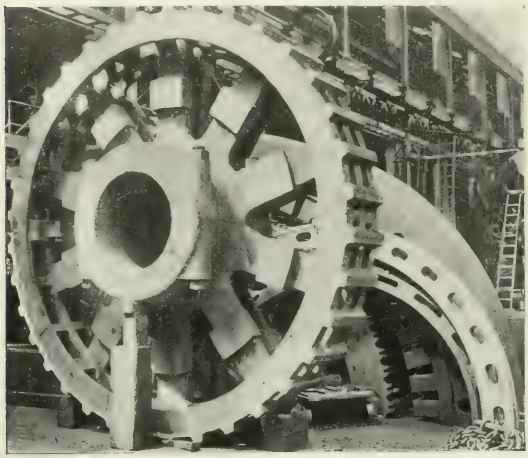


FIG. 3.—ARMATURE SPIDER CASTING.

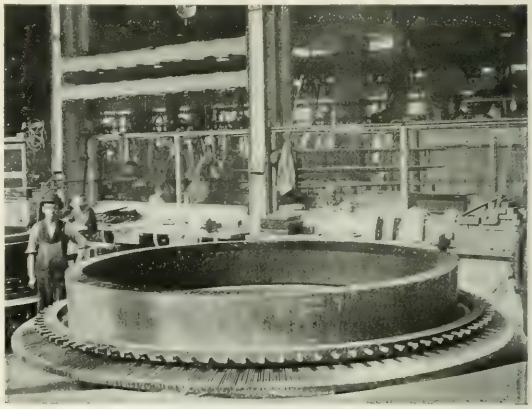


FIG. 6.—COMMUTATOR RING 12 FT. IN DIAMETER.

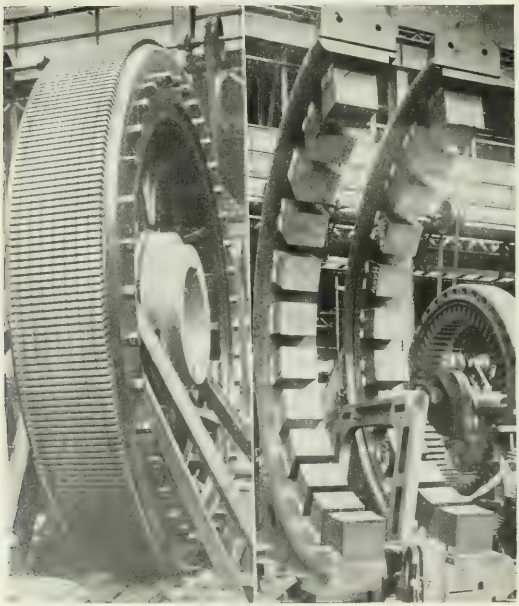


FIG. 4.—ARMATURE CORE READY TO RECEIVE COMPLETE COILS.

FIG. 5.—TWO HALVES OF FIELD.

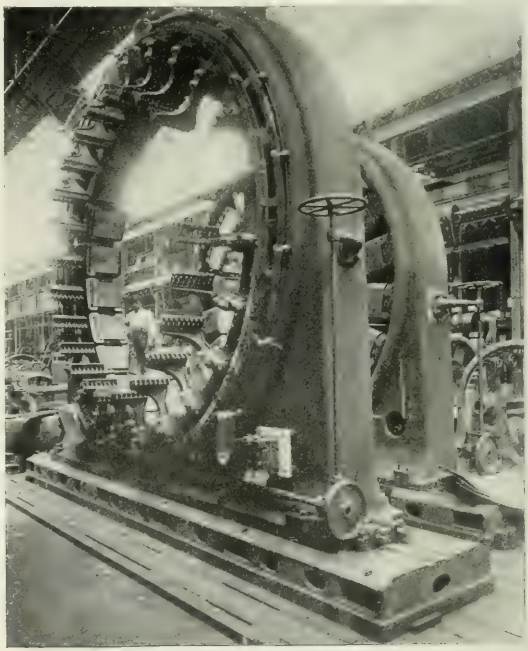


FIG. 7.—COMPLETE FIELD.

By the use of this balancing method, the armature can be considerably out of center, and no injurious results occur, for the balancing currents do not flow through the brushes, but through specially provided connections. In addition to this, the fact that the currents in the conductors are alternating currents, which are "leading"

in some coils and "lagging" in others, enables a very small current to balance the circuits effectively. This method of balancing the magnetic circuits is also advantageous in preventing any heavy magnetic pull on one side of the armature should it get out of center through the wear of the bearings. The pull which may be exerted by one side of the field on a large armature, even if out of center by but a fraction of an inch, may become very high. Such an increased pull on the armature results in the heating and rapid wearing of the bearings, but this method of evening the induction under all the poles produces the same magnetic pull at all the poles and prevents, therefore, an unbalanced pull.

Another notable feature is the method of saturating the pole tips so as to prevent the distortion of the magnetic field and the consequent sparking at the brushes when the load changes. The method is simple and very successful in operation. It consists in cutting off the corners of a part of the laminations of which the pole is made up, leaving only sufficient metal to carry the normal induction. Accordingly when the load is put on the armature, the cross-magnetizing force is absorbed by these saturated pole tips without distorting the magnetic field. Thus a remarkably steady field and a constant position of the neutral point are obtained without any regulating device or complexity of structure.

The machine, as a whole, has been very generously proportioned to meet the severe conditions of service required by the Boston Elevated Railway. In ordinary service it runs remarkably cool. The open-bar winding, the open construction of the armature spider and core, and the edge-formed series coil of several bars in multiple with air spaces between, make a construction that renders the machine proof against overheating.

The Bremer Arc Light.

Although the Bremer arc light has been the subject of many notices in European electrical journals for the past year or more, very little or no information has been obtainable by which to judge the remarkable claims that have been made as to its revolutionary character. Such information, however, is at length offered in two patents that were granted last week to Hugo Bremer, of Neheim, Germany, one on the material of arc light electrodes and the other on a form of arc lamp.

The electrode, it appears, is of the kind in which a metallic salt or salts is mixed with pure carbon, but with the addition of another substance which comprises the new feature. It is stated that disturbing influences have stood in the way of application of metallic salts, first through the scorified secretions of the salts, and, secondly, through the circumstance that if the percentage of metallic salts is increased and the amount of carbon reduced accordingly, the heating effect produced by the combustion of the carbon is greatly reduced so that the metallic vapors are not completely brought to incandescence. The scorified secretions, on the other hand, will sooner or later form an incombustible coating which will eventually smother the arc.

The principle on which the Bremer invention is based consists in the introduction in the electrode of borine or fluorine, whereby the otherwise solid scoria will be softened or liquified, thus causing them to drip off periodically. In order that the fluxed scoria may drip off and not interfere with the light, the round form of carbon pencil is not used, the cross sections illustrated in the patent being of such a shape as to present sharp edges, such as a square or a section with four concave sides.

A specimen claim is for an electrode composed of pure coal and of from 10 to 70 per cent of metallic salts or metalloids, such as calcium, magnesium, glass fluor-spar and the like, in combination with a high quantity of boron and fluorin, and a further quantity of 25 per cent of fluorin, bromine or iodine—the electrode being provided with ribs or grooves to receive a sharply edged section.

For an electrode, the light of which shall give a yellowish tint, fluorine may be used mixed with the carbon in conjunction with more than twice its quantity of calcium or calcic salts; a more whitish tinge may be given to the light by adding some magnesium. It is stated that the easiest way to add the fluorine and borine is to bring it in connection with the other metal salts, such as cryolite or fluor calcium, or to mix the pure carbon with fluor carbonite.

The second Bremer patent describes an arc lamp in which two or more inclined carbons are used for both the positive and negative electrodes, both sets of carbons being inclined above the horizontal, the carbon points being surrounded by a metal chamber open below. With such an arrangement the Bremer type of electrode will deposit a snowy coating on the surface of the reflector during combustion, whereby the metallic parts will be better protected against the influence of the heat radiated, and a highly reflecting, dull-white coating provided. The coating obtained in this way will adhere to the metallic parts in a thickness of about an eighth of an inch, and it is only after they have exceeded a certain measure of thickness that the excess will fall down when fresh carbons are inserted. In the case of carbon pencils pointed upward at an acute angle, the influence of a magnet or solenoid is brought to bear on the arc so that it is projected downward, the magnet being energized by the same current which feeds the lamp. The coil itself is not in close proximity to the arc but is provided with an extension piece of more than twice the length of the magnet core, the end of which is immediately above the arc.

The Development of Trolley Freight Systems.

Milk and cream form a most important item in the freight carried on the various interurban roads radiating from Cleveland. It is figured that in the neighborhood of 10,000 gallons of this commodity are brought into Cleveland daily by the various lines. The Northern Ohio Traction Company alone averages over 2500 gallons daily, special cars being used for the purpose. On the return trips several hundred gallons are carried to Akron. The Cleveland & Eastern Railway handles about 3000 gallons of milk daily. The milk question has proven a perplexing proposition to the city authorities. The interurban companies have been in the habit of unloading cans at various points inside the city, frequently delaying city cars for 10 or 15 minutes. The authorities undertook to force the companies to unload all cars at their downtown stations, but thus far they have been unsuccessful. It is claimed that the State has acknowledged the right of interurban roads to carry freight, and there is no restriction or provision as to the manner of unloading, hence the companies claim they can unload freight at any point the same as passengers.

The Commissioners of Cayahoga County, Ohio, are endeavoring to draw a line as to the amount and extent of freight which may be carried on electric railways which operate along highways. The statutes of Ohio do not place any limit upon the amount or kind of freight which may be handled by an electric railway, but the Commissioners propose to place restrictions in all franchises granted in the future. The promotors of the Cleveland, Richfield & Akron Railway and the Cleveland & Warren Street Railway, which are now endeavoring to secure franchises, demand that there shall be no restrictions on the freight proposition, while the Commissioners say they will not grant the franchises unless there is a clause prohibiting the carrying of other than box or package freight. It is claimed that the railway people propose to haul coal, machinery, grain and, in fact, almost anything that is carried by the steam roads.

Within the past 14 months there has grown up an express and freight business over the trolley lines of the Connecticut Railway & Lighting Company, between New Haven and South Norwalk, including the Naugatuck division, that is giving the steam roads and the express companies using them lively competition. It was started by C. M. Cole, of New Haven, and is known as the Cole Electric Express Company. Three auxiliary delivery wagons were employed on the start. The company now has 19, and in all towns on the line of the trolley has found it necessary to employ permanent agents. In a few days the company will put into service a new 40-ft. freight car, the first of a series. The largest patrons of the Electric Express are the farmers, who find it a convenient and economical way of sending their produce to market.

The Telephone as a Detective.

The chief inspector of the United States Post Office Department has just made his report. In connection with the work of the inspector's office a story is told of a young attorney who unwittingly gave evidence against himself. He had written an obscene letter to a married woman and was suspected by her husband, who accused him of the act. Leading him into an inner office locking the doors and displaying a loaded revolver, the attorney admitted his crime and taunted his victim. How to trap him was a question, as he denied the charge in public, but laughed at the man in private. After the expenditure of much thought, a miniature telephone was contrived, with an almost invisible transmitter, in the top of a silk hat

worn by the aggrieved husband, with an insulated fine gold wire, connecting with a receiver in the possession of a postal inspector. Another visit was paid to the attorney's office and again behind his closed doors he acknowledged repeatedly that he had sent the letter. But this time the inspector at the other end of the telephone heard every word. When confronted with the evidence the man broke down and confessed.

Electrolytic Refining of Lead.

Mr. Anson G. Betts, of Upper Troy, N. Y., has just patented a novel and carefully elaborated method for the electrolytic refining of crude lead. The chief difficulty attending this operation arises from the tendency of lead to electro-deposit upon the anode in the form of peroxide, and it is suggestive to note that certain of the processes heretofore proposed for the separation of metallic lead at the cathode are now used in technical analysis to estimate the metal as peroxide at the anode, a circumstance which sufficiently indicates the cause of their commercial failure. This tendency to anodic precipitation is especially marked in alkaline solutions, and in acid solutions of the nitrate. From acetate solutions under proper current conditions metallic lead may be obtained, but such solutions are but feebly dissociated and therefore of low conductivity, and are, moreover, very susceptible to oxidation and secondary decomposition.

Mr. Betts's improvement as concerns the method, lies in the employment as the electrolyte of fluorine compounds of lead, and especially the fluosilicate $Pb\ Si\ F_6$—a salt which, in acid solution, is sufficiently soluble, of high conductivity, and from which there is said to be no tendency to anodic precipitation. The anodes are of "work-lead," and the cathodes of iron which has been coated with pure lead by dipping. The lead dissolves and deposits freely, leaving at the anode a complex slime containing the foreign metals or their salts, and forming at the cathode a deposit of pure lead, which, as the operation proceeds becomes loose, rough, uneven and vaguely crystalline, and must be rolled or pressed into smooth and compact form at short intervals.

For the purpose of compacting the cathode deposit as required, the inventor has provided an ingenious but highly complicated device, comprising a traveling truck mounted upon rails upon the vat, and carrying porcelain rolls and automatic means whereby the cathodes are successively and repeatedly raised from the electrolyte, rolled, and returned to their positions. This apparatus forms the subject of a separate patent bearing date of July 30. The deposited lead, when of sufficient weight, is removed from the iron cathodes by simple immersion in molten lead, enough lead adhering to the iron, however, to protect it from the acid electrolyte when again immersed therein.

The fact of the discovery of an electrolyte capable of yielding under all conditions an exclusively cathodic deposit of lead possesses both chemical and technical interest. If this deposit were also dense and reguline, there would be little question as to the commercial value of the method disclosed. But whether the market value of lead can support the complicated and costly apparatus used for the intermittent treatment of the cathode plates during the refining operation is a question best left to the future experience of the patentee.

The Telegraphic Heart of England.

The following data from *Titbits* is quite interesting: The Central Telegraph office at St. Martin's-le-Grand is the busiest spot in London. Day and night, Sunday and week day, throughout the year, the place is the scene of great activity, for the building is never closed. At this one telegraph office between 125,000 and 150,000 telegrams are handled daily. The record number of messages received and dispatched in one day is 195,411, which was the number reached on the day before the late Queen's Diamond Jubilee in 1897. There are no fewer than 1226 telegraph instruments, and a staff of nearly 4600 persons is employed. There are 2470 men telegraphists, about 1200 lady telegraphists, 880 messengers and 50 special servants. When anything important occurs the Central Telegraph Office is exceedingly busy sending reports across its numerous wires. Often as many as 500,000 words are dispatched in the early hours of the morning of a famous parliamentary speech. When Mr. Gladstone introduced his Irish Home Rule bill, in 1886, over 1,000,000 words were dispatched over the wires from the head office. This is regarded at the Central Telegraph Office as a "night's" record.

Messages can be sent from this office to all parts of the world. In addition to the telegraph wires there are numerous telephone circuits, one of the most interesting being that from London to Paris. As many as 300 persons have used it in a single day, and a charge of $2 is made for every talk of three minutes' duration or less.

CURRENT NEWS AND NOTES.

ST. LOUIS, MO., FREE RIDES.—The St. Louis Transit Company hereafter, instead of requiring the poor children of the city to exhibit a physician's certificate in order to ride free of charge during the heated term, will issue tickets and place them in the hands of the Fresh Air Mission.

PROPOSED PARIS-ANTWERP ELECTRIC ROAD.—Consul-General Hughes sends the following from Coburg, July 11, 1901: Under the patronage of the King of Belgium, a French-Belgian syndicate is being formed, it is reported, to build an electric express line for passengers and light freight between Paris and Brussels, and from the latter place to Antwerp. The trip from Paris to Brussels is expected to be made in one and a half hours, and from Brussels to Antwerp in 10 minutes.

ELECTROSTATIC INDUCTION MOTOR.—Professor Hidetaro Ho calls our attention to a misprint in the article which appeared in our issue of June 15 on a rotary field electrostatic induction motor devised by Professor Ho. The starting torque of the hysteresis motor of Arno, which has points of similarity with the motor described, is stated to be 18 gramme-centimeters. The correct figure is .18 gramme-centimeter, thus being considerably less than that obtained with Professor Ho's motor, which in one test was .71 gramme-centimeter.

THE A. A. A. S.—The fiftieth meeting of the American Association for the Advancement of Science is to begin at Denver on Aug. 26. The association has never before met further west than Minneapolis. The last meeting was that held at Columbia University in this city last summer. The meetings at Denver will be held in the Denver High School. There are several changes to be proposed in the organization of the society. One is to give the permanent secretary a salary of $5,000 a year, or else to provide him with salaried assistants to do the increasing routine work of the association. There is also an idea of changing the time of meeting of the association from the summer vacation to the Christmas holidays. A new section to consider commerce and manufactures will probably be organized. The principal address to be made at the meeting will be that of the retiring president, Professor R. S. Woodward, of Columbia; Governor Orman, of Colorado, and Mayor Wright, of Denver, will make welcoming addresses. It is hoped by many that the association will show new life.

METALLIC SODIUM BY ELECTROLYSIS.—An interesting modification of the commercial process for the manufacture of metallic sodium from a fused electrolyte is described in a recent patent (Aug. 6) issued to George P. Scholl, and assigned to Charles W. Roepper, both of Philadelphia. Metallic sodium is now produced exclusively by the electrolysis of fused caustic soda between concentrically disposed electrodes separated by a cylinder of wire gauge, following the method invented by Hamilton Young Castner. Mr. Scholl's improvement consists in adding to this fused caustic electrolyte a certain proportion, approximate 50 per cent., of sodium sulphide, the mixture being then fused and the voltage of the electrolyzing current maintained at so low a point as to decompose only the sulphide. Sodium is withdrawn at the cathode, and the anion, sulphur, reacting upon the caustic reconstitutes the sulphide, which is again electrolyzed, the process being rendered continuous by the addition of caustic in quantity proportionate to the sodium recovered. Since the voltage theoretically required for the electrolytic decomposition of the sulphide of sodium is only 1.8, this process should represent a considerable economy of current. The fact that hydrogen is not set free with the metal at the cathode, as is the case when fused caustic is electrolyzed, represents not only current economy, but an important technical advantage, for it is the danger arising from the presence of hydrogen in the highly heated decomposing chamber which, more than any other factor, has imposed a limit to the size of the cells now used.

PRISONERS TO POLES.—At Trenton, N. J., two members of the United States Life Saving Service are in the county jail serving a 30-day sentence on a charge of trespassing on the Pennsylvania Railroad tracks. They were arrested by a constable, who chained them to telegraph poles for seven hours before taking them to jail.

NEW WATER POWER DEVELOPMENT AT SAULT STE. MARIE.—The contract for the second water power canal, of the Lake Superior Power Company, at Sault Ste Marie, Ont., is likely to be awarded to Mr. George Goodwin, of Ottawa. This new canal will be longer than the present power canal, and will also be larger, 26 ft. deep and 150 ft. wide. The excavation will include 500,000 cubic yards of rock and 40,000 cubic yards of earth. The head gates and power house are not included in the specification.

INDEPENDENT TELEPHONE MOVEMENT IN SAN FRANCISCO.—It is stated that the People's Mutual Telephone Company will soon start to work completing its underground system. The company has now more than 5000 contracts for telephone service, and many houses have already been wired and are ready for connection to the underground system. A contract has been entered into for switchboards and 6000 telephones, involving an obligation of $126,000, and another contract for cable involving $176,000.

THE LONDON METROPOLITAN.—A *Herald* London cable says that the announcement that the Metropolitan Railroad Company had declined the offer of C. T. Yerkes to electrically equip its lines was premature. The bill which passed both houses and only awaits royal sanction authorizes the road to enter into a contract with the Yerkes syndicate to substitute electricity for steam. After royal sanction it will then rest with the Board of Trade to define which system of electricity will be adopted, and the Yerkes people have no doubt about the decision. The Metropolitan District line, lately acquired by Mr. Yerkes, announced last week a dividend of only 3 per cent on the guaranteed stock of 1882, for which a 4 per cent dividend is cumulative. Last year this 4 per cent was paid, and 3⅛ on a junior stock.

THE ALASKA CABLE.—The cable expedition which was expected to leave Seattle, Wash., for Alaska on Aug. 9 will not be able to sail until about the middle of the month, owing to a delay in the arrival of the chartered cable ship. Among the electrical men who will have charge of laying the Government cable, which will connect Juneau and Skagway, are Messrs. George R. Porter and Alexander Klein, of New York, and W. A. Speake, of Seattle. The cable has arrived in Seattle and will be loaded as soon as possible on the steamer Lakine, under Mr. Klein's supervision. The soundings for the cable, which is 125 miles in length, will be made while going up Lynn Canal, and the cable will be laid on the return trip. It is estimated that the actual work of paying out the cable will take about 18 hours with favorable weather.

WIRELESS TELEGRAPHY IN MASSACHUSETTS.—A telegram, Aug. 8, from Nantucket, Mass., says: Work upon the 160-ft. mast at "Bunker Hill," Siasconset, for the wireless telegraph system was completed at sunset this evening. The 80-ft. mainmast was raised on Saturday without mishap, and is strongly guyed with 2¼ wire rope attached to heavy sand anchors. The topmast is also guyed to the sand anchors, but by 1¾ wire rope. The guys from the topgallant mast, for electrical reasons, are of tarred rope. The pole will be painted white. The "ground" connections were made by placing eight heavy metallic plates, 2½ by 8 ft., in the ground at the rear of the operator's house. Over 100 cells will furnish current. Messrs. Bradfield and Lockyer have left for the South Shoal Lightship to install the plant upon that vessel. Commander J. D. Kelley, U. S. N., intends to have the service open to the public if desired.

BARIUM CARBIDE.—As long ago as 1894 M. Moissan attempted to produce barium carbide by the reduction of barium sulphate by carbon in the electric arc, but such is the stability of the alkaline earth sulphides at high temperatures that the yield of carbide was found to be inconsiderable even when the mixture was maintained in fusion for long periods. The sulphate was reduced to sulphide, but there the reaction ceased. Later Mourlot again called attention to the impossibility of completely reducing the sulphate to carbide, but stated that by rigidly limiting both the intensity of the arc and the duration of the heating a pure crystalline sulphide could be obtained, free from the admixed carbide found by Moissan. It is is now found, however, by M. Limb, that it is possible to completely reduce the sulphate to carbide by the simple expedient of adding to the charge, consisting of barium sulphate and carbon, sufficient iron to combine with all of the sulphur present, the solid reaction products being sulphide of iron and carbide of barium. This mixture treated with boiling water yields acetylene gas, a solution of caustic baryta and an insoluble residue of sulphide of iron. This process is of peculiar interest to beet sugar manufacture by reason of the production of caustic baryta as a by-product in the manufacture of acetylene.

FOREIGN TRADE OF GERMANY.—Ambassador White, of Berlin, has transmitted the following official statistics of the foreign trade of Germany from 1891 to 1900, inclusive, to the Department of State: In 1891 the United States occupied fourth place in the import trade of Germany, with a total of $108,528,000, being preceded by Great Britain with $160,888,000; Austria-Hungary, with $142,324,000 and Russia, with $138,040,000. In 1895, the imports into Germany from the United States rose to $121,618,000, and after that year increased rapidly until 1900, when they reached the sum of $266,750,400. The United States thus stands far above any other country in this trade, being followed by Great Britain, with $199,920,000; Russia, with $173,740,000; Austria, with $172,312,000, and France, with $72,590,000. During this period, American imports into Germany have increased more than those of the last named four countries together. As regards the export trade of Germany, the United States has occupied third place during this whole period. In 1900, the United States imports from Germany were to the value of $104,482,000; in 1899, $89,726,000, and in 1898, $79,492,000. Up to 1898, they showed a tendency to decline, amounting in 1891 to $84,966,000, and sinking in 1894, under the tariff of 1890, to $64,498,000, the lowest point reached. The first place in the export trade has been continually held by Great Britain (which is the only large country with which German trade shows larger exports than imports); the second is held by Austria-Hungary, and the fourth by Holland, though from 1896 to 1899, inclusive, this was held by Russia, which is now fifth.

SOLUBLE ANODE IN CAUSTIC SODA MANUFACTURE.—Two French chemists, Hippolyte Palas and Felix Cotta, have just patented in this country (Aug. 6) a process for the simultaneous production by electrolysis of copper sulphate and caustic alkali. The direct reaction between metallic copper and sulphuric acid has an efficiency of only 50 per cent, one-half of the acid being resolved into gaseous sulphur dixodie, whereas under the influence of the electric current an anode of copper dissolves quietly and completely to sulphate. It is therefore not surprising that the proposition to utilize the current for the solution of copper should date from the dawn of electro-metallurgy. The further conception that the sulphates of the alkali metals might replace sulphuric acid for this purpose, the operation proceeding in a cell divided by a porous diaphragm and resulting in the formation of sulphate of copper in the anode compartment and caustic alkali at the cathode, is attributable to the remarkable and comprehensive English patent to James Dickson, No. 2044, of 1862, and quite recently Mr. J. G. A. Rhodin has described a modification of Dickson's method in which the operation is conducted in a revolving compart-mental cell employing a porous diaphragm and a cathode of mercury. The serious defect of these processes lies in the fact that by diffusion of the respective solutions, a precipitate of hydrate of copper is formed within the substance of the diaphragm, reducing its porosity and ultimately interrupting the current. The improvement of Palas and Cotta consists in interposing between the electrodes a double-walled diaphragm, and in feeding the alkali metal sulphate solution which constitutes the electrolyte between these walls under such pressure as to force it to percolate into both electrode compartments with a velocity sufficient to fully counteract the diffusion of the copper sulphate and the caustic, thus preventing their intermingling and the consequent choking of the diaphragm. The margin of novelty in this invention is, however, not wide, for not only is the basic idea old, as pointed out, but even the double diaphragm and intermediate feed have been employed by Browne and Chaplin for the electrolytic production of lead nitrate and sodium hydrate as a step in the manufacture of white lead.

TESLA WIRELESS TELEGRAPH STATION.—It will be remembered that definite statements were made that Mr. Tesla early this Fall would exchange wireless signals with Europe. The newspapers now report that the first station of his wireless system will be built at Wardenclyffe, nine miles east of Port Jefferson, L. I. The purchase of 200 acres of land on the shore of Long Island Sound has just been completed. The work of putting up the necessary buildings will begin in a short time. The main building is to be 100 ft. square, and it will be occupied by an electric plant of 350 horsepower. The estimated cost of this part of the plant will be nearly $150,000. The Wardenclyffe station will be the main one of the system, and it is stated that Mr. Tesla expects to be able to communicate with all countries of the world from that point. The deferred date of the test is not given.

REGULATION OF DOUBLE-CURRENT MACHINES.—Two interesting patents were issued Aug. 6 to J. L. Woodbridge relating to a method and means of regulating double-current machines, this term including machines having both collector rings and commutator, whether used as generators or as rotary converters supplying either direct or alternating current. With the present type of these machines very little, if any, modification has been possible in the relation between the direct and alternating e. m. f. which they deliver. In the double-current generator they must rise or fall together with any variation of speed or field excitation. In a rotary converter receiving direct current at constant voltage if any attempt is made to increase the alternating e. m. f. by strengthening the fields, the only effect will be to reduce the speed of rotation, the alternating e. m. f. remaining the same. If the rotary is receiving alternating current at constant e. m. f. and delivering direct current, an alteration of the field excitation changes both the direct-current voltage and the alternating counter e. m. f. together. This is necessarily accompanied by a change of phase relation between the applied and the counter alternating e. m. f., and equilibrium is not re-established until the phase position of the armature is altered sufficiently to introduce into the alternating supply lines wattless currents of such magnitude in many cases as to cause objectionable effects. It has been found, however, that the ratio of the alternating to the direct-current voltage in different double-current machines may be markedly different on account of the difference in the relative breadth of the pole faces and the resulting difference in distribution of the lines of force. The object of the arrangement described in the patents is to alter the relative distribution of the lines of magnetic force over the pole face. For example, by concentrating the lines of force near the middle of the pole face they will become more effective in producing alternating e. m. f. and the ratio of alternating-current to direct-current e. m. f. may thus be increased, the latter being dependent not upon the distribution of the lines of force, but upon the total number of such lines; conversely, if the lines of force are spread over a broad pole face or concentrated near its tips, they become less effective in producing alternating e. m. f., and the ratio of alternating to direct-current e. m. f. will be reduced. This object is attained by dividing each pole piece into three sections or horns, each of which is supplied with a winding which may be separately adjusted. These windings may be the usual series field winding with each section made capable of modification and adjustment by means of adjustable shunts, or auxiliary windings in shunt across mains may be used and controlled by rheostats. By this means the magnetic flux from any of the three horns is independently controlled, and by an adjustment to suit each case the ratio of the alternating to direct e. m. f. may be controlled to suit the requirements of a double-current generator and of a rotary delivering direct current or one delivering alternating currents.

LETTER TO THE EDITORS.

Popular Science and Corpuscles.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with much interest your editorial of last week on "Popular Science and Corpuscles," which comments on the subtle and ingenious doctrines expounded by that distinguished physicist, Professor J. J. Thomson.* While you do not accept these doctrines unqualifiedly, yet I consider that you show them more favor than is merited, and I beg the privilege of your columns to make a few remarks on the subject.

In the first place, as to the so-called atom, the writer is far from holding it sacred and indivisible after the canons of Boscovitch and his school. On the contrary, all the evidence now attainable points the other way, particularly that derived from spectroscopic considerations. Long ago some one very aptly remarked that to judge from its manifold rates of vibration the atom of iron must be somewhat more complicated than a piano! In view of the complex system of harmonics that can be derived from a single fiddle-string, this may be an over statement, but the error is at least in the right direction. So far as the mere matter of complex constitution goes there is not the slightest objection to a sub-divided atom. It may be composed of $(n+1)$ corpuscles, each different from all the others, and each possessing a particular set of properties. It may be possible to split these corpuscles off and send them rattling through ordinary matter like gravel through a picket fence.

But granted all these possibilities, they cannot be accepting as physical facts upon purely electrical evidence. In the first place, the writer must confess to a great deal of difficulty in forming a clear mental picture of the electrical charge upon an atom, let alone a corpuscle. Of course, it is entirely demonstrable that atoms have certain very well defined relations to electrical energy, but so they have to gravitation and heat. In fact, all the physical properties of matter are so interconnected that the existence of any one set of relations is not a fit subject for exclusive hypothesis. The dynamical relations of what we are pleased to call electric charges in ordinary bodies of measurable dimensions, are quite well defined, and are proper subjects for calculation. But that the laws thus ascertained may be applied with even an approximation of precision to bodies of the dimensions and properties of molecules and atoms, is by no means either demonstrated or a safe extension of our exact knowledge. Electro-chemical data are good, *de bene esse,* as our legal friends pleasantly put it, but he is a bold man who attempts to entangle cause from concomitant in so complex an issue. Until we are prepared accurately to define the dynamical nature of the condition we find in charged bodies, it is rash, although it may be temporarily convenient, to assume that condition as capable of existing as such in atoms, or a portion in corpuscles, if the latter have a place in the reckoning. That a molecule is capable of transferring a definite amount of electrical energy under given conditions to a particular body is not by any means adequate proof that the molecule is charged in the ordinary sense, any more than the heating of a body by solar radiation is proof that corpuscles charged with definite amounts of caloric have infringed upon it. Electrical science has not yet escaped from the caloric state of development. No one has yet been able to define the nature of the stresses that exist between the plates of a condenser, and yet people talk glibly about the existence of these stresses in hypothetical bodies of unknown dimensions, form and dynamical properties.

The corpuscular hypothesis in its recent developments is profoundly interesting, and may involve immense gains in our knowledge of physical phenomena. But the evidence on which it rests needs a thorough overhauling by skillful hands before it can be seriously considered as a basis for a revision of ordinarily received ideas. Until the doctrine of corpuscles rests upon other than electrical evidence, it must of necessity be, in view of the uncertainty of such evidence, upon very insecure foundations. Before it can be accepted even in the light of a tenable physical theory it must be backed by physical and chemical evidence, and plenty of it. It is all very well to devise further hypothesis as to why such additional evidence might be unattainable, but the fact remains that the electrical evidence is *per se* unsatisfactory. Least of all is it sufficient upon which to base a fluid theory of electricity. It is rather risky under all circumstances to escape from a physical dilemma by postulating conditions which are not susceptible of proof save in terms of the very things which require explanation.

Professor Thomson's speculation is most ingenious and striking, fraught with most beautiful possibilities, but the misguided zeal with which it has been taken up along the line of purely electrical investigation, is to be deplored. In the very nature of things, under the terms of its devising, it must, whether false or true, fall in with a large group of physical facts which hitch up fairly well with any hypothesis that is arranged to fit any one of them, thus producing a mass of pseudo-evidence likely to be popularly taken for far more than it is worth. This is one of the most serious difficulties in the way of investigating the intimate properties and structure of matter. When there is strong evidence, quite apart from electrical theory, of the existence of the atomic dust in question and some independent evidence of its properties, the electrical bearing of the facts can have a very definite value to the investigator. But until such time as evidence other than electrical appears, the whole matter should be rather

held in abeyance pending either such evidence or such additional knowledge of the dynamics of electric charge as will enable a more definite physical interpretation to be put upon the facts. Instead of tumbling over each other to find possible applications of the hypothesis, investigators would do well to settle down to independent investigation of the facts on which the hypothesis was based, to discover, if may be, further evidence of their physical relations. It is all well enough to "hitch your wagon to a star," but in physical science it is a long step from hypothesis to even proximate proof.

New York. [illegible]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Converting Alternating Current Into Direct Current by Means of Electric "Valves."—Montpellier.—An article in which he first gives some historical notes on the experiments of Ducretet, Pollak, Graetz and Liebenow, with aluminum electrodes as "valves" for converting alternating into direct current. These experiments have not been commercially successful, as the efficiency of the conversion was not over 15 per cent, the greater part of the electrical energy being transformed into heat. Moreover, the aluminum plate is soon destroyed, and the same is the case with the lead plate which forms the other electrode, and the composition of the electrolyte is changed; finally, up to five cells are required on a 100-volt circuit. Some progress has recently been made by Nodon, who found a means of preventing the destruction of the electrodes and the variation of the composition of the electrolyte. The main feature of the arrangement of Nodon is that the surface of the "active" electrode is much smaller than that of the "passive" electrode. The ratio of the two surfaces in his experiments was 0.001. The passive electrode consists of graphite, the active electrode is a pencil of an alloy of zinc and aluminum. The nature of the electrolyte is not mentioned. He utilizes the two half-periods separately in two different circuits and adds the two actions together as usual. Under these circumstances, he claims to have obtained an efficiency of 90 to 95 per cent. The action of his "valve" is due to the instantaneous formation of an insulating layer of a double phosphate of zinc and aluminum on the surface of the active electrode, when the current passes in one direction. This insulating layer then acts like a "valve" and prevents the passage of the current. In the next half period when the current passes in the opposite direction, this insulating layer is instantaneously destroyed and the valve is, so to say, open. The rectified current, obtained in this way, has properties characteristic of both direct and alternating current. This rectified current produces electrolysis and can be used for charging accumulators, but at the same time it develops effects of self-induction in inductive coils, and produces Foucault currents and hysteresis. These secondary actions cause a loss of energy. The inventor has devised several arrangements varying with the purpose for which they serve, in order to prevent these losses. He has experimented with alternating currents up to 2000 volts. A condition which must be fulfilled is that the temperature does not rise above 300 degs. C. This is accomplished by means of water cooling. The industrial efficiency of the conversion has been found to vary betwen 80 and 95 per cent. When the apparatus is used under normal conditions and at a sufficiently low temperature, the durability of the apparatus is quite great, the metallic electrodes not being destroyed and the composition of the electrolyte not being sensibly changed. Only the graphite electrodes are slightly eaten up at the points of their surface near the metallic electrodes. The weight of the apparatus averages 8.8 lbs. per kilowatt under a pressure of 500 volts.—*L'Elec.*, July 13.

REFERENCES.

Direct-Current Dynamos.—Eichberg.—An illustrated article on the "Transformer properties of the direct-current dynamo armature." He shows how the function of the potential at any point of the armature may be represented diagramatically and applies his method to a discussion of the conditions under which alternating currents can be taken off from a direct-current armature, and of similar problems.—*Elek. Zeit.*, July 11.

The Synchronous Motor.—A didactic article explaining phase relations in the synchronous motor, illustrated by vector diagrams.—*Am. Elec.*, Aug.

POWER.

Electrical Distribution of Power Along the River Tyne.—An illustrated article describing the new central station at Wallsend, near Newcastle-on-Tyne, England. The plant is the outcome of a series of extensions of the old plant of the Newcastle Electric Supply Company, and has been established by that company in co-operation with the Walker & Wallsend Union Gas Company. The system comprises a generating station at Neptune Bank, and several sub-stations from which local distribution is made. The station at Neptune Bank delivers three-phase alternating current to the lines at 5500 volts and 40 cycles, which is transformed at the sub-stations to 440-volt three-phase alternating current, and 480-volt direct current. A feature of the sub-station distribution is that the 440-volt three-phase alternating current is distributed for power purposes only, and the 480-volt direct current is distributed on the three-wire system for lighting and power purposes, principally lighting. The Neptune Bank power station contains four principal generating units consisting of 700-kw alternators of the revolving-field type, direct driven at 100 r. p. m. by triple-expansion engines of the vertical marine type. There are also two direct-current generating sets of 100 kilowatts capacity each, and one 50-kw machine. The article deals principally with the steam plant.—*Am. Elec.*, Aug.

Transmission Plant for Mines.—Some notes on an electric plant at the lead and zinc ore mine at Fronzoch, near Devil Bridge, in Cardiganshire. Arrangements are made so that the generator can be driven either by a waterwheel or a steam engine. Water power is usually available from September till May. During the summer months the steam engine has to do the work. Three-phase currents are generated at a potential of between 2000 and 2500 volts between each phase. In all, there are in use the following motors: Two 50 horse-power, at 2000 volts; one 85 horse-power, at 2000 volts; one 35 horse-power, at 2000, and one 85 horse-power, at 200 volts.—Lond. *Elec.*, July 26.

Electricity in Iron Works.—Hanscom.—An illustrated description of the electric installation of the Union Iron Works, of San Francisco. The power station has a capacity of 600 kilowatts, which is worked up to its full capacity and at times with 25 per cent overload. The direct-current system is used. The current is used for lighting incandescent and arc lights and for power purposes, for the cranes and for motors, driving individual tools and groups of tools. An interesting application of electricity in the shipyards of the Union Iron Works is the annealing of armor plates.—*Jour. of Elec.*, June.

Transmission Line Construction.—Some editorial notes on two papers of Dutcher and Poole, read before the Pacific Coast Transmission Ass'n. Both brought out the fact that to-day the most susceptible portion of any long-distance high-voltage transmission system rests in the transmission line. It is said that 75 per cent of the shut-downs occurring in transmission service may properly be charged to the line, and a realization of this contingency was largely instrumental in causing the Standard Company to install storage batteries in its sub-stations, and causing the Bay Counties Company to erect a double line.—*Jour. of Elec.*, June.

Engines for Dynamos Running in Parallel.—A communication on engine design for driving dynamos which have to run in parallel. He concludes that the most suitable engine would have two or three cranks with two cylinders on each crank, governing on the H. P. cylinders. The fluctuation of crank effort would be made as small as possible in the region where cut-off takes place. The cyclic irregularity would be met by a flywheel of moderate weight. The speed would be high, so as to reduce the number of poles for a given

frequency, and keep down the mass of the rotating parts. The governor is only sensitive enough to respond to changes of speed greater than those occurring cyclically in each revolution.—Lond. *Elec. Rev.*, July 26.

Mond Gas.—Some editorial notes referring to the scheme of a British company, of long-distance power transmission by means of Mond gas. It is pointed out that Mond gas "is by far the best solution, up to the present moment, of the problem of turning coal into cheap gas fuel for heating and power purposes." It is thought that "in the near future there will be a large amount of long-distance power transmission by the aid of Mond gas—but the power will go through electric cables, not through gas pipes. There are many considerations which lead us to this conclusion, and not the least of them is the fact that Mond gas is a diluted gas, i. e., a gas having a large percentage of nitrogen and other inert constituents."—Lond. *Elec.*, July 26.

REFERENCES.

Italian Water Power Installation.—BIGNAMI.—A long and well illustrated description of the water-power plant at Paderno d'Adda, Lombardy, which has at present a capacity of 15,000 horse-power, and has been noticed before in the Digest.—*Eng. Mag.*, Aug.

Boiler Room Efficiencies.—ENNIS.—An article on the steam generating plant, in which the author suggests processes of economical steam production. He treats of the boiler, furnace, coal, steam piping, feed water and the apparatus used in the boiler room having a direct function in the generation or use of steam.—*Am. Elec.*, Aug.

TRACTION.

Motor Car Tests.—RANKIN KENNEDY.—An article in which he points out that long-distance runs as tests of automobiles are foolish. What is required to be demonstrated is a car for handy work in and about town and for short excursions, always ready and fairly free from ailments. Careful battery tests are necessary. The capacity, the full weight, the capacity per pound of full weight must be determined, also the cost of maintenance. The latter test can only be made in time by regular running under careful observation. Every battery has a limited rate of discharge beyond which it cannot be worked without damage.—Lond. *Elec. Rev.*, July 19.

REFERENCE.

American Engines for the Glasgow Tramways.—An illustrated article, describing the new Allis engines built for the Glasgow Corporation Tramways.—*Am. Elec.*, Aug.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Tension Switching and Fusing Devices.—MASSON.—An illustrated paper read before the Pacific Coast Elec. Transmission Ass'n. He starts with the statement that "high-tension switching is best done when not done at all." The abnormal strains which are introduced into the insulation of high-tension circuits, are mainly due to the following causes: Atmospheric discharge, sudden short circuits or grounds on the circuits, changing and unbalancing the electrostatic capacity of the circuit by switching, fusing, etc. All danger of switching can be avoided by proper arrangements and methods of operation. The one fact to be kept in mind in arranging a station's wiring and switches is that no high-tension circuit should be made or broken unless there is a source of e. m. f. and power on each side of the switch, and—when closing—that both sides are in synchronism or that there is no current at all on it. He discusses the necessary arrangements for six different cases. The first is one generator, one set of transformers, one transmission line; the second is one generator, two sets of transformers, one transmission line; the third is two generators, two sets of transformers, one transmission line; the fourth, fifth and sixth cases refer to two transmission lines and two or three generators and two or three sets of transformers. For each case detailed rules are given. For instance, for the case of one generator, two sets of transformers and one transmission line: here low and high-tension switches and fuses should be used on the transformers. The line should be connected to the transformer and generator before starting, or at least to a dead set of transformers, and they should then be connected on the low-tension side to the generator. Transformers should be cut in on the low-tension side first, closing high-tension side last, and in cutting out transformers, "open the high-tension side first."—*Jour. of Elec.*, June.

REFERENCE.

High-Potential Switches.—Well illustrated descriptions of the newest types of high-potential switches. Lee describes the Martin switch, McFarland the latest Westinghouse types, Currie the latest Stanley types, Wirt the latest General Electric types; Van Norden, Taylor and Doble describe some experiences made with the Masson-Taylor switch.—*Jour. of Elec.*, June.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effects Due to Moving Charges.—E. P. ADAMS.—An account of an experimental investigation. It is well known that the magnetic effect due to moving electric charges, which is a consequence of Maxwell's theory and had been proved experimentally by Rowland and others has recently been claimed as non-existent by Cremieu. While all previous experiments have been made with rotating disks, the present author has experimented with moving charged spheres. J. J. Thomson has recently developed a theory of the magnetic force which would be produced by the motion of a sphere charged to the highest possible potential. The electricity for charging the spheres was furnished by the battery of 10,000 storage cells of the Jefferson Phys. Laboratory of Harvard Univ.; two sets of spheres were used, which were charged oppositely, one being connected to the positive pole of the battery and the other to the negative epole; a large water resistance was in series with the batterey. Great difficulty was experienced, due to the wind produced by the revolving spheres which had a velocity of about three miles a minute. This was overcome by building a shield around the spheres to keep the wind from blowing direct on any part of the magnetometer support. His principal result is that there is an actual magnetic effect due to moving charges. The agreement between theory and experiment is fully as good as could be expected when all the uncertain elements in the determination are taken into consideration. —*Am. Jour. of Sc.*, Aug.

PENDER.—An account of a similar investigation. The results obtained by him "show beyond any doubt that electrical convection does produce magnetic action, or, more exactly, that when the sign of electrification of a moving charged body is changed, an electric conduction current is induced in a neighboring circuit, of a strength equal to that which would be induced in this circuit by reversing the direction of a conduction-current in a circuit coinciding with the path of the convection-current."—*Johns Hopkins Univ. Circ.*, No. 152, May; June; abstracted in *Am. Jour. of Sc.*, Aug.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Storage Battery.—LUCAS.—An article in which he says there seems to be no reason why the reoxidation in the Edison cell should enter more deeply into the positive active mass than heretofore, and why this process should be improved by the addition of graphite. Apparently the special processes of preparing the active masses are new. He thinks the third and fifth claims of the British patent could not be upheld in a legal suit. The arrangement of the blocks of active mass is said to have been applied in Edison's own modification of the Chaperon-Lalande cell. The use of nickel is in general not new, either. The remark that iron does not decompose the water, he says, is wrong. The iron, he claims, must react with the alkali, otherwise the cell could be inactive.—*Automotor and Horseless Veh. Jour.*, Vol. 5, p. 493; abstracted in *Centralblatt f. Accum.*, Aug. 1.

Regarding the first criticism referred to above the latter journal remarks that it is wrong to suppose that in other accumulators with peroxide of nickel, the charging action is only superficial. Regarding the Edison patent, it is said: "We do not believe that a German patent will be granted. For, first, the combination peroxide of nickel, alkali and iron is not new; second, there are no details of construction which could be patented; third, the process of making the active masses cannot be patented, as the processes for this purpose have long been known, also in connection with the original raw material, and these cannot be construed to be the special "technical effect," for without doubt, at least just as good effects can be obtained by other ways." Reference is made to the remark in the ELECTRICAL WORLD AND ENGINEER, p. 181, in which was pointed out that the Edison cell differs from the Michalowski cell, because zinc dissolves in alkali, and because the positive mass is Ni_2O_3 with Michalowski and NiO_2 with Edison. It is said that

finely divided iron is easily soluble in alkali, and that a compound NiO_2 cannot be obtained, or, at least, not with certainty, by the way described by Edison. Generally, mixtures are formed, the percentage of oxygen of which is nearer to the oxide Ni_2O_3 than to NiO_2. Referring to an editorial in the ELECTRICAL WORLD AND ENGINEER, July 6, in which the hope had been expressed that a chemically regenerative cell of this type would be reached, the charging being effected by some purely thermo-chemical process, and that a method might thus be obtained of obtaining electrical energy from coal, the following remark is made: "From this it would appear that the newspaper report printed some time ago and then denied, that Edison could obtain electricity from carbon, proves to be true, at least in his mind and that of his friends." (*Centralblatt f. Accum.*, Aug. 1.

Edison Battery.—JUMAU.—An illustrated article in which he first gives abstracts from Edison's patent specification and from Kennelly's paper. While Kennelly gives the capacity of the new Edison cell as 30.85 watt-hours per kilogram of total cell, the present author uses the discharge curves given by Kennelly for two different discharge rates, in order to calculate the watt-hours per kilogram which the cell gives out until the voltage has dropped to 1 volt. He finds from these diagrams that for the 4 hours 55 minutes discharge the capacity in watt-hours per kilogram is 27.61, while for the 3 hours 10 minutes discharge it is 28.72. This is an anomaly, and there seems to be something wrong somewhere, as it is not likely that for a faster discharge the capacity is greater than for a slower one. He then gives for comparison the corresponding values of the lightest commercial French batteries, the Fulmen, B. G. S., Heinz, and Societe pour le Travail Elec. (affiliated with the Elec. Stor. Batt. Co., of this country). The latter battery has the highest capacity in watt-hours per kilogram of cell, namely, 27.49 for a 5-hour discharge and 23.23 for a 3-hour discharge. "When comparing the corresponding values of the capacity in watt-hours per kilogram of weight, one may be astonished not to find a greater difference. Indeed, in the lead cell, one ampere-hour requires 3.86 gram of lead and 4.46 gr. of peroxide of lead, hence, on the whole, 8.32 gram of active material, while in the Edison cell it requires only 1.045 gram of iron and 1.685 gram of hyperoxide of nickel (the formation of his compound being assumed), hence on the whole, only 2.73 grams of active material. If one takes into account the ratio of the active mass to the total weight of plate, which value, according to the description, must be approximately equal to the same ratio in a light lead cell, and if one also remembers that the coefficient of the accessories (the ratio between the weight of cell and the weight of the plates) must be smaller for the Edison cell, on account of the small quantity of electrolyte required, one may conclude that in the latter case the coefficient of utilization of the active material (the ratio between the capacity obtained and that calculated theoretically from the mass of active material) must be smaller than the same value in the light lead cell. It is known that the coefficient of utilization of active material of the lead cell is different for the various methods of making this material, for different thicknesses of the layer of active material, and for different current densities, and there is no doubt that the Edison cell is subjected to the same rules. If one believes the inventor, however, one must give up the hope of an improvement in this direction, as he claims to have invented the only possible method of making the active material." Concerning the durability of the new accumulator, it is said it would be interesting to know whether the capacity remains the same during the whole life and whether there occurs a swelling of material at one pole and a contraction at the other. He refers to the use by Michalowski of Ni_2O_3 for accumulator plates, while Edison says that the formula of the oxide used by him is NiO_2. "To sum up, the interest of the Edison cell does not lie in the discovery of a new couple, but in the discovery of a special process of preparing material which heretofore could not be rendered sufficiently active. This is certainly a very important solution, and one not without difficulties, as one may judge from the considerable number of experiments which had to be made, as for the iron alone, the number of the compounds tried was several hundreds. A way has been opened to experimenters and an indication has been given that one should not despair of finding a means of rendering substances active which can enter into the construction of new accumulators." The invariability of the electrolyte is said to be a favorable condition, but not a new one, as the Jungner cell has the same property. The most important property of the Edison cell is the insolubility of the active substances at the end of the discharge as well as at the end of the charge, which is one of the indispensable conditions which must be fulfilled to make the [illegible] cells really industrial.—*L'Eclairage Elec.*, July 27.

Pascal Marino Lead Cell.—HIBBERT.—An illustrated description of a new battery, devised by Pascal Marino, which has peroxide of lead and spongy lead electrodes like the ordinary lead cell, but the plates are arranged horizontally and the acid used is phosphoric, not sulphuric. Each plate consists of a thin sheet of lead, flanked by a frame. Within this frame, both above and below, and in contact with the lead plate, is disposed the active material. Between one plate and the next is a separator, very porous, whose exact nature is not stated. Running vertically through the plates are one or more carbon chimneys for the purpose of carrying off the evolved gases. It is claimed that this is successfully accomplished. For the purpose of forming the active substances from the original materials sulphuric acid is used, but as soon as the formation is complete, the acid is changed, phosphoric acid being used in its place. The ordinary processes of charge and discharge are afterwards carried on in the phosphoric acid, but "after each charge a few drops of a solution of hypophosphorus acid are added for the purpose of destroying any peroxides formed in the liquid." The advantages claimed for this cell are, first, the very large proportion of active material, and, secondly, durability. It is said that the tendency to local action is greatly diminished in phosphoric acid. The present author calls the cell an interesting variation from the ordinary, but believes that the weak point will probably appear in or near the line of junction between the leading and the sheet to which it is attached. Further, phosphoric acid has a relatively low conductivity, its maximum being less than one-third that of sulphuric acid. The e. m. f. varies with the strength of the phosphoric acid, but is always lower than the value obtained with sulphuric acid. Phosphoric acid is much more viscous than sulphuric acid, therefore diffusion is slow.—Lond. *Elec. Rev.*, July 26.

Electro-Chemical Industry.—SWAN.—A long abstract of his presidential address to the Society of Chem. Industry at Glasgow. After some historical remarks he gives a review of the present developments in copper refining, bullion refining, aluminum processes, zinc., copper and nickel extraction processes, the electrolytic alkali and chlorine industry, organic products, the fixation of atmospheric nitrogen and electric furnace products. He then speaks on the probable developments of the future. While at present by far the greatest number of electro-chemical and electro-metallurgical plants are operated by water power, he thinks that the last word has not yet been spoken as to the cost of power developed by coal. Great advances have in recent years been made in the direction of reduction of cost, by improvements in the steam engine, the gas producer, and the gas engine. There is great reason for hope that help in the more economical generation of power for electro-chemical work may come from the further development of the gas engine. He then refers to the generation of electrical energy from chemical energy, and says that even if zinc was as cheap as coal, the voltaic cell could not compete with the dynamo, as "the cost of labor and the complication of handling the gigantic cells, and keeping them in operation, would so far exceed the cost of producing electricity as we now produce it, that we should still continue to use the far more convenient water turbine and steam engine and dynamo." He then says that for the same reasons a carbon cell, if possible at all, cannot be practicable in any form "where the electrolyte is liquid and the elements are plates that require renewal." He thinks that if there is a hopeful way, "it is in the direction of the gas-consuming cell. A bold attempt at the solution of the problem in that way was made some years ago by Mond and Langer, when they produced a gas battery on the principle of Grove's gas battery, that yielded a considerable current in proportion to its size, and consumed nothing but hydrogen and atmospheric oxygen"; but the high-priced platinum electrodes made its use prohibitive. He then makes some remarks on the present conditions of the British chemical industries and on the importance of the proper education of electro-chemical engineers. The address is discussed in an editorial. The writer says about Swan's remarks on carbon cells and gas cells that he ignores "that carbon can only be obtained in gaseous form (at workable temperatures), in combinations which represent a loss of thermal energy. A carbon gas cell at ordinary temperatures is therefore impracticable in the present state of scientific knowledge, while an oxygen or hydrogen gas cell would cost too much for its raw materials to be economically of any value."—Lond. *Elec.*, July 26.

Electro-Galvanizing.—An illustrated description of a Cowper-

Coles regenerative electro-galvanizing plant which has recently been erected for the Vulcan Shipbuilding Co. at Stettin, Germany, for the coating of boiler tubes for water-tube boilers and general shipyard work. A diagram shows the position of the zincing tank, washing tank and pickling tank, and the plant for regenerating the electrolyte. The dynamo is an 8-pole, 2-commutator machine, and gives 3000 amperes at 6 volts. An air compressor is used for the circulation of the electrolyte, which is effected in the following manner. The acid solution falls over a wooden sill placed in one corner of the galvanizing tank into an overflow tank, and then flows into the compressed air tank. Air is then blown into the compressed air tank and the solution forced up into the regenerating tanks. Zinc dust mixed with small lumps of coke is placed in the regenerating tanks on wooden grids covered with cocoanut matting so as to form a filter-bed and at the same time regenerate the electrolyte. The regenerated electrolyte returns to the galvanizing tank at the bottom at the corner opposite to that at which it leaves. The electrolyte contains 35 oz. of crystalized zinc sulphate to the gallon of water. In practice it is found very important to keep the zincing solution slightly acid, otherwise the zinc coating will not be adhesive, and will have a tendency to blister. The best proportion of free sulphuric acid is about 0.1 oz. to every gallon of water.—*The Elec. Chem. and Met.*, July.

Deposition of Copper from Various Electrolytes.—BEADLE.—An account of some experiments made to find the difference of structure which copper deposited from various electrolytes under varying conditions shows from that deposited from the sulphate. Among others a copper nitrate solution, acidified with nitric acid, was used, containing 352 grams of copper per liter. It compared favorably with the sulphate solution, which was made on the lines of that used in refining plants. The copper deposited from the nitrate solution seemed harder and tougher and of as good a color. The nitrate solution, too, is very much less apt to creep over the sides of the containing bath.—*The Elec. Chem. and Met.*, July.

Metallurgy of Nickel.—J. B. C. KERSHAW.—A description of various dry and wet nickel processes. Among other things, he mentions that the Papenburg Works, where the Hoepfner process is used, are working successfully and producing 1½ tons per day. Another wet process is that of the Balbach Copper Co. by which plates of over 99 per cent nickel, 20 inches by 30 inches by ⅜ inch are obtained from a neutral or alkaline nickel sulphate solution, the anode being crude nickel.—*Feilden's Mag.*, July; abstracted in *The Elec. Chem. and Met.*, July.

Conversion of Direct Into Alternating Current from the Electro-Chemical Standpoint.—An anonymous article referring to the well-known recent researches on the speaking arc and on current variations in the electric direct-current arc. Duddell has pointed out that the necessary condition for the conversion of direct current into alternating current in the arc is that with an increase of current the voltage should decreasee. The bearing of electro-chemistry upon this is the fact that electrolytic conductors are such with which this condition is particularly easy to realize. This condition is fulfilled when, in consequence of the increase of the current, such a change is brought about in the chemical or physical properties of the circuit, that an abnormal diminution of resistance occurs, this diminution being so large, that the resultant resistance multiplied with the increased current, gives a value for the voltage less than its value was before the change of the current occurred. It is well known that in electrolytes a rise in temperature (which is always caused by Joulean heat) is connected with a fall of resistance. Take the case of a tube filled with an aqueous solution of sulphuric acid, the cross-section of the tube being variable. A constant current is passed through the tube. When the cross-section of the tube is gradually diminished and the current density therefore increased, then a point will be reached when the rise of temperature, due to Joulean heat, and therefore also the decrease of the resistance, will be large enough that an increase of the current causes a decrease of the voltage at the terminals. Another, at least theoretical possibility, is offered by working about a point where the number of ions suddenly greatly increases with a rise in temperature. A small rise in current, therefore, because of the consequent heating, causes a great increase in conductivity and diminution in voltage, which, properly adjusted, would also lead to the condition that with an increase of current the voltage decreases.—Lond. *Elec. Rev.*, July 19.

REFERENCES.

Fluorine.—KELLER.—An illustrated Franklin Inst. paper in which he gives a review of Moissan's researches on fluorine and the fluorine compounds.—*Jour. Frank. Inst.*, Aug.

Local Action and Other Losses in Storage Batteries.—FAY.—An article in which, after a comparison of the efficiency of alternating current transformers and of storage batteries, he discusses the several losses in a storage battery and the control of these losses in order that the efficiency may be a maximum.—*West. Elec.*, July 27.

Dry Cell.—An illustrated description of the "Hydra double battery," which is a "semi-dry cell."—*Sc. Amer.*, Aug. 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Measuring High Resistances.—ROOD.—A second illustrated paper on his new method of measuring high electric resistances which was described in the Digest, Oct. 13, 1900. He gives an account of some improvements and describes in detail the electrometer, the condensers, the units of resistance, the battery, the manipulation and the building up of a set of resistances.—*Am. Jour. of Sc.*, Aug.

The Oil Lamp as Applied to Commercial Photometry.—E. J. MCALLISTER.—A letter enumerating the points of superiority of the oil lamp photometer over the Lummer-Brodhun screen, for the rapid comparison of lamps on a commercial scale.—*Am. Elec.*, Aug.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—An illustrated article on a new system of wireless telegraphy. The receiver has been invented by De Forest and Smythe, the transmitter by Freeman. The principal points in which the new system differs from the Marconi system is that no coherer is used at the receiving end and no induction coil at the transmitting end. The action of the electric waves upon the new receiver or, as it is called, "responder," is to cause a sudden increase of its resistance; but the action is said to be essentially different from that of the so-called anti-coherers. An ordinary telephone receiver is preferably used with the "responder." In it one hears, as it were, the sound of the spark at the sending instrument. If desired, an ordinary relay may be substituted for the telephone and the signals received on the Morse sounder. It has been found that an oscillation having a steeper wave front will operate a receiving instrument at a greater distance than another of more gradual rise. The new transmitter is based on this principle. Experiments made in Chicago over 1½ miles, and over 4 miles are said to have been very satisfactory. Details of the new receiver and transmiter are not given.—*West Elec.*, July 27.

REFERENCES.

Multiplex Telegraphy.—The first part of an illustrated description of the Mercadier multiplex telegraph system.—Lond. *Elec. Rev.*, July 19.

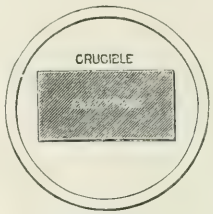
German Telephone Exchange.—An illustrated description of the new trunk exchange No. 1 in Berlin.—Lond. *Elec. Rev.*, July 26.

Rochester.—An illustrated description of the Rochester Telephone Co.'s equipment.—*Elec. Rev.*, Aug. 3.

Telephone Cable Carriers.—HENRY.—An article, with diagrams, on a method of stringing telephone cables on poles by means of a special carrier. The article gives all of the dimensions of the carrier and also shows how to use it in stringing cables.—*Am. Elec.*, Aug.

MISCELLANEOUS.

Electric Furnace.—An anonymous article on improvements made by Parker in electric furnaces for electro-metallurgy, especially calcium carbide. His primary idea was to reduce the labor required, by adopting simpler arrangements and automatic machinery as far as possible, and also to devise some method of preventing the formation of a thick crust of improperly fused carbide. His furnace consists essentially of a circular revolving crucible lined with carbon and an elongated carbon as the positive electrode. The adjoining diagram shows the relative proportions of the two. The crucible is fed by means of two hoppers fixed, though not in connection with it, at either side of the positive electrode. The feed is automatically arranged at a very slow speed, and as the crucible revolves at a carefully arranged rate in accordance with the current available, and the feed, which is also dependent upon the current, the powdered mass is immediately conveyed, in thin layers, as it were, under the action



ELECTRIC FURNACE.

of the electrode and at once melts. It is evident that since the hoppers are stationary and the crucible revolves, the powder is spread out equally all over the bottom of the crucible, and with the carbon being also stationary, each layer of the coke and lime receives the full effect of the current. It will be seen from the diagram that the corners of the electrode are within measurable distance of the crucible sides, and so there will be no appreciable portion of the mass or crust, which is not thoroughly melted. He also has arranged a suitable train of gearing, by which the electrode is automatically raised the whole time the furnace is working, so that the length of the arc may always be kept constant. By this arrangement the liability of a broken arc is greatly reduced.—Lond. *Elec. Rev.*, July 26.

REFERENCE.

Obituary.—An account, written by Nichols and accompanied by a good portrait, of the life and work of Henry Augustus Rowland.—*Phys. Rev.*, July.

Electric Rock Drills.

By George H. Waltman.

It is a matter of common knowledge to engineers interested in rock drilling machinery that the power used for the past number of years to operate rock drills has been either air or steam, and, as a matter of fact, up to within the last two or three years they have held almost undisputed sway.

The air drill has passed through various evolutions of improvements, each advancing step tending to simplify its construction, and it appears to have practically reached the limit of improvement.

As constructed at the present time, it is a simple and comparatively durable machine, and will stand a large amount of hard usage. It has been conceded that these machines transmit to the cutting bit all the power that the best modern steel will endure, so that it is impossible to expect much increase in the cutting capacity, unless very decided improvements be made in the steel now manufactured for drills.

One of the chief objections to air drills has been the uneconomical use of power, as it is universally agreed that the steam plant equipment necessary to operate air drills is extremely large in proportion to the amount of work delivered upon the bottom of the drill hole: in fact, it is easily shown that not more than about one-tenth the initial energy of the steam is so delivered. Perhaps the most satisfactory manner of determining the amount of power consumed in operating air drills is to operate the compressor by an electric motor, and with the aid of volt and amperemeters in the circuit, the electrical input is determined. The writer submits the following data from a number of tests made in this manner:

The test was made in one of the large mines in Butte, Mont., where they were operating a three-drill compressor from a Thomson-Houston motor. The style of drill was one of a prominent make, size three inches, corresponding to a weight of drill of about 340 lbs., unmounted, the drills being practically new. The distance from the surface to one drill was 200 ft., and of the other, 450 ft. Standard Weston measuring instruments were used. During a test of half an hour's duration with two drills in operation the air gauge showed 60 lbs. per square inch, the ammeter a mean average of 70 amperes, and the voltmeter 440 volts, corresponding to 30,800 watts, or 41 electrical horse-power, or 20.5 horse-power for each drill. The conditions under which this test was made were ideal for the drills, for the reason that one drill was only 200 ft. distant and the other 450 ft., which is a comparatively short air transmission line.

It is evident that little if any improvement can be expected over present air compressor practice. Among the many reasons that tend to make the system inefficient is that it is necessary in an air compressor to employ cooling water to carry away the heat of the compressed air, which is a direct waste of a large percentage of the power stored in the air. The air friction, the inevitable leakage and the sluggish action of cold-compressed air are further reasons for inefficiency of the air drill.

With both steam and air drills are associated the inconveniences always experienced where the piping must be conveyed around sharp angles, down steep declivities, or through and across inaccessible ravines or rivers.

Among electric drills is one known as the Gardner "electric rock drill." This name, however, is somewhat misleading, being, in fact, a misnomer, as the drill is in reality a mechanical drill, but operated by an electric motor. No departure has been made in principle from standard air drill practice, except where dictated by the requirements due to the difference in the source of power. This drill is used in many of the Colorado camps, and is adapted to the mining

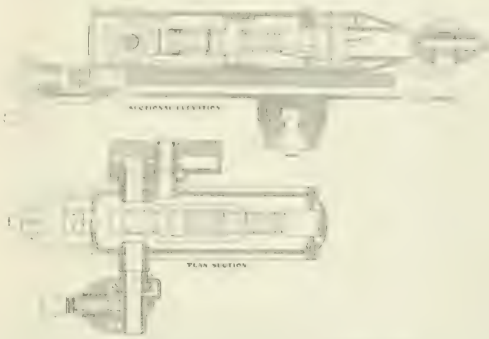


Fig. 1.—Section Views of Drill Mechanism.

of all kinds of ores and metals, and for open rock work, quarrying slate, marble, cement rock, etc.; in fact, for all purposes where rock drilling is required.

Their light weight and general construction are new features in rock drills, and a decided advantage in the matter of handling the machine. The power required to operate this make of drill is stated to be from 1 to 2 horse-power, and the average cost from 50 cents to $1 per day for current. It is claimed that a drill of the same size operated by air would average from $8 to $15 per day. Fig. 1 gives two sectional views of the Gardner drill. The drill is operated by an electric motor. In the ordinary equipment the motor runs at 1800 r. p. m., and is geared by means of a phosphor bronze pinion and a cast iron gear to a jack shaft. This cast iron gear is loose on the shaft, which it drives by means of two fiber friction disks on either side of the hub, the pressure being produced by a spring which is set at sufficient tension to drive the drill under normal conditions; should, however, the drill steel stick in the rock and prevent rotation of the flexible shaft, the cast iron gear will slip, thus preventing serious damage to any part of the mechanism. The power is transmitted from the jack shaft at the motor through a flexible shaft to a pair of mitre gears at the crank shaft of the drill. This crank shaft has a roller on the center crank pin, and transmits power to what is termed a draw-bar in which is a cam slot designed for giving the draw-bar a relatively quick forward stroke,

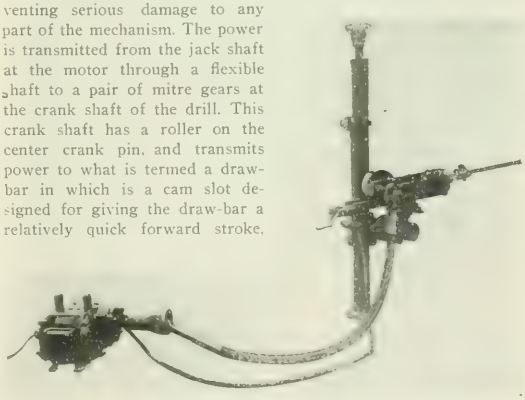


Fig. 2.—Motor and Drill.

and a slow return. This draw-bar transmits power to the piston through spiral springs, which are of sufficient strength to strike the blow necessary to cut rock, at the same time being useful to form a cushion if it is desired to ream a hole, as the drill can be run while not striking rock without serious damage to the machine. At the motor is a small rheostat which is connected to a controller by means of flexible wires in a rubber casing, the controller being placed at the drill so that the operator can at once manipulate the drill and controller.

The rotation of the drill is effected by means of ratchet wheels located in the forward part of the body of the drill and surrounding

the piston. The piston has straight grooves which engage the corresponding ratchet wheel for guiding the piston straight during the forward stroke, and spiral grooves which engage the corresponding ratchet wheel for turning the drill on its backward stroke. Fig. 2 shows the drill and motor connected up ready for use.

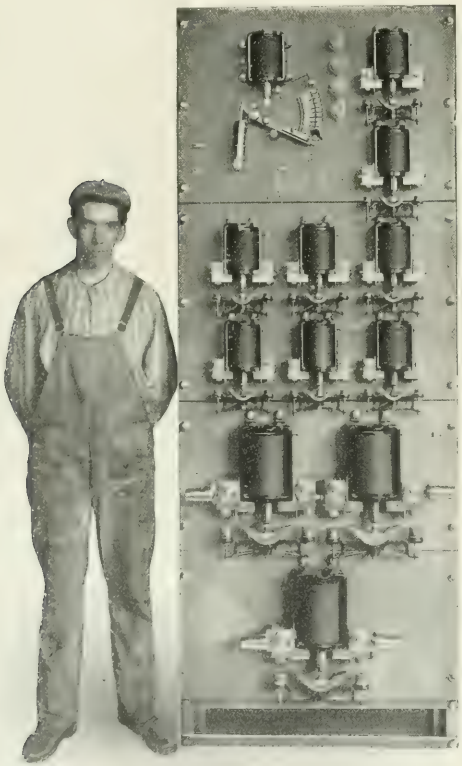
An Improvement in Socket Construction.

LOCKING BINDING SCREW.

Contractors and others installing lamp sockets find a considerable loss in every installation from binding screws dropping out and being lost, and from other screws holding the socket mechanism together working loose, the workman throwing the defective pieces into the scrap pile without the knowledge of the foreman or superintendent. The illustration herewith shows a method of preventing the removal of the wire binding screws, adopted and patented by the Marshall-Sanders Company, of Boston. This firm also fastens all other screws in the manufacture of sockets, with a special hard cement which adheres to the screws and porcelain, preventing the parts from working loose.

Self Starter for Large Motors.

The accompanying illustration shows a Cutler-Hammer self-starter for a non-reversing motor of 150 horse-power at 220 volts. In starting large motors by means of any form of sliding contact, it is not only difficult to obtain a good contact, but as considerable



SELF-STARTER.

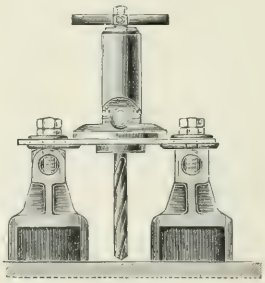
pressure is always desirable, a large and powerful solenoid is necessary to lift the lever. A large number of segments would also be necessary to cut down the sparking occurring as the brushes move slowly from one segment to the other.

To overcome this difficulty the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has substituted for the segments and sliding contact, a number of solenoid controlled switches, which cut out sections of resistance with a quick movement, thereby eliminating all sparking. Excellent contact is made by means of laminated copper brushes pressed tightly against the contact posts by means of the strong pull of a solenoid plunger. These solenoid switches are energized one after the other by means of the master solenoid, shown in the upper left-hand corner of the cut, which operates a lever, the motion of which is retarded by a dashpot connected, as shown. Each one of the small contacts is connected with the winding of one of the solenoid spools below, so that as the lever is moved slowly over these contacts, the solenoid switches are energized one after the other, thereby gradually cutting out the resistance and causing a smooth and easy starting of the motor.

The accelerating solenoids are comparatively small and only remain in circuit for a fraction of a second, while the lever of the master solenoid is moving over the contact segments. After all the small accelerating solenoids have been energized and de-energized one after the other, the last step of resistance is cut out by the large solenoid switch on the right-hand side near the bottom of the controller. This solenoid remains permanently energized as long as the motor is running. The other two large solenoid switches shown in the cut, as used for connecting, respectively, the positive and negative of the supply lines to the motor. These switches, moreover, are supplied with heavy carbon blocks, between which blocks the arc is drawn when opening the circuit to stop the motor. Located behind the slate are powerful blowout magnets which greatly assist in disrupting this arc.

It will thus be seen that it is only necessary to close a small switch having a capacity of not over an ampere or two, which switch controls the winding of the two main solenoids in order to close the motor circuit. It is thereby possible to start a motor of any size with a delicate pressure regulator or very small switch attached to a float or other controlling mechanism. When the motor is operating at full speed, one side of the circuit passes directly through the contacts of the two lower solenoids and the other side through the contacts of the bottom solenoid to the positive and negative sides of the motor, respectively. This arrangement forms a short path through the motor of inappreciable resistance. The Cutler-Hammer Company also build these devices for operating large elevators and hoists, the only difference being that these types of controllers are supplied with solenoid controlled reversing switches. This type of controller is made for both reversing and non-reversing motors in sizes ranging from 15 to 300 horse-power at 100 to 600 volts.

Electrically Driven Drill.



An electricaly driven drill of particular interest to shipbuilders, boiler makers and structural iron workers has recently been invented by J. C. Lincoln, and will be placed on the market by the Lincoln Electric Company, of Cleveland, with which he is identified. The device which is illustrated herewith, consists of a short platen or base, on which is mounted the drill, which is of ordinary construction. To the ends of this platen or base frame are attached two small but powerful electromagnets. Each of these magnets is about 4 inches in diameter, but is capable of sustaining a pull of about 800 lbs. each. The drill is driven by a beveled pinion, which meshes with a beveled gear lying close to the platen or base inside the housing, as may be seen by inspection of the cut.

The drill is intended for use on any iron surface, and may be used as readily on a vertical surface or on the under side of a horizontal surface. The drill frame and magnets weigh from 40 to 50 lbs., and can easily be handled by a man with one hand. It is the case that usually a man using a tool of this sort in shipyards would be supported in a rope sling carrying a board on which the workman sits. In such a case the motor could be supported under the board or in

any convenient place by the sling which secures the workman. The power is transmitted by the motor to the drill by means of a flexible shaft. The shaft can be very easily disconnected and connected to the drill, so that it is practically but a moment's work to remove the drill after having bored the hole.

Taking a concrete case, suppose an iron vessel has sprung some of its sheets and it is necesary to replace one or two of them. The rivets all along this sheet must be drilled out so as to remove the damaged portions. The workman is swung from above, and in addition to the ropes which support him, an electric cable carrying current at 110 volts is at hand. By means of a snap switch the power can be turned on the magnets and the drill placed anywhere on the surface of the sheet. The magnets having a combined adhesive power of 1600 lbs., the tool is almost as firmly secured in place as if the frame was bolted to the iron plate. The flexible shaft can now be connected to the drill, and the current turned onto the motor. If the work is being done inside the hold of the vessel, the same wire which furnishes current to the tool can supply one or more electric lamps for illumination. These could be attached to the seat if desired.

One of the notable features of the drill is that it can quickly and accurately be adjusted after the magnets have been seated. The platen or base carrying the drill is mounted on the magnets through two eccentrics. One of these gives a motion along a line parallel to the axes of the magnets, and the other gives a motion in a direction at right angles to this line. In this way it is possible to bring the drill with great exactness and almost instantly to the point desired for drilling the hole. The platen is then clamped into position with a thumb-screw, the current is turned on the motor, which is of 1 horse-power capacity, and the drill cuts through the work at the rate of from ½ inch to 1 inch per minute until the rivet is drilled through, the drill being fed forward in the usual manner by the handle shown at the top of the housing.

The operations required for moving the drill are as follows: First, turning the current off the motor; second, turning the current off the magnets; third, moving the drill to approximately its new position; fourth, clamping the drill in place by means of turning on the current on the magnets; fifth, making the exact adjustment by means of the eccentrics; sixth, turning the current onto the motor. As each of these operations takes only a few seconds, a very short time is required to set the drill. Its extreme lightness makes possible a rapidity of action which would be impossible with a heavier tool. The drill has an adjustment of about 5 inches, and if it is desired to drill a deeper hole than this, it is necessary to change the drill. A drill as large as one inch can easily be used.

Improvement in Hot Wire Instruments.

To avoid injury to hot-wire instruments from overloads, Camillo Olivetti, of Ivrea, Italy, a well-known manufacturer of such instruments, has introduced a safety attachment. The device consists of a central silver spring connected to one of the terminals of the instruments. When the current has reached the highest safe value for an instrument, the pointer presses against this spring, whereby contact is made with a small rod connected to the other terminal, and the hot wire is short circuited. In this shunt circuit an automatic or cut-off or signaling device can be inserted, and in this way the instrument made to act as a safety appliance for the circuit to which it is attached.

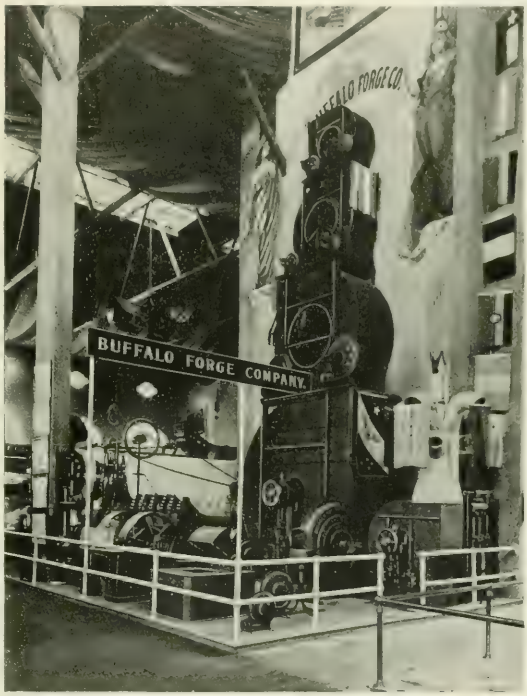
Pan-American Exhibit of the Buffalo Forge Company.

One of the most interesting centers of the Pan-American Exposition is the Machinery and Transportation Building, filled to overflowing with machinery of all descriptions. In a conspicuous position in the building near the northwest doors will be found the exhibit of the Buffalo Forge Company.

The most prominent portion of the exhibit of this company consists of a stack of four steel plate fans of the standard Buffalo top horizontal discharge type placed one on the top of the other. These vary in size from a fan at the bottom 150 inches in diameter to one 60 inches at the top. The highest point of the latter fan is 32 ft. above the floor line. The largest fan at the bottom is directly coupled to a standard [illegible] by a high [illegible] engine, with [illegible] below shaft and together with the three other fans runs at a slow speed, discharging air into the neighborhood surrounding. This stack of fans stands against the back part of the exhibit, and on the wall behind it is hung a large decorative painting, 27 ft. wide and 56 ft. in height, which represents two female figures holding up a pictorial representation of the manufacturing plant of the company.

To the right of this stack of fans and at one corner of the exhibit is located an apparatus to illustrate the Buffalo fan system of heating, ventilating and drying. It comprises in this instance a 60-inch up-blast steel plate fan, with direct-connected fan engine, two sections of steam heater pipes, heater casing, steam connections and other accessories, of the system in which ventilation is effected by employing a fan to maintain a forced circulation of air over the heater pipes and through ducts to such delivery points as may be desired.

The Buffalo down draft system of forge construction is also illustrated by two patterns of forges, one for heavy work and one for light, the former served by a Buffalo volume blower so as to illustrate the manner of producing the blast and exhaust currents at the



A LARGE PAN-AMERICAN EXHIBIT.

forges. The blower is driven by a direct-connected electric motor. Another interesting machine which is displayed is a large Buffalo steel pressure blower of the type employed for furnishing blast to foundry cupolas, and this is so arranged as to be driven by invisible means, discharging its air below the floor.

Other large machines shown comprise a 10 by 10 Buffalo horizontal center-crank engine and a 6 by 6 standard single vertical engine. All of these machines are furnished with automatic flywheel governors, and enclosed to run in oil, and are typical examples of standard modern high-speed engines. A complete line of the various blowers built by this company is also displayed. There are types of portable forges on view. Of other apparatus there is exhibited a Buffalo planing mill exhaust fan for handling sawdust, shavings and the like, three types of blacksmiths' drills, a combined punch, shear and bar cutter, and an angle iron cutter.

In addition to this chief exhibit, the Buffalo Forge Company has also supplied to the Pan-American Exposition several other pieces

of apparatus which are of considerable interest. In the handsome marble structure which is to be the home of the Buffalo Historical Society, namely, the permanent New York State Building, where the American Institute of Electrical Engineers meets, has been installed a complete fan system apparatus for heating and ventilating the building, the fan being designed for a complete air change once every 10 minutes. A novel device for washing and filtering the air which is forced into the building is installed in conjunction therewith. In the "Service" power houses at the northwest corner of the grounds has been placed a 17 by 28 by 18 Buffalo horizontal tandem compound engine with automatic flywheel governor and self-oiling system. This is one of the large engines at the Exposition, and is employed for driving a Westinghouse alternator for lighting purposes. In the same power house is installed a Buffalo mechanical induced draft apparatus, consisting essentially of two Buffalo steel plate fans 200 inches in diameter, with overhung fan wheels, water cooled bearings, and direct connected 12 by 14 Buffalo horizontal center-crank engines, the whole apparatus placed on an elevated platform and installed to serve 17 large vertical boilers. We may also mention two 80-inch Buffalo down-blast steel plate fans, driven by induction motors and employed for cooling the battery of General Electric transformers in Electricity Building.

Storage Battery Exhibit at the Pan-American.

The Electric Storage Battery Company, of Philadelphia, manufacturer of the "Chloride" accumulator and the "Exide" accumulator, has one of the most interesting and comprehensive exhibits to be found in the Electrical Department of the Pan-American Exposition. In the central portion of their booth in Electricity Building is placed one of the specially wound motor-driven boosters designed by and built for the company, having an output of 800 amperes and 100 volts, at full load. Alongside of this is shown a special switch for controlling the operation of the booster in connection with the charge and discharge of the battery. A 25-point, 2000-ampere end cell switch motor-driven, with both electrical and mechanical indicators, is exhibited. A typical switchboard with standard apparatus and a new type of end cell switch is shown farther along this side of the enclosure.

On the opposite side are to be seen the different types of lead-lined tanks for central station, railway and miscellaneous uses. There are also shown samples of a new style of tank which has recently been designed, known as the "All-Metal" tank.

On the third side is displayed a group of some of the special types of "Chlorides" and "Exide" accumulators specially adapted for vehicle work, and a second group of standard chloride cells adapted to the numerous applications for which these batteries are required, ranging from the smallest type, the 3-B to the Type 13-F. Special elements designed for telephone and telegraph work consisting of two plates cast in couplets and requiring no connector or burning to set up, and examples of cells made to meet the requirements for traction work, are also found in this section.

Among the cells exhibited is one of Type G-53, which is a size used very largely in heavy railway service. The Metropolitan Street Railway Company, of New York, operates nine batteries aggregating 2742 cells of this type and the Buffalo Street Railway Company has in service three batteries with a total of 846 of these cells, representing an output of 7276 kilowatt-hours. Among the central station cells shown is one of Type H-51. The Buffalo General Electric Company operates 150 cells of this type with an output of 2336 kilowatt-hours.

The display is most interesting to electrical engineers as illustrating storage battery construction developed by years of experience in installations in every section of the country. The number of batteries installed in Buffalo by the Electric Storage Battery Company enable the company to show visitors who are interested, plants in a wide variety of service in daily operation. To facilitate the inspection of these plants the Battery Company issues passes to visitors applying for them. The Electric Storage Battery Company has also issued for distribution from its exhibit a very interesting illustrated bulletin, giving in brief outline many different applications of its product to central station, electric railway, miscellaneous lighting and power uses, etc.

STORAGE BATTERY EXHIBIT AT THE PAN-AMERICAN EXPOSITION.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Although there was a recovery in prices, the trading was narrow and dull. The announcement by the labor union that there would be a general strike of the employes of the United States Steel Corporation was calculated to have a demoralizing effect upon the market, which had already experienced a liquidation and decline on the damage to the foreign crop and the strike. United States Steel stocks, however, received powerful support at about 40 for common and below 90 for the preferred. The money market closed easy at 2@2½ per cent for call money, 4@4½ per cent for 30 to 90 days, and 4½@5 per cent for longer periods on mixed collateral. Commercial paper is quoted at 4½@4¾ for prime double names. In tractions, Brooklyn Rapid Transit kept quite steady, the total sales for the week being 26,080 shares; Metropolitan Street Railway fluctuated between 163 and 166; the sales aggregating 5100 shares. General Electric fell as low as 246½, but showed greater strength at the close of the week, the last quotation on Saturday, being 250½. The trading was rather light, only 3060 shares having changed hands. Western Union fell to 90, but recovered some of the loss at the week's close, the last quotation being 92, the highest price reached being 93; the sales were 22,950 shares. On Tuesday of this week General Carriage showed the effect of the announcement of the appointment of a receiver for the company. Following were the closing quotations on Tuesday night, Aug. 13:

NEW YORK.

	Aug. 3.	Aug. 13.		Aug. 3.	Aug. 13.
American Tel. & Cable..	—		General Carriage.....		1
American Dist. Tel.....	—		Hudson River Tel.....		120
Brooklyn Rapid Transit..	75¾	74½	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry..	166	166⅜
Electric Boat.....	17	17	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	44	40	N. Y. Elec. Veh. Tran...	12	10
Electric Lead Reduc'n...	—	1½	N. Y. & N. J. Tele.....		170
Electric Vehicle.....	7	5½	Tel. & Tel. Co. of Am...	6	3
Electric Vehicle pfd.....	15	10	Western Union Tel.....	91½	93
General Electric.....	253½	253			

BOSTON.

	Aug. 3.	Aug. 13.		Aug. 3.	Aug. 13.
Am. Tel. & Tel.....	160	160	Mexican Telephone.....	—	2
Cumberland Telephone...	—	—	New England Telephone..	133	—
Edison Electric Light....	255	*255	Westinghouse Elec.....	—	—
Erie Telephone.....	—	46	Westinghouse Elec. pfd..	79½	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Aug. 3.	Aug. 13.		Aug. 3.	Aug. 13.
American Railways.....	40	40	Phila. Traction.....	—	95¼
Electric Storage Battery..	80	70	Philadelphia Electric....	5⅝	5⅛
Elec. Storage Batt'y pfd.	80	70	Pa. Electric Vehicle.....	—	¾
Elec. Co. of America....	7⅛	7⅛	Pa. Elec. Veh. pfd.....		¾

CHICAGO.

	Aug. 3.	Aug. 13.		Aug. 3.	Aug. 13.
Central Union Telephone.	—	—	National Carbon pfd.....	—	83
Chicago Edison.....	176	160	Northwest Elev. com....	49	47
Chicago City Ry.....	207	201	Union Traction.....	13¼	13⅝
Chicago Telep. Co.....	—	273*	Union Traction pfd.....	58	58
National Carbon.....	—	17			

*Asked.

GENERAL CARRIAGE COMPANY.—A temporary injunction was granted in the Chancery Court at Trenton, N. J., last week restraining the General Carriage Company from doing any further business. At the same time William G. E. See, of Jersey City, was appointed temporary receiver. Aug. 26 was the day set for argument in the injunction proceedings. Assistant Secretary Joseph F. Tracy, of the General Carriage Company, states that the proceedings were of a friendly nature and that they had been instituted by a stockholder and creditor. He had heard talk of a reorganization scheme, but wasn't prepared to go into details. The General Carriage Company was organized in New Jersey, for automobile purposes in New York City, with a capital stock of $20,000,000, $19,000,000 of which has been issued. The stock fluctuated wildly at times on the Exchange, and was once sent up to 200, when there was a fight for a small block of it. The officers are: President, Cyrus Field Judson; secretary, Edwin M. Post; assistant secretary, Joseph S. Tracy; treasurer, Orlando F. Thomas; directors, Cyrus Field Judson, Joseph Leiter, Winfield S. Jewell, Robert McKinstry, Orlando F. Thomas, Edwin M. Post, Samuel Thomas, Camille Weidenfeld, Louis W. Wormser and Joseph F. Tracy. O. F. Thomas has been appointed receiver of the property in this State by Judge O'Gorman, of the Supreme Court, in a suit brought by Henry C. Hepburn, a stockholder. A meeting of the executive committee was held on Aug. 8, at which it was stated to be impossible to continue the business in its present condition as an attachment for over $4,000 had been placed on the company's property here, a second attachment for $11,000 on cabs sent to Chicago for repairs, and a third attachment for $45,000 was obtained against the company here on Aug. 7.

AMUSING, IF TRUE.—The *Wall Street Journal* is responsible for the following news of a "combine" to down electricity: "It is said that conferences are to be held in this city next week looking to a consolidation of several companies which have been experimenting for the purpose of finding a cheaper motive power than electricity for urban and suburban street car and heavy trucking work. These companies are said to have made considerable progress in an experimental way, but are far from an earning capacity. It is pointed out that as they all have a common end in view it would be more economical to carry on their experiments under a common head with the mature experience of each."

DIVIDENDS.—The Detroit United Railway Company has declared a quarterly dividend of 1 per cent, payable Sept. 2. The Niles Bement-Pond Company has declared a quarterly dividend of 1½ per cent on its preferred stock payable Aug. 15, and a semi-annual dividend of 3 per cent on its common stock payable in two installments of 1½ per cent. The Metropolitan West Side "L," of Chicago, has declared a semi-annual dividend of 2 per cent on its preferred stock. The declaration in February last was 1½ per cent.

UTICA TROLLEY BONDS.—A syndicate of capitalists has, as already noted, acquired the five street railway properties in and around Utica, N. Y., which will be connected, re-equipped and extended. The completed system will serve a population of about 100,000. The properties, with the expenditures involved, will represent a cost of over $3,000,000, a portion of which will be provided by an issue of bonds which has been placed with N. W. Harris & Co., of this city.

UNITED POWER & TRANSPORTATION COMPANY.—The Reading & Southwestern Electric Railway Company stockholders have agreed to lease the line to the United Power & Transportation Company for 999 years. The United Company is to pay the interest on $100,000 bonds, and an additional rental of $15,600, sufficient to pay 12 per cent on the par of the Reading & Southwestern stock. In case of default the United Company forfeits a bond of $20,000, and in addition agrees to pay $50,000 damages.

JERSEY CITY TROLLEYS.—The stockholders of the Jersey City, Hoboken & Paterson Street Railway Company will meet in Hoboken on Aug. 15 to ratify the action of the directors in guaranteeing $1,000,000 of first mortgage bonds issued by the Bergen Turnpike Company for the purpose of building a trolley line from Hackensack to Hoboken, which is to connect with the Jersey City, Hoboken and Paterson line.

WASHINGTON & ANNAPOLIS ELECTRIC.—The directors and stockholders of the Washington & Annapolis Electric Railway have decided to increase the capital stock of the company from $1,500,000 to $2,000,000 by the issue of 10,000 additional shares.

Commercial Intelligence.

THE WEEK IN TRADE was, on the whole, very gratifying, and there were indications that the general rise in prices which began in June is going on, due to the activity in all the markets and lines of consumption. It is noted by *Dun* that there is no complaint from any part of the country over the volume of current distribution of merchandise, and what hesitation is observed in general trade is chiefly due to the uncertainty as to the duration of the labor troubles in the steel manufacture. Collections continue good, better weather has helped the agricultural classes, money is easy, and stocks of merchandise carried are not above the average for this season of year, particularly in the West and Southwest. Railroad earnings are a remarkable illustration of the activity of general business, gaining 13.2 per cent in July over 1900, and 25.2 per cent over 1899. Bank clearings at New York for the past week gained 75.8 per cent over 1900, and 34.7 per cent over 1899; and at leading cities outside New York gained 23.0 per cent over 1900, and 22.6 over 1899. The tenor of the *Bradstreet's* reports is the same, and as to prices it is remarked that the continuance in July of the rise in prices of staples, first noted in June, may be regarded as proof that the reaction in values which has continued for a year and a quarter has at last given place to a contrary movement. The approximate index num-

ber on Aug. 1 this year was 84.800, a gain of one-half of 1 per cent over July 1 and of 1.5 per cent over the low-water mark reached on June 1. By the rises of the past two months much of the decline in the first half of the year has been recovered, the index number being now only one-half of 1 per cent below that of Jan. 1, 1901, and at the highest point reached since that date. Failures in July were 12 per cent heavier than in June this year, but liabilities were 19 per cent smaller, while as compared with July a year ago the number is slightly larger. The number was 837, with liabilities of $15,-343,119 and assets of $8,506,536. For the seven months failures number 6,292 and liabilities aggregate $82,302,602, an increase of 10 per cent in number and of 17.8 per cent in liabilities over a year ago. The Treasury Bureau of Statistics notes excellent trade conditions in such great staples as cattle, wheat, hogs, cotton, coal and coastwise business.

GERMANY AND AMERICA.—Mr. Charles A. Schieren, the well-known belting manufacturer, at one time Mayor of Brooklyn, has just returned home from a trip to Germany, where he found American goods in high favor, while the feeling of the commercial classes is one of jealousy. But, he said, "they are making most strenuous efforts to keep pace with our progressive spirit, and they have adopted in late years many important changes. They have established commercial and mechanical schools for the training of young men, and pay especial attention to the training of young men in the use and handling of new and improved tools and machinery. The commercial classes are thoroughly informed as to the existing conditions of our mechanics. They appreciate fully the great difference between their skilled labor and ours. They know that we can produce many articles cheaper than they can, although paying higher wages. They understand that our mechanics are quicker, more alert and able to produce more with our improved tools and machinery than theirs. Therefore, the principal aim of the German manufacturer at present is to educate and train his mechanics until they are equal to the American workmen in skill. One of the characteristics of the German is persistency. It is possible that by the application of this national trait the commercial classes may succeed in creating in the near future a class of mechanics superior in skill and intelligence to ours. They already excel us in commercial education, and they have accomplished many things that have surprised the civilized world. They may overcome the great barrier of the present social conditions of their laboring classes and successfully compete for the supremacy of trade and commerce in the markets of the world."

TRADE WITH BRAZIL.—Mr. J. S. Mello, of San Paulo, Brazil, a representative of the Agriculture Association of Brazil, in the interest of which he made an extensive tour of this country, has just returned home. His purpose principally was to purchase agricultural machinery for use on the coffee plantations. The planters, he said, are greatly in need of improved implements, particularly for the cleaning and weeding of coffee. Modern sugar machinery is also needed. Before leaving he said: "I have purchased many thousand dollars' worth of American machinery. Some of these have never been seen in Brazil. The planters, who already do a large business with the United States, desire to increase their trade with this country. There is, however, a serious drawback to this. It is the absence of an American bank in Brazil. France, Germany and England all have banks in Rio, which greatly facilitate our business with those nations. The establishment of an American bank in Brazil will increase trade with the United States threefold."

TURBINES FOR NIAGARA.—The following special dispatch of Aug. 13 from London appears in the papers: "A dispatch to the *Daily Mail* from Geneva says that Wyss & Co., of Zurich, electrical engineers, have received a contract to supply all the machinery for the new electric installation at Niagara Falls. It will consist of 11 turbines of 5000 horse-power each. Mexico has also placed an order for an electric station of 100,000 horse-power with the same firm." The data as to Niagara is slightly incorrect. As before, the additional Niagara turbines will be built in this country by I. P. Morris Company, at Philadelphia, and the General Electric Company have the generator order. Escher Wyss & Co. have simply designed the turbines, being well known in that line all over the world. It is true, the big new wheel pit provides for 11 units, or 55,000 horse-power, but the wheels now building are six, or 30,000 horse-power capacity, as a first installment. With these few revisions the item will possibly pass muster.

POWER AND COAL IN FRANCE.—The British Consul at Marseilles speaks of a British combination to keep American coal out of that market, but states that as soon as the United States subsidizes shipping another combination will build a fleet of 15,000-ton vessels and construct huge depots at Marseilles, Genoa and Salonica, facilitating the work at those places with labor-saving machinery. The vessels will also trade with Manila, taking whatever freight is available when they have no coal to carry. They will also carry passengers. The combination will manufacture briquettes at its Mediterranean depots, working its machinery with electricity produced from water power. These briquettes are made by mixing petroleum and refuse coal, and the product is little inferior to the best Cardiff coal. Already a station has been acquired on the River Durance, which is capable of furnishing 20,000 horse-power.

BIG TROLLEY WORK.—There should be large orders coming from Pennsylvania for electric railway material. In the past few weeks, as noted in these pages, charters have been granted by the State Department at Harrisburg to no less than 16 companies for the construction and operation of electric railways in Pennsylvania. One syndicate, headed by Pittsburg capitalists, is to run its lines in the western and northwestern part of the State, in connection with electric railways already built, thus joining the different towns and cities. The companies are to spend $483,000 in the building and equipping of 83 miles of track. In the eastern part of the State one syndicate alone, backed by Philadelphia capital, is to spend $150,000 on the building of about 25 miles to join lines now in operation.

WATER POWER AT APPLETON, WIS.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have just secured quite a large order for waterwheels from the Wisconsin Traction, Light, Heat & Power Company, of Appleton, Wis. There will be two units of waterwheels, each unit consisting of three pairs of 42-inch horizontal Victor turbines for driving the main plant, and also two 24-inch horizontal Victor turbines for driving the exciters. The main wheels will develop 3200 horse-power, and the exciter wheels 150 horse-power. The gate work will be of the concern's patented draw-rod type.

BALL ENGINE CONTRACTS.—Recent export sales of the Ball Engine Company, Erie, Pa., are one engine to Cuba and one to Japan. The Consolidated Mines, Duluth, has recently started a 110-hp Ball engine for electric lighting. The University of Kansas, Lawrence, Kan., has purchased a self-oiling engine for testing purposes from the Kansas City representative of the Ball Engine Company, Mr. Clarence A. Burton, and the Colorado Ice & Storage Company, of Denver, Colo., will have its own electric plant, a 125-hp self-oiling engine, built by the Ball Engine Company, furnishing the necessary power.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., recently shipped to the Baker Iron Works, Los Angeles, Calif., a three-motor electric traveling crane, for their new shop. This crane was of special low type design, occupying but small space above the runway. This firm has also installed in the plant of the Aeromotor Company, of Chicago, a three-minor electric crane, 60-ft. span, fitted with alternating-current motors and equipment. This crane is of a special type designed for handling pipe, and is an interesting instance of the application of alternating current to electric crane service.

WESTINGHOUSE CONTRACTS IN ENGLAND.—The Mersey Railway, which runs under the river Mersey from Liverpool to Birkenhead, a distance of about one and one-half miles, is to be electrically equipped, and the British Westinghouse concern has the contract, despite strenuous competition. The Dublin Corporation has also accepted the tender of the British Westinghouse company for the furnishing of the necessary transformers and meters for the electric system of the Irish capital. Everything pertaining to the contract will be turned out in this country.

POWER AT HELENA, MONT.—The Missouri River Power Company, at Helena, is now installing six pairs of 45-inch wheels from S. Morgan Smith Company, of York, Pa. These operate under 31-ft. head. There are also a pair of exciter wheels. The larger ones are hitched to Westinghouse generators. The whole plant is being overhauled, the company dispensing completely with the supply pipes, and bringing the water right up to a new bulkhead placed in front of the power house.

ELECTRIC VEHICLE COMPANY, 100 Broadway, N. Y., has just received a letter from its London agency announcing the order by the Queen of England of another Mark XII Columbia Victoria. It is stated that Queen Alexandra intends presenting this beautiful carriage to her sister, the Dowager Empress of Russia. It is like her own, and is to be used in St. Petersburg.

AUTOMOBILES FOR AFRICA.—The American Bicycle Company, which manufactures steam automobiles in Toledo, Ohio, has just shipped three high-power automobiles from that city to Cape Town. They were ordered by the British Government for the use of army officers in South Africa.

BELL TELEPHONE OUTPUT of instruments for the month ended July 20, by the American Telephone & Telegraph Company shows a decrease of 9085 instruments in the gross.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week just ended Aug. 8: Antwerp—126 packages electrical material, $5,134; 1 case electrical machinery, $75. Argentine Republic—91 packages electrical material, $2,648; 1 locomobile, $1,200; 1 package electrical machinery, $17. Bristol—106 packages electrical machinery, $8,630. Belfast—3 cases auto parts, $500. Brazil—150 packages electrical material, $2,958; 14 packages electrical machinery, $2,700. Bremen—13 packages electrical material, $164. British East Indies—8 cases electrical machinery, $2,500; 3 cases electrical material, $124. British Guiana—37 packages electrical material, $501; 1 case electrical machinery, $50. British Australia—227 packages electrical material, $13,400; 27 packages electrical machinery, $1,854. British Africa—45 packages electrical material, $4,879. British West Indies—10 cases electrical material, $131. Chili—3 packages electrical material, $135. Cuba—60 cases electrical machinery, $1,208; 63 cases electrical material, $2,089. Central America—12 packages electrical material, $306. China—16 coils cable, $550; 6 packages electrical material, $330. Glasgow—86 cases electrical machinery, $3,700. Hamburg—14 packages electrical material, $6,924; 16 packages electrical material, $418. Hong Kong—1 package electrical material, $31; 1 case electrical machinery, $10. Havre—14 cases electrical material, $524; 21 packages electrical machinery, $1,946. Japan—7 packages electrical material, $62; 44 packages electrical material, $2,737; 74 cases electrical machinery, $18,429. Korea—14 packages electrical material, $2,340. Liverpool—60 packages electrical machinery, $3,071. London—130 packages electrical machinery, $5,363; 161 packages electrical machinery, $4,284; 22 packages motor vehicles and parts, $10,170. Marseilles—29 cases electrical material, $662. Mexico—391 packages electrical material, $3,309. Manchester—29 cases electrical machinery, $43,977. New Castle—38 cases electrical machinery, $4,310; 8 cases electrical material, $1,000. New Zealand—1 case electrical material, $60; 21 cases electrical machinery, $648. Philippines—12 packages electrical material, $845; 5 packages electrical machinery, $5,500. Peru—13 cases electrical material, $410. Riga—1 package electrical material, $83. St. Petersburg—2 cases electrical machinery, $500. U. S. Colombia—2 packages electrical material, $173. Vienna—1 package electrical material, $28. Venezuela—313 packages electrical material, $1,632.

THE RIDGWAY DYNAMO & ENGINE COMPANY.—Owing to the great increase in their business the Ridgway Dynamo & Engine Company, Ridgway, Pa., decided on May 1 to increase their capital stock to enable them to enlarge their works. As a result of this they are now erecting additional buildings, which will be nearly double the dimensions of the old. The whole plant, when finished, will cover about 2½ acres of land. All will be equipped with the most modern machinery and tools, and the capacity of the works will be considerably more than double what they are now. The new buildings will be constructed of steel, with brick walls, and include large additions to both the machine shop and the foundry, together with new boiler house complete. The latter will be furnished with elevators and storage bins for the keeping of large quantities of coal. The new machinery includes five electric cranes, three in the machine shop and two in the foundry, a new power plant complete, which embraces 500 horse-power of water-tube boilers, with brick stack, one engine and generator of 300 kilowatts, and a second engine and generator of 100 kilowatts. The tool equipment includes, besides a variety of lathes, boring mills and milling machines of ordinary types, a specially designed boring mill for cylinders and engine beds, and specially constructed milling machines for various operations on engines and generators. It also embraces a large electrically driven air compressor, hydraulic press, etc. The company is erecting a new office building of brick, which will possess ample facilities for conducting the commercial and drafting departments of their business. The basement of the building will be fitted up as an electrical laboratory for testing and research under the direction of Milton E. Thompson, chief engineer of the company. The additions are now well under way, and it is expected the enlarged works will be in full operation by the middle of October.

BROWN HOISTING WORKS.—The large four-story office building of the Brown Hoisting Machine Company, at Cleveland, is being removed a distance of 500 ft. to make room for the new plant which is to take the place of the one destroyed by fire some months ago. A notable feature about the removal of this building is that the business of the company is being carried on as usual without the least interference in any of its details. The sewerage and water supply are provided for by inserting sections of hose from time to time as the distance increases. The telephone and messenger service and electric lighting are also in operation as usual. Some of the wires enter the building from the front, and these are reeled up from time to time, while those entering from the rear have been spliced with long sections, which are unreeled as fast as necessary. The structure is of brick and stone, and weighs 12,000 tons. It has a vault in the center reaching the entire height, weighing over 500 tons. The building is being moved at an angle of 40 degs., and will have to climb a grade of over 8 inches en route. H. Sheeler, of Chicago, is doing the work, assisted by the Brown Company's engineers. Railway rails and steel rollers are used in the work.

NEW STREET RAILWAY FOR MEXICAN CAPITAL.—Arrangements have been almost completed whereby the Ferrocarril de Circunvalacion, the new street railway company, in the City of Mexico, expects to begin work at once in constructing its lines. The concession granted to the company by the Mexican Government permits the operation of a line of street railway on 200 streets, which are not traversed by the existing electric traction company, the Mexican Tramways Company, Limited. The capital, according to advices just to hand from the Southern Republic, has been fully subscribed. Mr. Arthur Stilwell and other American capitalists are understood to be largely interested in the new enterprise. A meeting of the stockholders of the company was held last week in the City of Mexico, and while the proceedings of the meeting have not yet been made public, it is conceded that documents are about to be signed, in which everything necessary for the legal operation of the company will be set forth and work will be commenced in building the road. While nothing definite has yet been determined on the awarding of contracts, it may be taken for granted that all the requisite foreign material, equipment, etc., will be purchased in the United States.

BRITISH MIDLAND RAILWAY ENGINEERS.—Messrs. R. M. Deeley and G. W. Wooliscroft, the engineers attached to the locomotive department of the British Midland Railway Company, who have been in this country for the last four months for the purpose of studying the best American electrical engineering methods, locomotive building and our shop practices in general, sailed last week for England. Though these gentlemen were somewhat reticent in stating to what extent American manufacturers would ultimately benefit by their visit here, it is believed by parties usually well informed as to foreign trade that Messrs. Deeley and Woolliscroft will embody in a report to the Midland directors several recommendations as to American electrical apparatus, machine tools, etc., which it is anticipated will result in the placing of considerable contracts in the United States in the near future.

PUMPS FOR VARIOUS FOREIGN COUNTRIES.—The International Pump Company is at present stated to be shipping considerable quantities of pumps abroad, more particularly to the Far East. A number of Worthington compound pumps are being ordered for shipment to Port Arthur. Within the last few days contracts calling for some 25 general service outfits have been secured by the Deane branch of the company for shipment to Hong Kong. It is said that these pumps will not be trans-shipped from that port, but are intended for utilization in various parts of Southern China. Requisitions have also been received by the Deane branch for some score of general service pumps which are to be forwarded to Java. The Dutch East Indies market is said to be a comparatively new one for American equipments of this description.

CONTRACTS FOR MECHANICAL STOKERS.—Westinghouse, Church, Kerr & Co. report recent receipt of a number of large contracts calling for Roney mechanical overfed mechanical stoker equipment. The orders include eight stokers for installation on the new Lincoln Wharf station of the Boston Elevated Railway Company, Boston, Mass.; six equipments for the Seattle, Wash., Electric Company; nine outfits for the Richmond Passenger & Power Company, Richmond, Va.; fourteen stokers for the New York Glucose Company's Shadyside, N. J., plant, and seventeen equipments for the Mathieson Alkali Works, Saltville, Va. A fair-sized contract has also been received for stokers to be installed in the plant of the Monongahela Traction Company, McKeesport, Pa.

LIGHTING APPARATUS FOR WESTCHESTER.—The Westchester Gas & Electric Company, which supplies Mt. Vernon, City Island, New Rochelle, Larchmont, Mamaroneck, Port Chester and Greenwich with electric service by separate plants, has under construction a 4000-hp central station at New Rochelle, to furnish the above towns. Boosters will be used at the central station, and the current transformed at stations in each town, to a suitable voltage, for commercial use. A. L. Chester is purchasing agent.

STREET RAILWAY MATERIAL. — The Coke Belt Street Railway Company, Greensburg, Pa., will, within the next fortnight, be ready to place orders for material, cars, etc., for 17 miles of road. E. H. Allen is general manager, to whom inquiries should be addressed.

PLANERS FOR EXPORT.—The Cincinnati Planer Company has just received some good-sized orders from Buenos Ayres, Argentine, Santiago, Chili, and Mexico City. There seems to be a general revival among Cincinnati concerns from the depressing effects of the recent strike.

CAR MATERIAL FOR GREECE.—The J. G. Brill Company, of Philadelphia, is about to make shipment of four carloads of car material, which is intended for use on the street railway system now under construction at Patras, the Pittsburg of Greece.

General News.

THE TELEPHONE.

GADSDEN, ALA.—R. L. Adams, manager of the Alabama & Georgia Long Distance Telephone Company, is now building a copper line from Gadsden to Birmingham, also to Anniston.

SACRAMENTO, CALIF.—The Pacific States Telephone & Telegraph Company has about 2500 telephones in use in Sacramento.

SAN FRANCISCO, CALIF.—It is reported that the Pacific Wireless Telephone & Telegrapn Company, with a capitalization of $5,000,000, will have its headquarters in San Francisco, and will operate in Colorado, Utah, Nevada, California, New Mexico and Arizona.

SAN FRANCISCO, CALIF.—Twenty-five miles of insulated telegraph cable has been received by Quartermaster Ruhlen in Seattle, Wash. It will be shipped to the Signal Service Office, Fort Egbert, Alaska, and it will form a part of the telegraph line from that point to St. Michael. The wire will be laid on the ground west of Fort Egbert in a tundra country, which is not suited for telegraph poles. The line is expected to be buried under snow and ice during more than half of the year.

DENVER, COLO.—The Pacific Wireless Telephone & Telegraph Company and the Continental Wireless Telephone & Telegraph Company have been incorporated in South Dakota, with headquarters in Denver. Each company is capitalized at $1,000,000.

MERIDEN, CONN.—The Southern New England Telephone Company has made the following changes in the toll line rates: Commencing at midnight of July 31-August 1. First, the ten-minute night period will be abolished and a five-minute period will be substituted; second, to points where the rate is five, ten or fifteen cents the night rate will be the same for five-minute period; third, where the day rate is twenty-five cents the night rate will be fifteen cents for a five-minute period.

HANKINSON, N. D., is to have a telephone exchange.

PIERRE, S. D.—The Bridgewater Telephone Company has been formed, with a capital of $2,300. Incorporators: T. W. Dwight, C. S. Meredith, Jacob Tschetter, W. W. Moyes and W. C. Burroughs.

DOVER, DEL.—The Diamond State Telephone Company is about to lay a cable across the Chesapeake Bay from Love Point on the eastern shore to Sandy Point Lighthouse on the western shore, connecting with the Chesapeake & Potomac Telephone Company. It will be five miles long and will weigh 70 tons. The deepest point along its bed will be seventy feet below the surface of the water.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company recently requested permission to string two wires along poles of the Baltimore & Ohio Railroad from Benning Road to the Chesapeake Beach Railroad, and along this railroad to Bloomsburg Park northeast. The electrical engineer has reported that the application should be granted with the usual conditions attached.

BARTOW, FLA.—The Peninsular Telephone Company, G. S. Van Buskirk, representative, is about to arrange for installing a system in accordance with the telephone franchise received recently.

KISSIMMEE CITY, FLA., has granted C. A. Carson, doing business as the Kissimmee Telephone Company, of Kissimmee City, Osceola County, Fla., and his successors and assigns, the franchise of establishing, installing and operating a first-class telephone system.

PUNTA GORDA, FLA.—Mr. E. A. White is getting the material upon the ground for the telephone system which he proposes to erect in Punta Gorda, and hopes to have the service completed by Sept. 15. The system will be extended to Solana and other suburbs, and will connect with the Peninsula telephone line from Tampa, Bartow and Arcadia, which line will also be extended to Fort Myers and connect with the service to St. James and Naples.

BLUE RIDGE, GA.—The Southern Bell Telephone & Telegraph Company, Atlanta, Ga., is negotiating with T. S. McKinney relative to construction of a system at Blue Ridge.

ATLANTA, GA.—The Southern Bell Telephone Company will erect a handsome four-story structure adjoining their exchange on Prior Street. The new building will be used for their office.

ELBERTON, GA.—The local exchange has been purchased by the Southern Bell Telephone Company, who will construct a new exchange and a long-distance toll line to Atlanta. W. T. Gentry is general manager of the company at Atlanta.

IRWINTON, GA.—A new telephone line is now in course of erection between this place and Milledgeville, a distance of twenty-two miles. Mr. A. I. Smith is the owner and builder. He has just completed a line from Irwinton to Toombsboro and Dublin, connecting with the local exchange in the latter place.

ATLANTA, GA.—A new and more direct telephone line to New York has been opened up. It shortens previous telephone routes by 150 miles. The new line is by way of Charlotte, which now has direct communication with Atlanta. Rates have been reduced from $10 to $5.75 during the day and $2.90 at night for three-minute tolls.

PAYETTE, IDAHO.—The Payette Telephone Company has been organized by A. B. Moss, Peter Pence, W. A. Coughanour, James A. Lauer, B. P. Shawhan, D. C. Chase, E. Zimmerman, J. R. Banks and C. E. Brainard. The capital stock is $5,000, all subscribed. Sixteen miles of wire and poles have been ordered. This company was formed for the purpose of building to meet the Idaho Independent Telephone Company's line coming from Pearl.

WILLIAMSBURG, ILL.—Mr. C. A. Gregory is erecting a metallic telephone line to Williamsburg and Fairbanks.

SPRING VALLEY, ILL.—The Bureau County Telephone Company is now engaged in running a line into Mineral.

BECKFORD, ILL.—The Lee County Telephone Company will install a new automatic pay telephone at the assembly near the upper gates for the use of the public.

PULLMAN, ILL.—The Pullman telephone office has been abolished, the new office being located at West Pullman, where the Chicago Telephone Company has recently completed their new building.

CHARLESTON, ILL.—The Charleston Telephone Company, owners, Messrs. Brooks and Cadle; Manager, F. A. Brooks, now has a switchboard of 415 drop capacity and 325 subscribers. It operates 200 miles of local circuit and 40 of toll line.

CHICAGO, ILL.—More than 1,800 farmers within a radius of thirty miles of the city of Chicago have telephones in their homes. This includes only telephone connections with regular exchanges, connecting with the country seats and other towns, and all can be reached from Chicago.

ALTON, ILL.—The Kinloch Telephone Company has made announcement in Alton that its toll line from St. Louis via Belleville, East St. Louis and Edwardsville will be completed at once, and that when the line is complete to Alton, a toll office will be opened here and that free service between Alton and St. Louis will be given until the exchange in Alton is complete.

STREATOR, ILL.—The Northern Illinois Telephone Company is showing rather unexpected financial vitality. It has recently purchased the franchise of LaSalle County, owned by the same company, and also a franchise of DeKalb County and another of the city of Mendota. The exchange of the city of Streator has just begun operations with a large number of telephones and plant.

CHICAGO, ILL.—General manager A. S. Hibbard, with the approval of President John I. Sabin, has instituted a plan designed to improve the service of the Chicago Telephone Company. The have appointed a number of "subscribers' agents," each of whom bears a card identifying him, who will personally inspect telephones.

PEORIA, ILL.—The six-party telephone line service is abolished. In place of this there is a new ten-party line set up, the only party service hereafter to be of two or ten instruments. Moreover, there are to be nothing but metallic circuit instruments put up. The rate charged for six-party line telephones heretofore has been $18 per year. This price is to be charged hereafter for lines on which there are ten parties. The cost of the two-party instrument is advanced to $30 and that of the independent goes up to $42.

BLUFFTON, IND.—The United Telephone Company is extending its lines to Zanesville by way of the Huntington and Zanesville pike.

PARKER CITY, IND.—The Parker Telephone Company has been formed; capital stock, $2,500. Directors: Alvin Miller, Charles F. Halliday, L. A. Rodgers, N. T. Chenowith, T. H. Condon and Samuel Jones.

CLERMONT, IND.—The Clermont Telephone Company has been incorporated; capital stock, $10,000. Directors: Benjamin F. Long, A. N. Miller, J. M. Carter, A. V. Hightshue, Charles T. Burgoyne, A. O. Rusie and A. J. Jones.

LAFAYETTE, IND.—The Mutual Independent Telephone Association, of Indiana, has elected the following officers for the ensuing year: President, L. A. Frazee, Connorsville; vice-president, C. A. Zion, Lebanon; secretary-treasurer, H. B. Gates, Indianapolis.

CHURUBUSCO, IND.—Mr. Virgil A. Geiger owns and operates a telephone in connection with his newspaper, *The Truth*. The capital stock is $10,000; switchboard capacity, 100 drops; subscribers, 145, on complete metallic circuit. He has 50 miles of toll line, and extensions are projected.

INDIANAPOLIS, IND.—The Odell Telephone Company, of Glenhall, Tippecanoe County, filed articles of incorporation on the 3d inst; capital, $10,000. The company proposes to construct and operate telephones and exchanges in Tippecanoe, Montgomery and Fountain counties. Samuel B. Lutz heads the list of stockholders.

FLORA, IND.—The Central Union Telephone Company, which has been operating an exchange in this city, has abandoned the field, removing all telephones. The company has been contesting with the Flora & Bringhurst Telephone Company, an independent exchange backed by home capital, and, notwithstanding no rentals have been charged by the Central Union since June, 1899, their patronage has steadily decreased, while the patrons of the home concern has more than doubled.

INDIANAPOLIS, IND.—The State Tax Board has increased the assessment of the New Telephone Company, of Indianapolis, from $115 a mile last year to $130 a mile this year; that of the New Long Distance Telephone Company, with headquarters in Indianapolis, from $15 to $25 a mile; that of the Central Union Company from $49 to $54 a mile. The assessment of telephone property throughout the State shows a general increase of $1,514,339 over the assessment of last year, the total being $4,443,529.

SOUTHPORT, IND.—The Central Union Company has completed an exchange here, and giving service to thirty-five patrons. Both companies were after the privilege. The Central Union made a proposition to give Southport people telephone service for $1.50 a month, if they would put up the poles and the wire, for $2 a month, the company to furnish the whole equipment. The latter was accepted and the company has put in first-class equipments. The patrons have free connection with Indianapolis, twelve miles distant, and with all the company's telephones in the county.

M'GREGOR, IA.—The Standard Telephone is arranging for the new line to Clayton.

DES MOINES, IA.—The Rex Telephone & Electric Company is contemplating an increase in the size of its plant.

CHARITON, IA.—The Chariton and Benton Telephone Company now comes into Chariton through the central switchboard. This ends all opposition to the Chariton company, which is giving excellent satisfaction to its patrons.

TOPEKA, KAN.—The Wilson County Telephone Company has been incorporated; $750 capital stock.

RILEY, KAN.—The telephone people are working on a line from [illegible] Riley, and it will soon be completed.

TOPEKA, KAN.—The City Council, by a unanimous vote, granted a franchise to the Pankey Telephone Company because of the fact that a very large number of the principal business men of Topeka had petitioned for it, the inference being that in the opinion of Topeka's business men another system was necessary.

MARYSVILLE, KAN.—A. G. Stupe, of the Kellogg Switchboard & Supply Company of Chicago, has been adding some improvements to the telephone exchange. A Warner power generator has been added. The Blue Rapids exchange has rather a new switchboard, too, with self-restoring drops.

SOMERSET, KY.—The National Transit Company has completed the telephone from Eastport to Somerset, Ky., for the convenience of the company.

PADUCAH, KY.—There is trouble between the Cumberland Telephone Company and the city authorities, the franchise under which the former operates being declared invalid.

BUCKFIELD, MAINE.—The New England Telephone Company intend to extend their line from this place to Turner village, connecting there with their long distance lines to Lewiston, Portland, Boston and all intermediate stations, and the Eastern Telephone Company are also building a line to cover the

NORWAY, MAINE.—The Eastern Telephone Company has been given permission to enter Norway, and in the meantime the New England Company is at work putting its line there in excellent condition and planning for its extension. The two companies are also competing for the business between Buckfield, Turner and points in that vicinity.

BALTIMORE, MD.—The Municipal Building now has an exchange of its own with Maryland connections.

CROSSVILLE, MD.—The Griffith Lumber Company contemplates constructing a 35-mile telephone line.

WESTMINSTER, MD.—The American Bell Telephone Company is extending its lines from York, Pa., to Washington, D. C. The line will be run via Centerville, Manchester, Snydersburg and Carrollton.

BALTIMORE, MD.—The Eastern Shore Telegraph & Telephone Company, of Baltimore, will lay a cable across the bay by Sept. 1, connecting the city with the peninsula. The distance across the bay is five miles. Communication is now made by way of Wilmington. It is believed the improvement will unite more closely the trade interests of the peninsula and Baltimore.

PORT DEPOSIT, MD.—The Diamond State Telephone Company, which has been operating in Cecil County for some time, has aranged with the Port Deposit Electric Company to have its wires upon their poles. Right of way has been granted for the erection of new poles through town, and the telephone and electric companies will use them jointly, and each to be responsible for their wires.

SARANAC, MICH.—The Citizens Telephone Company is extending its line from Lowe to Keene Township.

BAD AXE, MICH.—The Valley Telephone Company is extending its lines to Port Austin and Pointe Aux Barque.

MANKATO, MINN.—The Citizens' Telephone Company has work on the Mapleton exchange well under way.

WINONA, MINN.—The Northwestern Telephone Company is placing a new long-distance switchboard in its office in the city building.

ELY, MINN.—The City Council has granted to W. D. Gallagher a right of franchise to erect and maintain a telephone exchange within the city.

MINNEAPOLIS, MINN.—The committee on underground wires recommends that the petition of the Twin City Telephone Company for permission to lay underground wires be granted.

WINONA, MINN.—The Winona Telephone Company is constantly branching out, and its latest addition is the Trempealeau telephone line, which includes about seven miles of wire to Centerville around the village, including nine telephones and a drop switchboard and all other paraphernalia, including the city franchise and Bell rights. This has all been sold by the former owner, C. S. Utter, of the *Gazette*, to the Winona Telephone Company for a consideration of $225.

O'NEILL, NEB.—Articles of incorporation of the Holt County Telephone Company have been recorded in the Secretary of State's office. The company is capitalized for $10,000 and its principal incorporators are: O. O. Snyder, F. F. Birmingham, S. J. Weekes, T. V. Golden and Ed. F. Gallagher. The principal place of business will be O'Neill, but telephone lines will be maintained in both Holt and Boyd counties.

RALEIGH, N. C.—It is stated that the Bell Telephone Company will place its system under ground and make other improvements costing $10,000.

WAXHAW, N. C., is to have a new telephone exchange, to be known as the Eureka Telephone Company. Mr. H. M. Williams is president of the company and Drs. H. C. Houston and J. V. Hunter and Mr. J. M. Niven, directors. F. A. Krauss is secretary and treasurer, and W. F. Chears general manager. A fifty-drop board will be put in and they will have connection with Monroe, Mattheks and Charlotte. The board will be installed and all lines completed by September 1.

CAMDEN, N. J.—The Interstate Telephone Company, which has bought up the franchises and plants of most of the independent companies in New Jersey, has filed a mortgage for $5,000,000 with Register of Deeds Cole, in Camden. The mortgage was given to the Trenton Trust & Safe Deposit Company, to secure a $5,000,000 issue of bonds, and the latter, in turn, are secured by franchises and plants. A similar mortgage is said to have been filed in every county in the State.

SCHENECTADY, N. Y.—The Albany New Home Telephone Company is erecting poles for its system in this city.

ALBANY, N. Y.—The Albany Home Telephone Company has begun work on the establishment of the telephone plant which it proposes to operate in this city.

DUNKIRK, N. Y.—[illegible] the Dunkirk line has but recently been established, is to be improved at an expense of [illegible] local manager.

CLYDE, N. Y.—Negotiations are pending between the Inter-Ocean Telephone Company, of New York City, and the Lyons Telephone Company, of Lyons, for the purchase of the latter's stock. If the transfer is made, Alvin B. Bishop, of Clyde, one of the promoters and principal stockholders of both companies, will be retained as manager.

SCHENECTADY, N. Y.—Papers have been filed with the Secretary of State incorporating the Home Exchange Telephone Company, of Schenectady. The local people interested are Charles F. Veeder, A. M. Vedder, C. E. Palmer, R. T. Lomasney and G. M. Bostwick. The company proposes to install a system in Schenectady which will connect with neighboring cities, as well as suburban towns.

OAK HARBOR, OHIO.—The Ottawa County Telephone Company is installing a 250-drop switchboard at its branch exchange here.

VIENNA, OHIO.—A new automatic switchboard has been installed by the Independent Telephone Company of this place. A large force is at work installing telephones.

CINCINNATI, OHIO.—Employees of the Cincinnati Telephone Company who belong to the Telephone Employees' Mutual Benefit Association will, with their friends, enjoy an annual outing Sunday, August 18.

JACKSON, OHIO.—The Home Telephone Company is rapidly wiring the city. The cables are all up, and the connecting wires will be strung at once. The Home Company will start off with about 600 subscribers.

KENTON, OHIO.—The Kenton Telephone Company, which was formed in 1898, has a dropboard of 500 capacity and 450 subscribers. Farm lines are projected. The American Electric Telephone Company's system is used.

CLYDE, OHIO.—The Clyde Telephone Company has put up about a mile of cable and will soon be in shape to take care of a large number of subscribers which are on the waiting list. A number of farmer's lines are being built.

McCONNELLSVILLE, OHIO.—Irwin & Scott have purchased the interests of Thomas Drake in the Drake Telephone Company, and the company will continue business under the name of the Home Telephone Company. Improvements will be made.

LIMA, OHIO.—Hon. B. W. Richie, of this city, and C. M. Haskell, of Ottawa, are interested in a project for the building of several hundred miles of toll lines and a number of independent exchanges in the Indian Territory and Oklahoma.

MANSFIELD, OHIO.—The Mansfield Telephone Company has acquired the lines of the Farmers' Co-operative Company, including about 75 miles of toll line and an important exchange at Bellville. The sale of the property settles a long standing litigation.

MARYSVILLE, OHIO.—The Marysville Telephone Company is owned by Mr. N. E. Liggett and has been in operation since April, 1895. It now has a 250-dropboard and 200 subscribers, 60 miles of local circuit and 75 of pole line. Farmers' lines are projected.

YOUNGSTOWN, OHIO.—The Central Union Telephone Company (Bell) is canvassing the city in an effort to secure subscribers for a ten-party line service at a stipulated price of $1 per month. It is understood that under instructions from John Sabin, the company will introduce this service in the large cities in this territory.

CELINA, OHIO.—The Celina Telephone Company has had a remarkable growth during the past year, and has increased its subscription list nearly 100 per cent. Over 200 lines are in operation and the company will be obliged to install a switchboard having a larger capacity. H. H. Miller is secretary of the company.

FINDLAY, OHIO.—The Findlay Home Telephone Company and the City Council are engaged in a controversy over the prices established by the former. The company's franchise provides that residence telephone shall cost not to exceed $12 per year, but the company is charging $18 a year. An effort is being made to revoke the franchise, and the matter will probably be carried into court.

DAYTON, OHIO.—The Dayton Home Telephone Company has organized as follows: Directors—S. R. Harshman, John T. Barlow, H. C. Kiefober, F. G. Witheft, J. C. Reber, J. B. Hoge. Officers—John T. Barlow, president; H. D. Critchfield, vice-president; James C. Reber, secretary and treasurer; counsel, Albert Emanuel and H. D. Critchfield; Maxine Reber, consulting engineer. The capital stock of the company was increased from $100,000 to $750,000. The company will not only equip Dayton with a complete plant, but will build exchanges and farm lines throughout Montgomery County. The plant will be of the most modern type, with copper metallic circuits and underground wires in the business district.

BELLEVUE, OHIO.—The Huron County & New Washington Telephone Company has elected directors as follows: C. R. Callaghan, W. M. Halliday, Frank A. Knapp, R. R. Parkhurst, D. Calhoun, John H. Sheets, M. J. Callaghan. Officers, C. R. Callaghan, president; John H. Sheets, vice-president; Frank A. Knapp, secretary; W. M. Halliday, treasurer. The new company will be capitalized at $60,000, and assumed control August 1, with headquarters in this city. The company now controls exchanges at Monroeville, Chicago Junction, Plymouth, New Washington, together with toll stations at North Monroeville, New Haven, Centerton, Havana, Ruggles, Boughtonville, Peggton, North Fairfield and Greenwich, and has long-distance connections with the United States lines.

CLEVELAND, OHIO.—H. A. Everett, president of the Federal Telephone Company and its allied interests, has announced the following appointments: Mr. James B. Hoge, has been elected chairman of the executive committee of the company, and hereafter will be its chief executive officer. Mr. Maxine Reber has been elected second vice-president of the United States Telephone Company and appointed general manager, vice James M. Thomas, resigned. Mr. H. D. Critchfield, general counsel of the company, will have charge of all legal mat-

ters, including contracts and relations with other organizations, franchises, organization of companies, stock and bond issues, right of way, and all other matters of legal character. Mr. W. H. Park, general auditor of the company, will have general control and supervision of all accounts, and the system of accounting, including settlements with all connecting companies, as well as with the agents and managers of Federal properties. The above clearly defines the organization of the Federal company, and indicates that while Messrs. Everett and Moore will continue to advise, the company is so organized that each department has a controlling head.

GUTHRIE, OKLA.—The Topeka & El Reno Telephone Company has been chartered. The capital stock is $10,000. The directors are W. F. Evans, of Topeka, Kan.; Homer Burr Low, of Fort Worth, claim agent of the Chicago, Rock Island & Texas Railroad; F. H. Wright, of El Reno; G. W. Bellamy, of El Reno, and O. O. Blake, of El Reno.

GUTHRIE, OKLA.—The Red River Telephone Company, with headquarters at Lawton, has been chartered. The incorporators are Jacob Roberts, W. J. Steel and J. L. Callahan, of Kingfisher. The capital stock is $50,000. The officers of the company are: J. A. Overstreet, president; J. M. Callahan, secretary; George Newer, treasurer; W. J. Steel, general manager.

WOODBURY, PA.—Almonesson is to have telephone communication from Woodbury.

HUNTINGDON, PA.—The Juniata Union Telephone Company has been formed; capital, $1,000.

VERONA, PA.—The ordinance giving permission to the American Telephone Company to run its lines through Verona has been passed.

ERCILDOUN, PA.—The United Telephone Company is building a new line to Ercildoun, and some of the residents of that neighborhood are subscribing.

PITTSBURG, PA.—The Borough Council of Sewickley has decided to consider an application for a franchise made by the Pittsburg & Allegheny Telephone Company.

PITTSBURG, PA.—A number of the large coal companies in this vicinity are contemplating the introduction of the telephone into their coal mines, and it is expected that in case of an accident by which miners may be entombed, telephone communication with the outside world may greatly aid in their rescue.

PITTSBURG, PA.—One of the many features of the new Pittsburg Exposition, which will open in this city on September 4, will be its brilliancy from the standpoint of electric lighting. Not less than 5000 electric lights will be used in the main building alone. Most of these lights will be furnished by the Westinghouse companies.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company, which went into operation in Allegheny County about a year ago in opposition to the local Bell Company is now offering to subscribers an unlimited party-line service at $34 per year for business houses and at $24 per year for private residences. This cost is considerably lower than the charges made for similar service by the old company.

ERIE, PA.—The Mutual Telephone Company, stock $75,000, bonds $50,000, started operations November, 1897. They now use a 1500-dropboard and have 1400 subscribers. They are also about to begin laying and hanging 12,000 additional feet of cable and have already 13,000 feet in city conduit, besides long distance connections over the lines of the Union Telephone & Telegraph Company. Other details of the system were given recently in this department.

PHILADELPHIA, PA.—If the plans of the Telephone Company of America are carried out, according to Secretary T. W. Tryer, the company will install a system in West Philadelphia in which each call will cost two cents. The operation is to be carried on under the franchise recently granted to the Keystone Telephone Company. Secretary Tryer estimates that fully 100,000 telephones would be found necessary to fully equip the territory. Mr. Tryer stated it was the intention to place a telephone in every building free of cost to the occupants, and that the toll of two cents for each call would fully reimburse the company and also insure a profit.

GALLATIN, TENN.—A movement is on foot looking towards the organization of an independent telephone company.

HUNTINGDON, TENN.—The Carroll County Telephone Company, whose central office was recently burned, has resumed operations.

NASHVILLE, TENN.—The East Tennessee Telephone Company, capital $1,500,000, contemplates building a line from Richmond, Ky., to Jellico, Tenn., and is now securing rights of way. They will probably establish exchanges at Williamsburg, Corbin, London and Mt. Vernon.

ALPINE, TEX.—The Alpine-Terlingua Telephone Company has been incorporated with capital of $1,000, by A. M. Turney, R. L. Neville and J. C. Bird.

MEMPHIS, TENN.—The Memphis Telephone Company, the representative of the independent system, won the first decision in the fight pending between the two rival companies in the Federal courts, Judge Hammond having refused to grant the injunction asked by the Cumberland Telephone Company, the representative of the Bell system. Judge Hammond ruled that the application for an injunction restraining the new company from interfering with the manholes of the latter's conduit system was without ground, as the matter could be settled by an action for damages. He also stated that the city could force the Cumberland Company to move the manhole in question in the event that such action was necessary to give both the companies the same showing.

ALVIN, TEXAS.—The Vernon Telephone Company has purchased the Vernon electric light plant and consolidated the two systems under the name of the Vernon Light & Power Company.

EL PASO, TEXAS.—The Southern Independent Telephone & Telegraph Company, of El Paso, capital stock $200,000, has been formed to construct, maintain and operate a telephone and telegraph system in the city and county of El Paso.

STAUNTON, VA.—Mr. Guly, secretary and treasurer of the Long Distance Telephone Company, of Virginia, has been securing right of way for his company from Scottsville to Richmond. He says he hopes to have the gap between Charlottesville and Richmond closed by September 1.

STAUNTON, VA.—The Long Distance Telephone Company, of Virginia, incorporated July, 1900, has a present capital of $64,000, which is to be increased to $100,000. There are 333 miles of toll line and nearly 200 more are projected. President, James R. Kemper; Secretary and Treasurer, G. A. Gulley.

OREGON, WIS., is to have a telephone exchange.

MILWAUKEE, WIS.—A. B. Ferdinand, president of the Northwestern Telephone & Electric Company, is planning to build a telephone line in this city, and will ask for a franchise.

EAST TROY, WIS.—The telephone line in the farming district in this vicinity is developing on a large scale. Over 100 farmers have ordered telephones put in their homes.

BARABOO, WIS.—W. J. Bell, manager of the Baraboo Telephone Company, has been granted a franchise by the village board of Kilbourn, to construct and operate a telephone exchange in that place.

SUN PRAIRIE, WIS.—The North & East Bristol Telephone Company has purchased the Waterloo telephone exchange from Roach & Seeber Company and will shortly make extensive improvements.

NEENAH, WIS.—The telephone operators of the local telephone exchange went on a strike recently, but the manager had been drilling other operators, and there was no material interruption to the business.

KAUKAUNA, WIS.—The local system of the Fox River Valley Telephone Company, at Kaukauna and Neenah and Menasha, will be built this season, work beginning as soon as that at Appleton is completed.

WHITEWATER, WIS.—The Wisconsin Bell Telephone lines and the Walworth County Company have united at East Troy, giving to the Walworth County line the benefit of the Bell long-distance service.

EAU CLAIRE, WIS.—An ordinance has been passed granting to the Osseo Telephone Company authority to construct, operate and maintain a telephone system in the city of Eau Claire, for the term of twenty years.

MILWAUKEE, WIS.—The Citizens' Telephone Company, recently organized, is working to obtain a franchise to install and operate an independent telephone system in this city. The company is meeting considerable opposition.

MADISON, WIS.—The Chippewa Valley Telephone Company, of Bruce, Chippewa County, has filed articles of association. The capital stock is $10,000, and the incorporators are O. E. Pederson, A. L. Arpin, A. Hein and ten others.

GALESVILLE, WIS.—The W. P. Veitch Telephone Company's lines and franchise have been sold to the Arcadia Telephone Company for the sum of $4,000. The Veitch system includes the local exchange and lines to North Bend, Winona and Ettrick, about 75 miles in all.

KENOSHA, WIS.—The Kenosha opponents to the Wisconsin Telephone Company are planning to file a large number of suits against the company to collect damages for the use of the streets of the city. The recent decision of the telephone case in Racine has started the Kenosha people.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company, which was recently granted a franchise to enter the city, is at work putting up the poles. It will be an underground system on the streets, but poles will be placed for the wire where it is taken from the ground to be connected for use.

LA CROSSE, WIS.—The Osseo Telephone Company has purchased the Mondovi exchange and has already commenced repairing and rebuilding the lines of the latter. The company will connect their wires with the new La Crosse Independent Telephone Company, and will furnish a direct service between this city and Eau Claire.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company is the name of a company recently organized, and which has secured a franchise from the City Council to build an underground system in this city and connect with towns on the Soo Railway. Work on the line has been started in this city.

MARINETTE, WIS.—Applications for telephone franchises in Marinette and Menominee have been made by former Governor Edward Scofield, of Oconto, and A. L. Hutchinson, of Weyauwega, Wis. They agree to have the systems in operation within a year, and will make them part of the independent telephone systems of Wisconsin. Similar applications will be made in Oconto and Green Bay.

WAUSAU, WIS.—The stockholders of the independent telephone companies of the Wisconsin Valley will meet to formulate plans for consolidating all the valley toll lines. Among the supporters of the project are Judge Gaynor, of Grand Rapids; W. H. Bradley, of Tomahawk; Julius Thielman, of Merrill, and Senator A. L. Kreutzer, of Wausau.

WAUSAU, WIS.—At a meeting of the stockholders of the Marathan County Telephone Company held here August 6, it was decided that the company enter into the Wiseman Valley Telephone combination. All stockholders are given the alternative of entering the combination or disposing of their stock to the other members at par value. The first step to be taken toward consummating the plans formulated by the projectors will be the equipment of a direct copper wire from Grand Rapids north through the valley to Rhinelander. Following this improvement will come the erection of auxiliary lines to connect the principal valley cities with surrounding towns. It is estimated that through the consolidation the service can be improved 75 per cent, while the dividends will be correspondingly augmented. Now that all of the independent companies have signified their willingness to enter the combination a meeting will be held in the near future to perfect arrangements.

DOUGLAS, WYO.—President Wallace, of the Rocky Mountain Bell Telephone Company, states that the long-distance telephone line from Cheyenne to Douglas will be completed and in operation by Oct. 1. Work will be commenced on both ends of the line and rushed to completion. Local feeders will be built at once and the line extended to Casper. Next year the wire will be extended to Lander.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The local electric lighting company in Monterey, Calif., purposes to extend its lines to Pacific Grove, New Monterey and Oak Grove.

COLUSA, CALIF.—The Colusa Gas & Electric Company was recently incorporated by John Martin, Fred. H. Pierson, H. U. Roeding, H. R. Noack and William M. Pierson. Capital stock, $100,000.

SAN FRANCISCO, CALIF.—Montesano, Wash., which has been without electric lights for some time, will soon have the want supplied. Engineer M. B. Koontz has a force of men at work and will install a water-power electric lighting plant at Silvia Lake, from which current will be transmitted to the town.

SAN FRANCISCO, CALIF.—It is persistently rumored in San Francisco papers that Claus Spreckels will very shortly consummate a sale of the Independent Electric Light & Power Company's five-million-dollar electric system to the San Francisco Gas & Electric Company. The story is vigorously denied.

SAN FRANCISCO, CALIF.—The San Gabriel Electric Power Company, the El Reno and the East Side Lighting Company, have been engaged in a rate war, and the East Side concern is now furnishing its Los Angeles patrons with electric lights free of cost. The San Gabriel officials say they will allow their rival a monopoly of free service in Los Angeles.

SAN FRANCISCO, CALIF.—The California Central Gas & Electric Company has acquired a number of local electric lighting plants in towns along the Bay Counties Power Company's Yuba transmission lines. The current will be distributed over the wires acquired and strung by the Central Company. The Merchant's Lighting Company and the Santa Rosa Lighting Company, both of Santa Rosa, recently sold their electric plants to Mr. Martin's company. The plant in San Rafael has just been acquired, the Central Company having been assured of the granting of a 20-year franchise in Marin County. The Burdell electric light and power plant in Petaluma is being negotiated for and a pole line from there to Napa will soon be in course of construction.

BRITISH GUIANA.—The Demerara Electric Company, in which a number of Montreal capitalists are financially interested, has just secured the contract for the lighting of the city of Georgetown.

INDIANAPOLIS, IND.—Bids on the new public electric lighting contract will be opened August 31 by the Board of Public Works. The contract will then be awarded unless new trouble arises from further injunction proceedings. Electricians familiar with the specifications say they discriminate as unfairly against the Indianapolis Light & Power Company, as did the former specifications. This is taken locally as an indication of desire to favor the Home Heating & Lighting Company, whose officers are all close political friends of the Mayor and Board of Works.

ST. LOUIS, MO.—It has been learned from apparently reliable authority that the Eastern syndicate, which was negotiating for the Laclede Gas Company, and which has already purchased the Imperial Electric Light & Power Company, was the American Light & Traction Company. Mr. Emerson McMillin, president of the Laclede Gas Company, is president also of the American Lighting & Traction Company. It is stated that the negotiations may be renewed later, and it is thought that if the American Lighting & Traction Company, if it is in reality the concern seeking control, will come into possession of the local plants.

WADESBORO, N. C.—Options have been secured on the water-power of Bluitt's Falls on the Pee Dee River. The results of a survey indicate that over 2000 horse-power is available. A new survey of the power will be made this month.

FAYETTEVILLE, N. C.—The town has closed a contract with the Cape Fear Power Company for 100 horse-power to be delivered January, 1902, for supplying electric light for the streets and incandescent lights for public and private buildings.

TRENTON, N. J.—The Easton and Phillipsburg Steam Heat & Power Company has been formed; capital stock, $100,000; object, to supply heat and power; principal office, 5 Pennsylvania Railroad Building, Phillipsburg.

SYDNEY, N. S.—The Cape Breton Electric Company, of Sydney, has purchased the ferry steamer plying on the harbor, in opposition to the company's line.

CONNEAUT, OHIO.—The village authorities have decided to issue bonds to the amount of $20,000 for the purpose of improving the municipal lighting plant.

FOSTORIA, OHIO.—The National Electric Light Company, of Jersey City, has purchased a large plant in this city and is remodeling it and equipping it for the manufacture of incandescent lamp globes.

CLEVELAND, OHIO.—The city is making elaborate plans for the electric light decoration of the city buildings and public square for the annual encampment of the G. A. R., which is to be held in this city next month.

CINCINNATI, OHIO.—It is understood that a number of injunction suits will be filed against a proposed ratification of the contract given the Cincinnati Gas & Electric Company for the public electric light of this city for the next ten years.

CINCINNATI, OHIO.—An attempt was made to blow up the boilers of the Edison Electric Company's plant in Cincinnati a few days ago, and for nearly an hour every electric light in Cincinnati was extinguished. General Manager White has instituted a most thorough and searching investigation. A similar attempt was made a year or so ago to wreck the Edison plant.

COLUMBUS, OHIO.—John T. Norris, formerly superintendent of the municipal lighting plant has submitted figures showing that with eight men he can reduce the cost of lights per year to $36.10 per arc light. Director Immel is investigating the proposition, as he favors reopening the municipal lighting plant. At present the city is paying $74.50 per lamp under a private contract.

TIFFIN, OHIO.—[illegible] Company, the Tiffin Electric Light Company and the [illegible] pany, which has been hanging fire for some time, has finally been consummated. The new company will be known as the Tiffin Consolidated Gas & Light Company, and in addition to the local plant will operate plants at Delphos, New Bremen, and Minister. The incorporators of the company are: B. M. Daley and C. M. Nile[illegible] and W. H. Dore, of Tiffin.

GENEVA, OHIO.—Fred. Storm, who is identified with the Everett-Moore syndicate, of Cleveland, has submitted a proposition to the City Council of Geneva to erect an electric light plant in that place. He offers to furnish enclosed arc lights at $65 per year on a moonlight schedule or for $67.50 on an every night schedule. He has agreed that if given a franchise for five years or ten years he will give a bond [illegible] November 1. He agrees to furnish commercial light at a cost not to exceed 10 cents for 1000 watt-hours.

AKRON, OHIO.—A company is being organized in Columbus for the purpose of erecting a power station at Cuyahoga Falls on the Cuyahoga River. Between Kent and Cuyahoga Falls there is a drop in the river level of 135 feet. It is proposed to build a race or canal from the dam in the river at Kent, to a point a short distance below the falls in the river, and to erect the power station at the latter point. It is believed that the company can secure power enough to illuminate and operate factories in Barberton, Cuyahoga Falls, Akron and Kent. Agents of the syndicate are securing water right covering the entire distance.

OTTAWA, ONT.—The Canadian Niagara Power Company is inviting proposals for the wheel pit contract for the power development work to be carried out on the Canadian side. The capital required for the completion of the whole work, has been over-subscribed, an allotment of the debentures having recently been made.

OTTAWA, ONT.—A number of manufacturers of the city of Peterboro Ont., have united in leasing Dam No. 5, in the Trent Valley Canal, for the purpose of generating electric power for their several establishments. The City Council is offered the surplus power at $15 per horse-power per annum for a day of twelve hours.

OTTAWA, ONT.—It is stated that the Kewatin Power Company is about to ask for tenders for developing the water-power at the outlet of the Lake of the Woods, and for the installation of a transmission plant of some 6,000-hp capacity. It is the intention of the company to transmit most of the power there generated to Winnipeg, Man.

OTTAWA, ONT.—The Ottawa Electric Company has made application to the Department of Railways and Canals, at Ottawa, and the department has favorably considered the application that a portion of the canal reserve in the city of Ottawa be leased to the company in order that it may erect a distributing station. The new building will be a handsome structure and up to date in every particular.

PITTSBURG, PA.—The *Commercial Gazette*, one of the local morning papers, has completed the installation of an electrical advertising sign made by the Mason Monogram Company, of New York City.

COLUMBIA, S. C.—The new Royster fertilizer factory will be run by electrical power, and arrangements have been made with the Columbia Power Company for current.

OSHKOSH, WIS.—The Oshkosh Electric Light & Power Company will be reorganized and $60,000 spent in rebuilding the plant.

MERRILLON, WIS.—An election will soon be held to vote on the proposition to issue $10,000 for an electric light plant and water works.

GRANTSBURG, WIS.—The Grantsburg Electric Light & Power Company has been granted a franchise. A $15,000 plant will be built at once.

LA CROSSE, WIS.—It is said that a Chicago syndicate is about to close a deal for the purchase of all the gas and electric lighting and power companies in this city. The capital of the syndicate is $500,000.

MADISON, WIS.—The Common Council has passed a resolution to investigate private and municipal electric lighting plants of other cities, with a view of establishing a city lighting plant next year.

GRAND RAPIDS, WIS.—The Electric & Water Company of this city will double its present capacity in order to furnish power to numerous small manufacturers. The power will be furnished at actual cost.

STEVENS POINT, WIS.—The Wisconsin Valley Lighting & Power Company has been granted a franchise to construct and operate a street railway through the city. This company proposes building a line between Stevens Point and Grand Rapids.

KENOSHA, WIS.—The merchants of this city are indignant at the action of the Kenosha Gas & Electric Company in raising the price of arc lights 50 per cent and have started to burn their lamps for the full time that the circuit is on. There is talk of starting an independent company on the co-operative plan.

LA CROSSE, WIS.—A new electric light company, with a capital stock of $100,000, has been organized, to buy the electric light plant and water-power at West Salem. The works are located beside the La Crosse River, where there is a large water-power. It is thought that the plan of the company is to extend its line to this city, 12 miles, to compete with the Edison Company.

MILWAUKEE, WIS.—Keelyn & Smith have the contract for an electric power and lighting system for the coal docks of the C. Reiss Coal Company at Ashland, Wis. A 40-kw generator will furnish the power. The lighting will be complete, but the power will be added gradually, the present mechanical drive being replaced by electric eventually.

MADISON, WIS.—Work has been begun on the erection of a temporary $20,000 electric power-house to furnish power for the Madison street railway system until the power from the Kilbourn dam is brought into service. Philip L. Spooner is president of the company, which will develop the Kilbourn dam power, to be transmitted electrically to the surrounding vicinity.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Santa Ana & Long Beach Railroad Company was recently incorporated, with Santa Ana, Calif., as the principal place of business. Directors: S. H. Finley, W. T. Clark, C. F. Mansur, P. A. Stanton and F. G. Finlayson. Capital stock, $250,000.

WABASH, IND.—The Wabash River Traction Company has obtained a franchise for the extension of the line west from Peru to Logansport, Ind. The company is also considering other extensive improvements.

NEW ALBANY, KY.—Engineers who are surveying the proposed electric road from New Albany to French Lick will report to the parties interested. It is said that the syndicate is prepared to put up $1,000,000 in constructing the road.

CINCINNATI, OHIO.—The Pennsylvania Railroad has determined to equip the Springfield and Xenia branches of the Panhandle with electric service.

CINCINNATI, OHIO.—Mr. G. M. Hodges, of Dayton, Ohio, is pushing a project to build an electric line from Cincinnati to Hamilton, Ohio, and Muncie, Ind.

SPRINGFIELD, O.—The Little Miami Traction Company has asked the city for an extension of time in which to complete its work through the city. The company has been delayed in securing material and has been unable to complete the work.

CINCINNATI, OHIO.—Florence Harris, Charles Harris, Mamie Harris and husband, C. E. Harris and M. M. Harris filed suit in the Campbell County, Ky., Circuit Court against the South Covington & Cincinnati Street Railway Company, for damages aggregating $25,000.

LIMA, O.—Construction work will be started within the next thirty days on the northern extension of the Western Ohio Railway from Lima to Findlay. All but four land owners have granted right of way and condemnation proceedings are to be brought against these.

COLUMBUS, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has been incorporated, with a capital of $100,000. The incorporators: Ellis Bartholomew, William P. Heston, William A. Stephens, L. C. Heston, Claude Wyant. Headquarters will be in Toledo.

MASSILLON, O.—The County Commissioners have reached an agreement with the Canton-Massillon Street Railway Company as to the terms of a franchise and extension of its line from Massillon to Navarre. Although no franchise has been granted the company is pushing construction work.

CLEVELAND, O.—There has been considerable mystery surrounding the promoters of the recently incorporated Cleveland & South Lorain Traction Company, and it is now believed to be part of the project of Mayor Tom L. Johnson and Martin Mullen to build independent lines into the city.

FOSTORIA, O.—As it was unable to place cars in operation on July 4, the Toledo, Fostoria & Findlay Railway Company will not commence operation until the road is fully completed. All wires have been strung and ballasting is being pushed. Work has been started on an extensive pavilion in the company's new park near Arcadia.

GENEVA, O.—The citizens of this place are now endeavoring to induce the Cleveland, Painesville & Eastern Railway Company to build its extension through this place instead of south of it. When the road was proposed the village authorities declined to grant a franchise through town and the company secured a right of way about two miles south.

CINCINNATI, O.—The Cincinnati & Eastern Electric Railway Company, which will be the first interurban line to enter the center of the city, will break ground shortly for the construction of its line to New Richmond. The line will be twenty-one miles in length. The power house will be located near Coney Island. It is expected that the road will be in operation by November 1.

COLUMBUS, O.—The work of converting the Grove City line from broad gauge to standard gauge has been completed and cars are now in operation to Grove City. Construction work is being pushed to Morgan's Station and this will be in operation by August 15. The line is now owned by the Appleyard syndicate and is known as the Columbus, Grove City & Southwestern Railway.

CINCINNATI, O.—The Hamilton County Commissioners have granted a franchise over the Columbus & Wooster pike to the Cincinnati, Milford & Goshen Street Railway Company for a double-track road. The commissioners of Clermont and Hamilton County, in joint session, have granted franchises over the Milford bridge to the above company and to the Cincinnati & Columbus Traction Company.

CINCINNATI, OHIO.—The Fort Wayne, Dayton & Cincinnati Traction Company reach the center of Cincinnati from Venice along the Miami River to Miamistown, thence to Bridgetown and over the Harrison Pike and the Westwood steam railroad to Brighton. President Sam T. George says his company has two other roads under consideration. The capital stock will be $1,000,000, The entire length of the proposed main line is 356 miles.

SWANTON, O.—Construction work is progressing at the rate of half a mile a day on the Toledo & Indiana Railway Company's line west of this city. Nearly all the right of way has been secured and the graders follow the right of way men as close as possible. Track laying will start in the near future. East of Swanton the Toledo & Bryan Air Line Company is pushing construction work, and there are no indications of a compromise between the rival companies.

WOODSTOCK, ONT.—The Von Echa Company, owners of the Woodstock & Ingersoll Electric Street Railway, invited the members of the Councils of Brantford, Galt, Paris, St. George, Ingersoll and Woodstock, in Ontario, to take a trip over the Echa Company's ten miles of electric road. Messrs. Ickes and Armstrong, of Harrisburg, Pa., came to the city of Woodstock, Ont., two years ago, and formed the Von Echa Company. Since that time they have built a substantial line between Woodstock and Ingersoll. They now want to extend the road to Brantford, Paris, St. George and Galt.

LEWISBERRY, PA.—Right of way has already been secured for the road from Carlisle to Lisburn, and New Cumberland to Lewisberry, and a corps of surveyors is now at work surveying the line.

LEVIS, QUE.—It is said that the town of Levis, Que., is about to have an electric street railway, and that it is proposed to extend the system to other municipalities of Levis County. With this view, Mr. P. Lane, of the American Bridge Company; Hon. C. C. Colby, of Stanstead; Mr. E. C. Crosby, of Brattleboro, Vt., and others, have lately been over the ground.

UNION, S. C.—Col. T. C. Duncan, of Union, who is now erecting an electric line to Buffalo, may extend the same thirteen miles further to Glenn Springs.

GREENWOOD, S. C.—The matter of an electric line to Harris Lithia Springs is being agitated and has been taken up with the syndicate owning the springs.

EDGEFIELD, S. C.—A meeting of the citizens has been called to consider the question of building an electric line to Augusta, Ga., twenty-three miles. It is stated that if Edgefield offers sufficient inducements there will be no difficulty in securing the line.

GREENVILLE, S. C.—The Greenville-Piedmont Traction Company has been commissioned with a minimum capital of $100,000. The company proposes to erect a twelve-mile line to Piedmont, S. C. Among those interested are George M. Bunting, of Chester, Pa.; James H. Dawes, of Philadelphia, and others.

KNOXVILLE, TENN.—A new outcome of electric railroad strikes is seen in Knoxville, Tenn., where a union barber refused to shave a general manager, C. C. Howell, of the traction company lines.

NASHVILLE, TENN.—Ralph E. Aldrich, of Detroit, president of the Cumberland Coal & Timber Company, which company has been absorbed by the Tennessee Company, of Cleveland, Ohio, is reported as saying that the new company will build an electric line from Nashville to Chattanooga. The company projecting the line is capitalized at $5,000,000.

WALLA WALLA, WASH.—An electric railway franchise was recently applied for in Walla Walla, Wash., by O. R. Ballou, who has projected an electric power transmission and may utilize a small water power six miles from the town. He desires to use certain streets in Walla Walla, and intends to build an electric line that would connect Milton, Freewater and College Place with Walla Walla. The road, as projected, would be a belt line, one side of the loop passing near the foot of the Blue Mountains and the other further west, and would tap a rich fruit-growing region. If the Walla Walla River electric power system, projected by citiens of Athena, is completed in time, power may be purchased for the road.

MILWAUKEE, WIS.—Clement C. Smith, of the Falk Manufacturing Company, is interested in building an electric railway to connect Oshkosh and Fond du Lac.

RACINE, WIS.—The citizens have objected to the street railway company hauling freight over its lines in the city, and will try and establish an ordinance to prohibit this kind of traffic.

ELKHORN, WIS.—At a recent mass meeting the citizens voted unanimously to favor the granting of a franchise to the proposed electric road connecting Janesville, Delavan, Elkhorn and Lake Geneva.

KEWAUNEE, WIS.—L. J. Nash, of Manitowoc, Wis., representing the Higgins Electric Company, has presented to the City Council an application for a franchise for an electric railway to connect Manitowoc with Kewaunee by way of Tesh Mills. The granting of the franchise is favored by the citizens.

MILWAUKEE, WIS.—Representatives of the Milwaukee & Lake Geneva electric railroad are at work in the vicinity of Burlington. At Waterford the company has made a proposition to locate a power-house and repair shops in consideration of a bonus. The company has not as yet been successful in obtaining a franchise from Milwaukee, although this is expected to be passed very soon.

MARINETTE, WIS.—T. F. Frawley, of Eau Claire, and former General Manager Wyman, of the Milwaukee Electric & Railway Company, of Milwaukee, and an Eastern capitalist, have been here recently looking over the Marinette and Menominee street railway lines. It is understood that Mr. Wyman represents Boston capital, which is endeavoring to purchase the two properties. An option has practically been given on the Marinette system. The new company will expend $100,000 on the two systems. A central power-house will be built and the system converted into a belt line.

SHEBOYGAN FALLS, WIS.—The Sheboygan-Elkhart Lake Railway & Electric Company has been organized. The following are the officers: President, John M. Salman, Sheboygan; Vice-President, S. Blumenfield, Elkhart Lake; Secretary, P. P. Brueckhauer, Elkhart Lake; Treasurer, S. Thomas, Sheboygan Falls; Directors, John M. Salman, S. Blumenfield, P. P. Brueckhauer, S. Thomas and W. W. Scaman, of Plymouth. The capital stock is $200,000. The company proposes to build an electric railway line equipped for both passenger and freight traffic, from Sheboygan to Elkhart Lake, a distance of 22 miles.

THE AUTOMOBILE.

AUTOMOBILES IN FALL FESTIVAL.—In the floral pageant which will open the second Cincinnati Fall Festival September 16, will be an automobile division. Special prizes will be offered.

NEWPORT, R. I.—The Newport City Council has granted permission for the automobile races to be held on Friday afternoon, Aug. 30, on Ocean Avenue, in spite of the protests of owners and occupants of houses on that avenue.

NEW INDUSTRIAL COMPANIES.

ST. LOUIS, MO. The General Lighting Appliance Company, with a capital stock of $10,000 paid, has been incorporated. The incorporators are Gustav A. Pleus, Alfred C. Einstein, Fred. M. Eckerle and Joseph Ross.

THE W. F. IRISH ELECTRIC COMPANY, of New York City, has been formed; capital, $75,000. Directors: T. M. Belknap, F. M. Clute and C. R. La Rue, New York City.

THE NORDEN-BITTNER ELECTRIC COMPANY, of New York City, has been incorporated; capital, $100,000. Directors: John Bittner, Mortimer Norden and Andrew Bittner, New York City.

AMERICAN CARBON MOTOR COMPANY, of Buffalo, N. Y., has been formed, with a capital stock of $100,000, by W. T. Thompson, J. L. V. Wood, H. H. Ball, J. N. Frierson and L. D. Wood, of Buffalo.

NEW YORK ALUMINUM COMPANY, of Fishkill-on-Hudson, N. Y., has been formed, with a capital stock of $5,000. Directors: H. Behlen and C. Pilz, of Fort Wadsworth, S. I., and A. M. Kuhn, of Brooklyn.

THE DAYTON STORAGE BATTERY COMPANY has been incorporated at Dayton, Ohio, with $10,000 capital stock, by Frank Duchanam, George F. Grove, George E. Brown, James K. Newcomer and Charles Q. Tyson.

WILLIAM GARDAM & SON, of New York City, have been incorporated, with a capital of $10,000, to manufacture machinery, the directors being J. Gardam and C. W. Gardam, of Flatbush, and W. A. Gardam, of Brooklyn.

THE P. I. FAJANS ELECTRICAL CONSTRUCTION COMPANY, of New York City, has been incorporated; capital, $5,000. Directors: Isidor Fajans, New York; George F. Cook, Matteawan; Martin S. Kattenhorn, Keyport, N. J.

THE COHOES-WATERFORD HOME TELEPHONE COMPANY, of Cohoes, has been incorpoated, to operate in Albany and Saratoga counties; capital $200,000. Directors: S. B. Rawson, F. H. Sudro and I. H. Griswold, Elyria, Ohio.

THE VAN DEGRIFT EQUIPMENT COMPANY, of New York City, has been incorporated, to manufacture power transmission appliances; capital $1,000. Directors: F. H. Smith and R. F. Manning, New York City; F. S. Gemmell, Jersey City.

THE ELECTRIC EXCHANGE TELEPHONE COMPANY, of Schenectady, has been incorporated; capital, $10,000. Directors: Charles F. Vedder, Alexander M. Vedder, Charles A. Palmer, R. T. Lomasney and G. M. Bostwick, Schenectady; T. F. Barrett, Ballston; W. Barlow Dunlap, Amsterdam.

SAN FRANCISCO, CALIF.—The Oakland Electrical Company has been incorporated, with Oakland, Calif., as the place of business. Directors: J. O. Larrabee, J. W. Cox, C. F. Reuter, H. L. Osgood and F. H. Brooks. Capital stock, $25,000; subscribed, $4,075.

BROOKLYN, N. Y.—The Electrical Vitazone Therapeutic Company has been formed to manufacture and sell articles and devices necessary for the cure of ailments by means of electricity and to carry on the business of curing such ailments by electricity; capital, $100,000.

LEGAL.

ISLAND PLATFORMS.—Judge Lacombe in the New York United States Circuit Court has upheld the demurrer of Corporation Counsel Whalen to the bill of complaint in the suit brought against the city and the Rapid Transit Commission by Charles A. Fowler, of New Jersey, the owner of the Carpenter patent for the so-called bi-transit railway system, which includes the use of "island platforms" as one of its main features. It was alleged in the complaint that the Commissioners of the Rapid Transit Railway had taken the Carpenter idea. The Judge said that it was impossible to get a compact idea of the plan from the papers, and he added: "After several attempts to write an opinion which would express more compactly than does the patent itself its utter lack of patentable inventions it seems better to leave that document to speak for itself." The "island platforms" are to be on the middle line of the tunnel with tracks on both sides and access and egress by stairs up or down.

PERSONAL.

MR. GEORGE W. FOWLER, the representative of the C & C Electric Company, of New York, is visiting San Francisco on business.

MR. CECIL B. SMITH, of Toronto, Ont., has been appointed resident consulting engineer of the Canadian Niagara Power Company.

MR. R. T. GUNN has resigned as superintendent of the Lexington, Ky., Railway Company, to accept a position as superintendent of the station and light department of the Norfolk, Va., Railway Company.

PROF. EIJI AOYAGI, of the University of Kyoto, Japan, arrived in New York from Germany last week, and will visit a number of the more important electrical plants prior to sailing for Japan on September 11.

MR. H. C. PAYNE, of the Milwaukee telephone and traction interests, and formerly a leading member of the Republican National Committee, has just returned home from Europe and will spend a few days in New York. He was ill while abroad, but has improved in health.

MR. ARTHUR WILLIAMS, the president of the New York Electrical Society, has recently returned from a European trip of recreation and investigation, and has resumed his duties as general inspector, etc., of the New York Edison Company.

PROF. M. I. PUPIN has had his house at Yonkers, in the suburbs of New York, entered and ransacked, but nothing was taken. The burglars were either scared away or were looking for private papers, possibly relative to the doctor's inventions. There has been a good deal of burglarizing through that section, from the river to the Sound, but this case is more than usually mysterious.

GEN. E. B. FOWLER [illegible] Gen. E. B. Fowl[illegible] the war commander of the Fourteenth Regiment, and more lately prominently connected with the Postal Telegraph Company, which is to be placed in Fort Greene, Brooklyn, will be unveiled on Sunday, May 18, 1902. It will be the forty-first anniversary of the departure of the Fourteenth from Brooklyn for the front in the Civil War.

MR. G. V. FLYNN, who has been connected with the New York sales office of the Westinghouse Electric & Manufacturing Company, has resigned to embark in the electrical contracting business. Mr. Flynn has had an extensive experience, covering twelve years in the electrical field, and thus understands the business thoroughly. He has associated with him Mr. H. J. Reilly, Jr., who is well and favorably known in business circles in New York. They have opened offices and warerooms at 72 and 74 Trinity Place, Manhattan, under the firm name of G. V. Flynn & Company, and propose to handle all kinds of electrical contracts, making a specialty of the equipment of [illegible]

Trade Notes.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently shipped its nineteenth order of Cross oil filters to the American Tin Plate Company.

STEEL BRIDGE.—The Olean Street Railway Company is building a new steel bridge on its line at Portville, N. Y. The steel work is furnished by the National Bridge Company, 45 Broadway, New York.

THE AMERICAN TUBE WORKS, of Somerville, Mass., are building a new boiler house, roof trusses and other steel work, the material for which is being furnished by the National Bridge Company, 45 Broadway, New York.

THE ELECTRIC APPLIANCE COMPANY, Chicago, are advising their customers to meet gas and gasoline competition by using their Adams-Bagnall 3½-ampere arc lamps. These lamps are made for all circuits and are becoming [illegible] popular.

LOCKE INSULATORS.—From the statement in our issue of January 5, 1901, it would appear that the large steam and cable insulators used by the Bay Counties Power Company were designed at the factory of Mr. Fred. M. Locke, Victor, N. Y. To correct ambiguity in the wording, we are requested to state that the design of these insulators is due to Mr. R. H. Sterling.

THE MAXWELL M. MAYER ELECTRIC COMPANY has opened an office and salesroom at 42 Cortlandt Street, New York, in the electrical district, where it will have its machines on exhibition, and gladly explain their merits to friends and prospective buyers. It is also bringing out a line of enclosed and semi-enclosed motors which will be ready in the early part of September. This company's apparatus has been on the market for seven years and is meeting with constantly increasing favor.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, has lately received a contract from the De Beers Consolidated Mines Company, of Kimberly, South Africa, to oil the latter company's entire plant with the Siegrist system. Another contract which has just been placed with this company is from the Glasgow Tramways Company, of Glasgow, Scotland. The large companies throughout the world are now becoming familiar with the merits of this lubricating system, and in this case familiarity breeds respect—the more that is known about it the better the system is appreciated.

MANHATTAN ARC LAMPS.—Any one desiring information on Manhattan arc lamps can procure it from the Central Electric Company, of Chicago, who as agents for this lamp will be pleased to send descriptive bulletins and quote prices. The Manhattan is one of the oldest lamps on the market, and long experience has brought many changes which have greatly improved it, although the main features of the old lamp have been maintained. The Central Electric Company will carry a stock of the various types in Chicago in order to supply customers, who are in immediate need, without delay.

MODERN TELEPHONIC APPARATUS.—A most attractive and interesting catalogue has just been issued by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. It is a large octavo, 64 pages, with handsome dark-gray cardboard cover, printed in black with lighter tints of gray and brown. The registered trade mark title, "Central Energy," is given on a central panel, with a subscriber outfit in high color relief and a woman scattering flowers of award around it, while holding a receiver in her hand. The inside pages are printed in admirable type on beautiful paper, and we note that each illustration of apparatus is a fine wood cut, except a very large double-page view of the Stromberg-Carlson exchange at Rochester, N. Y., recently described in these pages. The wood engravings show up the details of the apparatus with striking distinctness, and the accompanying text is clear and succinct, not a word being wasted, and self-praise by adjectives being studiously avoided. The catalogue comes pretty near being the ideal for its purpose, and its compiler must, in all fairness, be very highly commended. The telephonic art in America in 1901 is well set forth by such literature.

STURTEVANT BLOWERS.—Over forty years ago B. F. Sturtevant, of Boston, Mass., established the first blower manufactory in the United States. Within ten years thereafter the necessity of equipping large fans with independent means of driving led to the designing and building of a line of fan engines. For the succeeding thirty years these engines have been developed to their present perfection. A little over ten years ago the rapid increase in the use of electricity as a motive power opened the way for the electric fan with motor and fan built one for the other. The opportunity was recognized and the B. F. Sturtevant Company (successors to Mr. Sturtevant) immediately established an electrical department, designed a full line of fan motors and thus gave the purchaser an opportunity to choose between an engine-driven and a motor-driven fan. To-day they have patterns for over 100 sizes and types of engines, ranging from 2 to 250-hp, and a record of over 8,000 engines sold since they first entered this field. In their various motor designs they are likewise equipped with an equal variety. A corresponding line of generators is also built by utilizing the essential parts of these motors. Both engines and motors have been developed

under the exacting conditions usually incident to fan practice, namely, high speed and constant operation with comparatively little attention. With these elements of the generating set at hand it has been a relatively simple matter to combine them in a complete line of many sizes, ranging from 1½ to 100 kw. Only those machines and combinations which are distinctively standard are listed in the new catalogue which is now in preparation. But others may be made almost without limit to meet any possible requirement within the range of capacity above specified.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUG. 6, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Atty., 177 Times Building, N. Y.]

679,731. TELEPHONE EXCHANGE SYSTEM; W. M. Davis, Chicago, Ill. App. filed Dec. 15, 1899. Improved means for controlling the circuits through the line relays.

679,[illegible] ELECTRIC ELEVATOR CONTROLLER; N. O. Lindstrom, New York, N. Y. App. filed April 15, 1901. A circuit across the brushes of the machine containing a resistance and an automatic cut-out therefor, is closed each time the main circuit is opened.

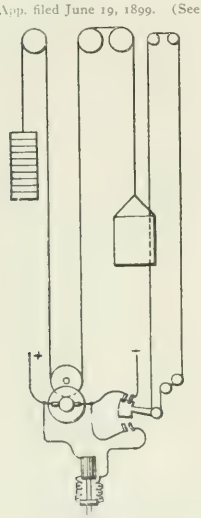
679,769. ELECTRICAL HOT WIRE MEASURING INSTRUMENT; P. Meyer, H. Hartmann and R. Abrahamsohn, Berlin, Germany. App. filed June 1, 1901. Consists in employing a leaf-spring which serves both to stretch the hot wire and to support a lever actuating the indicator.

679,788. TELEPHONE EXCHANGE SYSTEM; D. Sinclair and W. Aitken, London, Eng. App. filed Dec. 29, 1897. The invention consists in a line-signal and means for disclosing it to indicate a call, a clearing-out signal associated with link conductors for uniting lines, and means for bringing it into operative connection with the lines to signal for disconnection, and means for effacing the line-signal and rendering it inoperative when the clearing-out signal is brought into connection with the united lines.

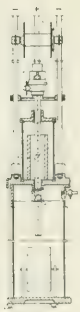
679,803. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; W. L. Voelker, London, Eng. App. filed July 30, 1900. Method of producing carbid filaments for electric incandescing lamps consisting in treating a carbon filament in an electric arc in the presence of vapor of the metal or metals constituting the metallic base of the carbid to be produced, the said carbon filament being converted into graphite and then into carbid at a single operation.

679,805. TEST SYSTEM FOR MULTIPLE SWITCHBOARDS; H. G. Webster, Chicago, Ill. App. filed Oct. 29, 1900. A system for giving audible signal to the operator when the line called for is in use by diversion of a portion of the current of the main battery without the use of an auxiliary testing circuit and battery.

679,812. METHOD OF REGULATING DOUBLE-CURRENT DYNAMO-ELECTRIC MACHINES; Joseph Lester Woodbridge, Cambridge, Mass. App. filed June 19, 1899. (See Current News and Notes.)



679,760.—Electric Elevator Controller.



679,926.—Manufacture of Filaments for Incandescing Electric Lamps.

679,813. MEANS FOR REGULATING DOUBLE-CURRENT DYNAMO-ELECTRIC MACHINES; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed April 30, 1901. (See Current News and Notes.)

679,824. ART OR PROCESS OF REFINING LEAD BY ELECTROLYSIS; Anson G. Betts, Lansingburg, N. Y. App. filed Oct. 12, 1900. (See page [illegible]

679,877. ELECTRODE FOR ARC LAMPS; Hugo Bremer, Nerheim, Germany. App. filed Nov. 13, 1899. (See page 259.)

679,878. ELECTRIC ARC LAMP; Hugo Bremer, Nerheim, Germany. App. filed July 16, 1900. (See Current News and Notes.)

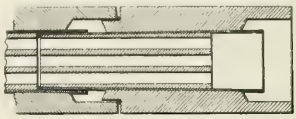
679,897. SELF-RESTORING FUSE BLOCK; M. L. Jones, Montgomery, Ala. App. filed April 4, 1900. Details.

679,924. ELECTRICAL CONTROLLING MEANS FOR WINDING MACHINES; R. Varley, Jr., Jersey City, N. J. App. filed Sept. 20, 1900. Electrical means for controlling a machine for winding magnet spools, consisting essentially of an electrical indicator in circuit with the coil of wire while it is being wound, and means for stopping the winding spindle the moment the proper resistance has been wound into the magnet.

679,926. MANUFACTURE OF FILAMENTS FOR INCANDESCING ELECTRIC LAMPS; W. L. Voelker, London, Eng. App. filed July 30, 1900. The method referred to in patent No. 679,803.

679,953. TROLLEY WIRE HANGER; A. D. Crossley, South Norwalk, Conn. App. filed Dec. 20, 1900. Details.

679,973. ELECTRIC FURNACE; D. Lance, R. L. E., De Bourgade and L. Schmitz, Paris, France. App. filed March 28, 1899. A narrow furnace



680,151.—Underground Conduit for Electric Conductors.

chamber, straight or annular, with resistance heaters external to both side walls; reaction gases admitted at the top through a porcelain distributor, are subjected to uniform and regulatable heat. Designed particularly for the synthesis of cyanides.

679,985. PROCESS OF MANUFACTURING COPPER SULPHATES; Hippolyte Palas and Felix Cotta, Marseilles, France. App. filed July 11, 1899. (See Current News and Notes.)

679,997. ELECTROLYTIC PROCESS OF OBTAINING METALS FROM THEIR FUSED COMPOUNDS; George P. Scholl, Philadelphia, Pa. App. filed Nov. 14, 1898. (See Current News and Notes.)

679,998. COUNTING TELEPHONIC MESSAGES; G. Seligmann-Lui, Paris, France. App. filed Sept. 25, 1900. Details.

680,001. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 1, 1901. A transmitting apparatus and a receiving apparatus; said receiving apparatus consisting of the air and ground plates, a coherer connected therewith, a main relay-circuit connected with the coherer, another circuit operated to oscillate the coherer when the main relay circuit is magnetized and demagnetized, means to operate a type wheel, means for stopping the typewheel at the proper place, means for pressing the paper against the proper type and means for spacing the paper.

680,002. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed April 18, 1901. The dash is indicated by causing the recorder magnet to be actuated three times to each actuation of the relay.

680,024. TELEGRAPH RELAY; J. E. Cordovez, Panama, U. S. of Colombia. App. filed Aug. 14, 1900. Details.

680,026. ELECTRICAL SIGNALING SYSTEM; J. A. Gehrung, St. Louis, Mo. App. filed March 14, 1901. General improvements affording simplicity and durability of parts and certainty and efficiency in operation.

680,050. PROCESS OF PRODUCING BARIUM CARBIDE; M. J. Claude (dit Claudius), Limb, Lyons, France. App. filed May 3, 1900. (See Current News and Notes.)

680,059. ELECTRICAL CALL OR ALARM DEVICE; A. B. Miller, Newark, N. J. App. filed Feb. 25, 1901. Details of a hotel call.

680,077. TELEPHONE TRANSMITTER ARM JOINT; H. B. Sabin, Cleveland, O. App. filed January 28, 1901. The arm is pivoted between conical screw points, the screws having lock nuts.

680,082. ELECTRIC ARC LAMP; H. Stenz, Chicago, Ill. App. filed Dec. 3, 1900. Details.

680,113. MOUTHPIECE; A. Bergman, Sacramento, Cal. App. filed April 17, 1901. The mouthpiece is made in sections, between which an antiseptic pad is confined.

680,134. ELECTRICAL CONTACT APPARATUS; K. DeKando, Budapest, Austria-Hungary. App. filed Dec. 31, 1900. Details of the conducting joint of a trolley in the form of a roller.

680,150. ELECTRIC CABLE; C. A. W. Hultman, Stockholm, Sweden. App. filed March 23, 1901. An electric cable comprising wire supports, each composed of a plurality of perforated insulating plates arranged edge to edge, means for locking said plates together and wires threaded through the perforations of the plates, for the purpose set forth.

680,151. UNDERGROUND CONDUIT FOR ELECTRIC CONDUCTORS; C. A. W. Hultman, Stockholm, Sweden. App. filed March 23, 1901. The conduit sections have telescopically interfitting sheaths inclosing them, which yield at the joints to adapt themselves to the settling of the ground in which they are placed.

680,191. ELECTROLYZING SALTS OF ALKALI METALS; E. A. Allen, Rumford Falls, Me., and H. K. Moore, Lynn, Mass. App. filed Oct. 22, 1897. For the electrolysis of sodium chloride; uses an anode of divided carbon and a cathode of wire sponge, with an interposed asbestos diaphragm. The cathode is unsubmerged, the hydrate formed being washed from it by the percolating solution.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, AUGUST 24, 1901. No. 8.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 24, 1901.

CONTENTS.

	PAGE
Editorial	281
The Institute Convention	284
Electrical Engineers of the Day—VIII. E. J. Berg	284
From Christmas Tree to Pan-American, by Luther Stieringer	285
Electrical Supply in Bangor, Me., by Alton D. Adams	291
Rapid Telegraphy, by Patrick B. Delany	291
Clark on the Conditions of American Telegraphy	292
The Nernst Lamp in Germany, by E. Kilburn Scott	294
New Telephone Exchange of Minneapolis	294
The Pan American Flambeaus	295
Elements of Illumination—XXX. By Dr. Louis Bell	295
Power Development in Wisconsin	296
Modifications of the Mercury Cathode Electrolytic Cell	297
The Electrical Hazard at the Pan-American	298
Current News and Notes	298
LETTER TO THE EDITORS:	
"Moblodge," by Myron A. Darbie	301
Digest of Current Electrical Literature	301
New Books	305
Storage Batteries in Central Stations	306
Eight Horse-power Gasoline Carriage	306
New Railway Signal	307
A New Sturtevant Generating Set	307
A Record Automobile Run	308
Exhibit of Exhaust Steam Utilization	308
McRoy at the Pan-American	308
A Historical Exhibit of Motor Controlling Devices	308
DEPARTMENTS:	
Financial Intelligence	309
Commercial Intelligence	310
General News	312
Trade Notes	317
Record of Electrical Patents	318

THE INSTITUTE CONVENTION.

We are glad to note that in spite of the unseasonable weather, and one might almost say, the unseasonable season, the American Institute of Electrical Engineers has been holding a good convention here and at Buffalo. The courtesies and hospitalities extended to the society and its foreign guests have been numerous and hearty, and we venture to think that our friends from Europe will take back with them pleasant memories of their trip and the exercises. Americans go to Europe in shoals. Few Europeans visit this country as tourists, and it will not be until there is more reciprocity of travel that a full mutual understanding between the Old World and the New can be established. Americans are always broadened in view by their trips abroad, but the benefits of a "sea change" are not a new phenomenon.

ELECTRIC TOWERS.

A few weeks ago we were indebted to Mr. Luther Stieringer, the consulting engineer of the Pan-American Exposition for a most interesting and instructive article on the illumination of Exposition grounds and other large open areas. The article was evidently read with much pleasure by our readers, and has been in demand; so that we are now glad to supplement it with another article from the same expert source, on electric towers. Mr. Stieringer not only traces their history and evolution, but explains how certain effects can be attained with others, presumably as good, should never be attempted. Few of the visitors who admire the entrancing spectacle at Buffalo stop to think of the experience and technique that lie back of the achievement. We regard Mr. Edison's comment one of the pithiest and most suggestive, namely, that all the fairyland of light that so delights the eye and satisfies the imagination is produced by "a hatful of filaments." It is the knowing how to use a mere hatful of filaments that has enabled Mr. Stieringer to stamp himself as pastmaster in the art of illumination.

RAPID TELEGRAPHY.

Mr. Delany's response to our editorial comment of the 3d inst., on the subject of rapid telegraphy, is a good *ex parte* statement of his position in the matter, and there is much force in his argument. The position of telegraphic operation in this country may be summed up in the statement that the great bulk of messages are sent by hand and written down by ear at an average speed of about 20 words per minute. The average telegram costs about 30 cents, and this is so expensive that the average American unit of population sends only about one telegram a year. It would probably be admitted that if the cost of telegraphing were reduced to nothing, or the wires were made free, while a service as good as now exists were still obtainable, nearly all the letters that now go by mail would be sent on the wire—love letters and important documents excepted. The present cost of telegraphing, therefore, radically stated, stands in the way of robbing the mails for the sake of the wires. On the other hand, it is clear, from the finances of telegraphy, that no material diminution in the cost of telegraphing can be expected under the existing system; so there exists a vicious circle of limitation. We cannot have a wider use of the telegraph without cheaper telegraphy, and we cannot get cheaper telegraphy with the present condition of telegraph traffic. Decided improvement may be expected from systems of the Buckingham type, which almost dispenses with the services

of the receiving operator, but all type-printing telegraphs must, by the natuer of their mechanism, be comparatively slow telegraphs, although several times faster than hand telegraphs. Consequently, type-printing telegraphs cannot finally cut the Gordian knot which ties existing conditions together.

Substituting machine transmission for hand-transmission will permit of handling more traffic, but not of reducing the expense of transmission to any great extent, and there will not be much more traffic until the cost of transmission is materially reduced. If, however, the labor of translating long hand into Morse, and Morse again into long hand, could be assumed by the public, so as to reduce the duties of the telegraph operators to superintending the successful transmission of the dispatches, the cost of telegraphy would be virtually reduced to the cost of superintendence, and the interest upon cost of wires and apparatus. Thus, if a business house in New York employed a stenographer who was also a Morse operator, and the same course were followed by a corresponding house in Chicago, then the manager of the New York firm could dictate his telegrams to his Morse stenographer who would transcribe his notes into perforated tape and a messenger boy would deliver this tape at the nearest telegraph office. The operator at the office would feed that tape in its turn through an automatic high-speed transmitter to Chicago. The receiving tape bearing the automatically recorded message at Chicago might be coiled up automatically at the rate of a thousand words a minute, if necessary, and the coil sent out by a messenger to the office of the Chicago firm. There it would be transcribed on a typewriter by the resident Morse stenographer. The cost of that communication of, say, 500 words, would be little more than half a minute's worth of the time of the New York-Chicago high-speed wire, plus the extra cost of the Morse power of the stenographers, plus messenger call service, minus 2 cents saved in mailing stamps. We think that Mr. Delany is fundamentally right in maintaining that all marked telegraph progress in the future must be in the direction of high-speed telegraphy. If it is not in that direction, what other course could it take?

POPULAR INFORMATION ON TELEPHONE RATES.

The manner in which errors of fact with regard to the conditions of telephone service are insistently repeated provokes the surprise of those who endeavor from time to time to set such matters right. This surprise becomes the more pronounced when the statements are repeated by newspapers known to be careful and worthy of crediting with the effort to be fair. As an instance of the latter nature we may refer to a recent editorial in the *New York Times*, which, in discussing telephone rates in this city, instanced a number of alleged figures from Europe, and added that in this city the local company charges $240 a year for a business telephone. As a direct consequence of this high charge, the *Times* stated there were only 42,500 telephones in New York. Now, the facts are distinctly contrary, and have been so set forth in our columns, which are read by the *Times* quite assiduously. We learn from the evidence given by Mr. U. N. Bethell, general manager of the New York Telephone Company, before the United States Industrial Commission, and quoted in these columns as well as those of the daily papers quite freely, that out of the 42,500 telephone subscribers in this city only 1400 are paying the old $240 a year rate, and it is the deliberate choice of every one of those few to pay that. With regard to the 40,000 subscribers not paying that higher flat rate, it appears that the average cost or yield per station per year is only $85. We may be wrong, but we think it will be a long time before telephone service in such a city as New York gets progressively much below that figure, whether there be competition or not. We are believers in the good done by independent telephony, and its ideas are frequently expounded in these columns, but there is a point at which any kind of telephone charges, whether independent or otherwise, become suicidal, and we are sorry to say that the tendency the last year or two in competitive telephony has been to give a service which was too cheap. The result is that everywhere throughout the independent ranks the telephone rates are not becoming lower, but are going up; and this is one of the healthiest signs we have yet seen in the movement. Last week we quoted some emphatic views on this point from an Indiana independent telephone man.

As regards the foreign figures quoted by the *Times*, we can only say that telephony in Europe from our personal observation and experience is not to be compared with telephony in America for efficiency and real cheapness. The *Times* falls back, for example, on the hackneyed instance of Stockholm. Putting aside the fact that Sweden is one of the cheapest countries in the world, we may point out that Stockholm has only one-thirteenth the population of New York, and that everywhere in the world telephone cost of operation increases with the size of the city. The *Times* quotes the Stockholm rate at $22. As a matter of fact, there is in Stockholm a fight between an energetic and enterprising local company and the Government, the company having twice as many subscribers as the official system. In order to get any kind of satisfactory service, a business man in Stockholm must use both systems. The least that this costs him is $40.50 a year, and every call interchanged between the two systems further costs the subscriber 2.7 cents. There are, moreover, limitations upon the service which a New York subscriber would not tolerate for one minute. There have also been absolute interruptions lasting for several weeks at a time, due to the fact that the wires were overhead and not underground. We may add that an official investigation in Holland elicited reports against the Stockholm figures as being too low, and that documents were laid before a select committee of the House of Commons also showing that the Stockholm rates were not high enough to warrant the maintenance of good service or could pay either the Government or the company. We might adduce a great deal of data along the same lines, but it would be familiar to our readers, and probably would not have much effect in stemming the tide of misinformation running through columns where one usually looks for something nearer the truth.

THE ELECTRIC SUBMARINE BOAT.

Recent reports from Toulon and Spezzia seem to indicate that the successes of the Holland boat in this country have stirred the marine Continental powers to unwonted interest in submarine navigation. The French, indeed, did pioneer work in this direction, and their "Gymnote," "Zede" and "Morse" have marked striking advances in the art. To judge from the reports which have filtered through the military and naval authorities, the Italian experiments have also been highly successful, and the next war between first-class powers may show some immensely interesting developments. It is a far cry from the ill-omened "David" that forever disappeared alongside the shattered "Housatonic," to the handy Holland boats and their foreign rivals, but there are few recent lessons in military and naval affairs that were not clearly foreshadowed in our Civil War, and the submarine boat is no exception. It only needed the development of the storage battery and the stimulus of a rising warcloud to stir inventors into action and governments into temporary flurry. The storage battery of to-day seems adequate for motive power if great speed is not attempted, and the rest is merely a delicate piece of marine engineering with the Whitehead torpedo for a working prototype. The experience derived from the latter seems to indicate, by the way, that a well-shaped body entirely submerged drives with very remarkable ease, and the porpoise rather than the pickerel seems to be the model for high speed.

Great speed in a submarine boat, however, seems to be a rather dubious virtue, not at all to be compared in importance with easy manageability and good radius of action. There is no trouble whatever in carrying battery enough for any speed at which it is safe to manœuvre the craft, even with the present lead cells, while if the new Edison battery fulfills the hopes of its inventor, its small weight and freedom from noxious fumes should make it a favorite in such work. It is hardly to be expected that submarine yachting will ever become a popular pastime. We shall never hear that the "Green Shark" ran down a submarine grocer's wagon or raced the "Blue Devil Fish" to a finish up the Sound. For even the Electrical World and Engineer would be stumped to report the proceedings; and what glory in a race without the reporter standing by to do it justice? There will be plenty of stimulus for a long time to come in wars and rumors of wars, and now that the art is fairly under way we shall expect the next few years to show sensational advances. The first bit of really hard fighting will try out the possibilities of the new craft in a way that will be intensely interesting, to say the least. We have always regretted that neither the Lake nor the Holland boat was given a chance at Santiago. Any other power would probably not have failed to grasp such an opportunity of testing a new and potent engine of war. A submarine cable-cutting cruise on the bottom of a hostile harbor would have done wonders in testing the practical value of the boats and in teaching their real place in warfare. As it is, they are still emphatically a very uncertain quantity, the importance of which is largely a matter of guesswork. Their advocates claim for them a revolution in the art of war, while there are those who hold that they are of little use save in a dark night and a narrow channel.

From all that we can ascertain, the modern electric submarine boat functions excellently from merely an operative standpoint, but has a very tough time in finding her way about. Against a ship at anchor in a well-defined position, a campaign ought to be, and apparently is, a fairly simple matter, but an attack on even a slowly-moving vessel would be in most waters something after the manner of chasing a black cat around a coal cellar at midnight. Mr. Holland, who certainly should understand the possibilities of submarine navigation as well as any one, is quoted as saying that the difficulties of finding one's way are so great that there is no defence against a submarine attack—not even another boat can be of any service; so that battles between such craft are almost out of the range of possibility. Obviously, the same causes act to render difficult any attack on a floating fort. But here, it seems to us, is a chance for electrical skill again to come to the fore. Given a successful method of communicating between a submarine boat and the shore, so that information could be freely exchanged, and the problem of coast defence at least would be greatly simplified. Even so it may turn out that boats of the Lake type prowling along the bottom like gigantic and malevolent crabs, have a certain advantage in utilizing landmarks at the bottom, nosing along like a steamer in a mist. But be this as it may, a method which will enable the crew of a submarine craft to locate themselves quickly and with precision would be of fundamental importance in their use for harbor defence. And until something of the kind is forthcoming, it looks as though submarine cruising would be of somewhat limited use. One can easily imagine a boat coming to the surface to locate an enemy, diving for the attack and then getting caught in a swirl of current and ending her career on a sunken rock or mudbank. An underwater cruise will probably never be attractive for nervous people, but a practical system of navigation at or near the bottom would at least rob it of some of its dangers and uncertainties and put submarine warfare on a far sounder footing than at present. Possibly the acoustic signaling system with which the late Professor Gray was so closely connected, might lend itself to such a task, but we are only suggesting the problem rather than attempting to solve it. With most of the Powers equipped with submarine boats, the advantage lies with the craft that can be most easily used, and this, to our mind, is the one that can be reasonably sure where she is going next in the perpetual London fog of a harbor bottom.

The Electromagnetic Effects of Moving Charged Spheres.

In the *American Journal of Science* there appears a paper by E. P. Adams upon this topic which is theoretically of great interest, although not of much practical importance at present. It was indicated by theoretical considerations some 25 years ago that an electrostatic charge when moving at a velocity small by comparison with the velocity of light, acted like a flow of electricity in a conductor, and was capable of exerting a magnetic force in its vicinity in the manner of an active electric conductor. Expressing this result in another way, a mechanical carriage of electricity was inferred to be analogous, in its local magnetic effects, to a flow of electricity. The late Professor Rowland won his first honors as a physicist by experimentally demonstrating this magnetic effect of a moving charge in 1876, and similar results have been obtained from time to time by other experimenters. Recently, however, M. V. Cremieu, of Paris, has thrown doubt upon the experimental results, by describing experiments of his own in which no such effects were obtained, and, in fact, he stated that he was convinced that the effect did not really exist. Mr. Adams' paper here considered describes experimental results recently obtained going to show that Cremieu has been deceived in some way by his results, and that the Rowland effect does exist.

When an electric charge is whirled in a circle about an axis, the mean electromagnetic effect in its neighborhood, according to the theory in question, is equal to that of an electric current delivering the same electric quantity per second, around a turn of wire coincident with the path of the revolving charge. Since the effect is always very small, because the charge is small, it can only be made apparent by moving the charge with great speed, so as to increase correspondingly the aggregate equivalent electric quantity passing per second, and by placing a sensitive electromagnetic needle in the most advantageous position to be acted upon by the magnetic force expected. In the case under consideration, there were 16 brass balls, about 1 inch in diameter, mounted at equal radial distances (about 8 inches), from a revolving shaft so as to magnify the effect of one charge 16 times. Each ball was charged to a potential of approximately 19 kilovolts, and the speed of the balls in their path was between 2 and 3 miles per minute. The result was to produce the equivalent of a current of a few microamperes circulating in a single turn. A similar set of balls was rotated in the neighborhood with opposite electric charges, for the purpose of obtaining a more definite distribution of the revolving electric field. A delicately suspended and sheltered set of astatic magnetic needles showed a distinct deviation under the influence of the rotating balls, and the magnetic force exerted was apparently of about the right magnitude. The pressure of 19 kilovolts, or 63 electrostatic C. G. S. units of potential—a fearful rhodomontade of description rendered necessary owing to the absence of a name for this unit—was produced by a storage battery of 10,000 cells. Assuming that the results are as reliable as they seem, it follows that just as a moving magnetic charge is the known equivalent for a magnetic current, or time rate of flow of magnetism, so a moving electric charge is the equivalent of an electric current, or a time rate of flow of electricity.

The Institute Convention.

In accordance with the programme announced last week and carried out as recorded in these columns up to the time of our going to press, the members, their foreign guests, etc., visited the Crocker-Wheeler works at Ampere on Thursday, Aug. 15, and were received by President Wheeler and Mr. Dunn. They made a thorough inspection of that interesting establishment, and returned to the city in the afternoon. In the evening a dinner was given at the Hotel Marlborough at 7 o'clock, and was attended by about 100 in spite of the extremely disagreeable weather and the absence of so many members of the Institute from the city at this season of the year. The dinner was presided over by ex-President Carl Hering, and speeches were responded to as follows: "The Land of Ampere," by M. Janet; "The Countrymen of Faraday," by Mr. N. C. Sawers; "The Successors of Ohm," by Professor W. Hallock; "The Heirs of Volta," by Mr. P. Torchio, and "The Legatees of Franklin," by Dr. S. S. Wheeler.

Next morning the members and friends, as guests of the New York Edison Company, Brooklyn Edison Company, Metropolitan Street Railway Company and the Manhattan Railway Company, embarked at 9.30 on a special steamboat and were transported to the riverside power plants of these companies. The Edison interests were represented by Messrs. Murray and Lieb, the Manhattan by Messrs. Pegram, Baker and Harrison, and Brooklyn Rapid Transit by Mr. Roehl. Luncheon was served on board and a most instructive day was spent by all, the trip ranging from the Bay Ridge station on the extreme south, to the Metropolitan station at Ninety-sixth Street on the extreme east.

There were no assignments for Saturday, which left time for private entertainment, and on Sunday morning, in spite of the extremely bad weather, a large party embarked on the special steamer "Montauk" for Albany. The day was spent in making the trip up the river with every condition favorable except that of climate, and in the evening on reaching Albany the party took dinner together at the new Ten Eyck Hotel, spending the night there. Next morning the party, as guests of the General Electric Company, proceeded to Schenectady from Albany by special train and spent the forenoon in wandering over the enormous works of that corporation. At midday luncheon was served in one of the newer shops and then the party proceeded by special train to Buffalo, putting up at the Niagara Hotel as its headquarters.

Beginning with Tuesday morning the convention assembled for business in the New York State Building and the rest of the week was devoted to the discussion of the programme, which has already been published. Thursday was Electric Day at the Exposition in honor of the visit of the Institute.

A Royal Trolley Car.

A magnificent royal car—probably the first in the world built for royalty—is now under construction by the Ottawa Electric Railway. The company is not sparing expense to make it one of the best electric cars that has ever run on any track. It is to be finished in a most elaborate manner, and on the front will be painted the name of the car, "The Duchess of Cornwall," and on either side will be carved the royal coat of arms. The car is to be finished in the royal colors, and on the inside, besides the fancy brass work and plate mirrors, will be a number of wicker and upholstered chairs. The car will carry the royal party to Britannia, where the Ottawa lumbermen will have a timber crib, which will be boarded for a trip through the Deschenes rapids and down the timber slides at Chaudiere Falls. The design of the car has been approved by Lord Minto and Sir Wilfrid Laurier.

St. Paul's Cathedral.

A special dispatch from London, says the architects' report to the Dean and Chapter of St. Paul's Cathedral reveals a really alarming condition in that edifice. The present damages can readily be repaired, but the danger is that St. Paul's, London's most splendid architectural monument, may have to give way to the march of progress. The building of the old underground railway tunnel caused some settling of the foundation, and the later tunnels caused perceptible, even alarming, damage. But tunnel railroads, sewers and other improvements for the public safety and comfort London must have, and the cathedral floated on sand and wet gravel may yet vanish.

Electrical Engineers of the Day—VIII.

E. J. BERG.

Ernst Julius Berg was born in Östersund, a small town in northern Sweden, in January, 1871. After completing the course in the High School of his native town he entered, at the age of 18, the Royal Institute of Technology in Stockholm, from which he was graduated in 1892 with the degree of Mechanical Engineer.

Immediately upon leaving college he came to this country with the intention of completing his engineering studies. After some experience in the manufacture of printing presses, he sought more congenial work in electrical engineering and secured a position with the Thomson-Houston Electric Company. He was quickly placed in charge of a division of the drafting room, and then began a series of experimental researches, during which, among other things, he developed the magnetic blow-out idea into the now almost universal blow-out fuses and circuit breakers.

On the transference of the engineering department of the General Electric Company to Schenectady in 1893, Mr. Berg was made assistant to Mr. C. P. Steinmetz in alternating-current designing. He directed the experimental work of the company and contributed largely during this time to the development of the monocyclic system, alternating-current motors, feeder potential regulators and many other details of alternating-current work, long since become standard.

From a subordinate position Mr. Berg soon became Mr. Steinmetz's right-hand man. He was among the very first to recognize

the advantages of the method of mathematical treatment by complex imaginary quantities, then advocated by Mr. Steinmetz, and to actually employ this system in everyday work, and, as a natural result, their many investigations at this time led to the writing, in collaboration, of the first complete treatise on the more complex alternating problems, viz., "Alternating-Current Phenomena."

For the past few years Mr. Berg has devoted much time to the design of alternators, induction motors and rotary converters, and to such related problems as the hunting of rotaries and the parallel operation of alternators, and has been granted many important patents relating to these and other lines of work. More recently he has been working on railway problems, especially with a view to the employment of alternating-current motors and high-potential trolleys.

In his presidential address to the Institution of Electrical Engineers last November, Professor John Perry said: "The engineer must be a real man; he must possess originality, the power to think for himself. * * * The man who is permeated by theory, whose theory is so much a part of his mental machinery that it is always ready for practical application to any problem, he is the real engineer." Mr. Berg's associates know him to be a *real* engineer, one who can calculate, who always in attacking a new problem first derives its equations. To him others often turn for precise figures where they must perforce surmise, to calculate or design what they devise, to locate trouble and find a remedy when others have failed.

He is a member of the American Institute of Electrical Engineers, and has read several papers before that body.

From Christmas Tree to Pan-American.

THE HISTORY OF ELECTRICALLY-ILLUMINATED TOWERS UP TO THE PAN-AMERICAN EXPOSITION.

By Luther Stieringer

FIG. 1.—SEVILLE TYPE OF TOWER.

THE first object approximating a tower upon which electric lights were placed for spectacular effects was a small Christmas tree which Mr. E. H. Johnson, then president of the Edison Light Company, placed in his New York residence for the amusement of his children in 1882. This tree was decorated with miniature lamps, which were colored by being covered with different colored silks. A photograph of this tree is shown herewith. The tree was revolved, and the lights were turned on and off by a commutating switch. This was also the first instance of commutation of the kind.

In 1883, at the Foreign Exhibition, in Boston, held at the Mechanics' Fair Building, one of the notable and most popular features was the Christmas Tree and Children's Festival, under the auspices of the prominent ladies of Boston. A mammoth Christmas tree was placed in the middle of the large hall, and in the center of the band stand. This tree was perhaps the largest ever placed in a building—at any rate, up to that time—being 50 ft. high, with 30 ft. spread. It was decorated with 160 lights of 10 and 16 candle-power. These were among the first of the incandescent lamps of less than 16 candle-power. The 10-cp lamp was at that time developed by the Edison Company for the use of small village plants where economy was desired. The various circuits on this tree had different colored lamps, which were turned on and off, or "played" in time with music. For this tree an elaborate commutator had been provided to manipulate the lights. This, however, was never used. Reliance was placed instead on a switchboard concealed from the audience and manipulated by an operator conversant with the music. The method of manipulation was kept a secret from the public, and this lent an air of mystery to the affair. The only person who was favored by admission to the operating room was the great singer, Christine Nilsson, who was so pleased with the performance in light, on the Christmas tree, that she was given an opportunity to play a tune in colors. This tree, a photograph of which is shown, was such a "drawing card" that it not only attracted large crowds from Dec. 15 to Jan. 1, but was the means of keeping the Foreign Exhibition open two weeks after its intended closing time, Jan. 1.

The Louisville Exposition of 1883 presented for the public enjoyment an illuminated circular water tower 30 ft. high, the top of which was encrusted with a large number of incandescent lamps. The shaft had at intervals a number of circular tablets. Intermediate between these were perforations of different design. These were covered with colored glass and lighted from within. Water was allowed to flow through and over the moss-covered tablets, descending from terrace to terrace and finally collecting in the basin in which the tower was placed.

At the Electrical Exhibition under the auspices of the Franklin Institute, at Philadelphia, in 1884, the first electrically-illuminated tower, column or shaft was erected. It was crudely constructed with a base, a pillar, and a cap, of no particular form. The base of this shaft had as an inscription the word "Edison," in which the letters were flashed successively. The shaft was entirely covered by incandescent lamps, the number of which represented the daily output of the Edison lamp works at that time. (See accompanying cut.) Interspersed among these lamps were a number of other lamps which were flashed or lighted and extinguished alternately at short intervals. A few lamps were also placed in the cap for permanent illumination. This tower was essentially a great novelty, owing to the rapidity with which the lights could be extinguished, thus indicating the marvelous control possible with the incandescent lamp.

Nothing material was done from the time of the Philadelphia Exhibition in this kind of spectacular lighting until 1890, although a structure was shown at Paris in 1889, in the Edison exhibit, which being in the nature of a booth could not be classified technically as a tower or shaft.

In 1890, however, as a new point of departure, there were several comprehensive tower installations. The Woman's Exchange exhibition at Lenox Lyceum, New York, had the "Tower of Light" of the Edison exhibit as its principal feature. This was the first tower to be lighted with miniature lamps. These were used because being in an interior the number of lamps necesary to produce the effect would have been too dazzling and would not have been in harmony, if larger than 4-cp lamps had been used. In the center of the hall a hollow white column 25 ft. high was covered with hundreds of lights arranged in spirals from top to bottom. Festoons of lamps were suspended from the tower to the galleries, the cords covered with green asparagus vines. This tower also was manipulated responsively to music from a concealed switchboard. The column was built by a stage expert and covered with canvas painted pure white flecked with mica scales. In appearance it was like a shaft of pure white marble.

At the Minneapolis Industrial Exposition of 1890, following that of the Lenox Lyceum, the Edison exhibit shown at the Lyceum was again presented, except as to the tower. Something of a comprehensive character was demanded at Minneapolis, to be placed and treated as the main feature of the exposition. In the center of a large hall, the Egyptian Tower of Light, a column 60 ft. high was erected in the form of a lotus flower, the tower as the stem, with its purple ribs at every angle of the octagon, the swelling top as the flower with its petals and sepals strongly defined. (See cut.) The

FIG. 2.—TREE LIGHTING EFFECT, 1882.

long stalk was studded with changing lights manipulated in time with the music of an orchestra. The surface lighted on this tower was over 4000 square feet, and was covered with 10,000 5-cp lamps. To obtain a scintillation effect, "diamond dust" was spread over the

surface. The lighting on this tower was also manipulated from a concealed keyboard by an attendant familiar with the music ren-

FIG. 3.—PYRAMIDAL TREE LIGHTING EFFECT, BOSTON, 1883.

dered. The manipulator was thus enabled to present just the combination desired. For example, when the band played "The Red, White and Blue," the colors were flashed at the instant the words were rendered in the band's stirring refrain, making it a thrilling moment to both eye and ear. At the opening, the tower accompanied Reeve's Band, and finally, toward the close of the Exposition, it was associated with the celebrated Strauss orchestra, in particular in the closing piece of music, the beautiful Blue Danube waltzes.

This time (1890) was an exceptional year for the building of electrically-lighted exposition towers. Following Minneapolis, the Mechanics' Fair at San Francisco had an illuminated pillar 22 ft. high, poorly constructed and continuously lighted. An attempt was made in this to duplicate the Lenox Tower. The use of 16-cp lamps would alone have been enough to make it a failure if nothing else. A photograph of this tower is shown. The last tower for the year and for some time, was at Portland, Ore., and was installed in the large hall of the Portland Exposition with embellished surroundings. This was of different design from the Lenox Lyceum tower, but had the general features of manipulation of that structure. It was operated in rhythm with music as an accompaniment.

For the World's Columbian Exposition of 1893 there was designed an electric tower in keeping with the demands of an exposition of such magnitude. The central position of an exhibit building is usually reserved as a place of honor for the choicest exhibit or feature. In the Electrical Building at Chicago the central space was allotted by the chief of exhibits in that department to a glass company which proposed to erect thereon the booth shown in the accompanying engraving, which was nearly complete before the management conceded that it lacked size as well as character, aside from inappropriateness. The Edison General Electric Company had had a design drawn for a centerpiece of its exhibit, to be located in this building, and to be the main feature of the exhibit. The central space having been already allotted, the result was a compromise with the glass company and a modification of the structure. To accommodate the glass company, the column or shaft was surrounded at the base with a circular colonnade, thus enabling the glass concern to display its wares that were applicable to electric uses. Its original display was to have been entirely of cut glass. However, arrangements were finally effected satisfactory to the glass company comprehending a new design and the abandonment of all the work done on the original booth. The pedantic artistic requirements of the management demanded that every structure erected in exposition buildings should conform to the conceptions of propriety and the critical indorsement of a board of artistic censors.

When the design of this tower was submitted for consideration to meet the conditions and requirements of the time, there were objections raised to a colonnade surrounding a shaft as not being correct in architecture. The designer happened to recollect, however, that the Washington Monument in its original design had a circular colonnade with quadrigas surrounding a square shaft, but he was unable to secure a copy of this interesting drawing at the moment, and fortunately in his search found that the Column of Victory in Berlin, Germany, which is accredited with being

FIGS. 4, 5, 6 AND 7.—ORIGINAL DESIGN, PROTOTYPES AND FINAL RESULT, EDISON TOWER, CHICAGO WORLD'S FAIR, 1893.

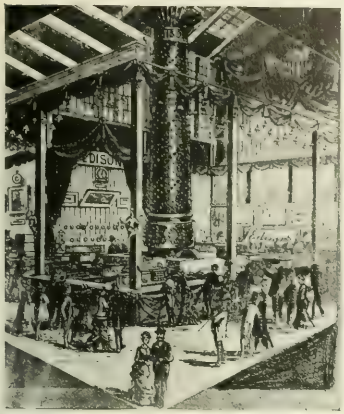


FIG. 8.—EDISON TOWER, PHILADELPHIA, 1884.

FIG. 9.—"TOWER OF LIGHT," LENOX LYCEUM, NEW YORK, 1890.

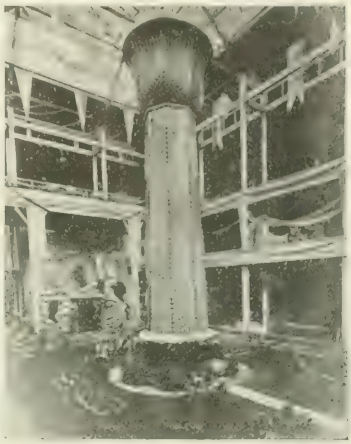


FIG. 10.—EGYPTIAN TOWER OF LIGHT, MINNEAPOLIS, 1890.

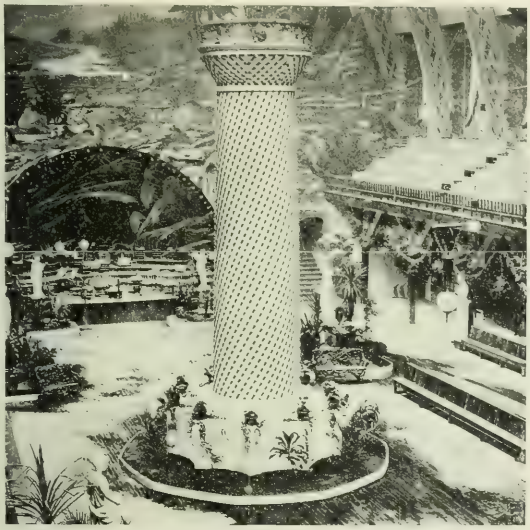


FIG. 11.—ELECTRIC TOWER, PORTLAND EXPOSITION, 1890.

FIG. 12.—PILLAR OF LIGHT, MECHANICS' FAIR, SAN FRANCISCO, 1890.

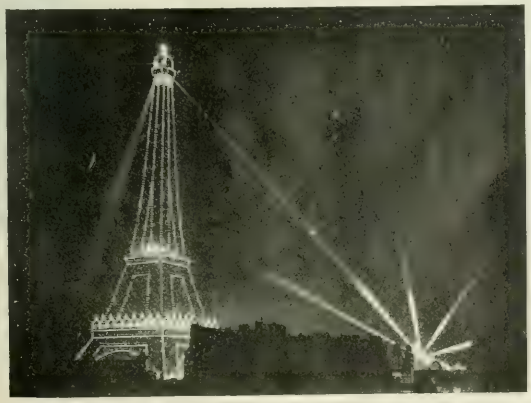


FIG. 13.—THE EIFFEL TOWER EFFECT IN 1900.

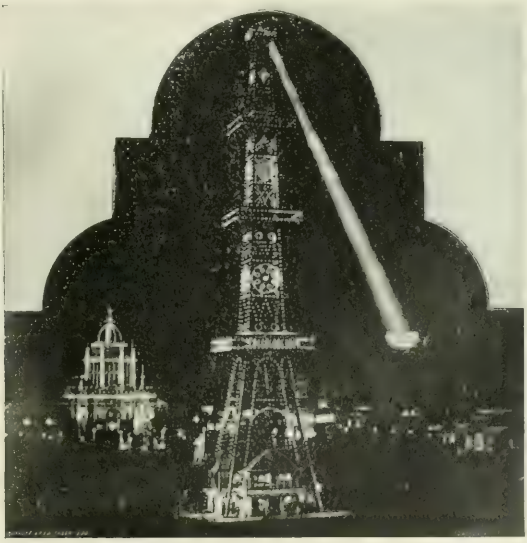


FIG. 14.—BONET STEEL TOWER, MIDWINTER FAIR, SAN FRANCISCO, 1894.

ELECTRICALLY ILLUMINATED TOWERS UP TO THE PAN-AMERICAN EXPOSITION.

a masterpiece, was surrounded with a circular colonnade. When the designs were finally submitted to the lamented Mr. Chas. Atwood, designer-in-chief, he indorsed them without further question as to their architectural and artistic accuracy. Columns, shafts and triumphal arches are the only forms by which to depict achievement. In the case of the Berlin shaft, it is surmounted by a figure of Victory, typifying

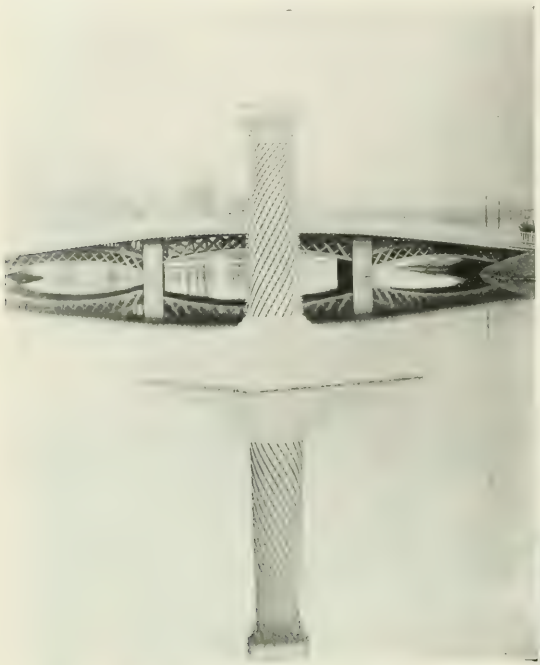


FIG. 15.—THE MIRRORED TOWER, ATLANTA EXPOSITION, 1895.

success attained. The Edison Tower at Chicago was surmounted with an incandescent lamp, typifying the achievements of that remarkable creation of inventive genius.

The cap and shaft of classical design were made commemorative of this achievement by an embellishment of its exterior with over 8000 incandescent lamps in color, capable of giving rhythmic expression, as they did on the opening night, June 1, 1893, when they accompanied Sousa's band. With what results to the popular eye and

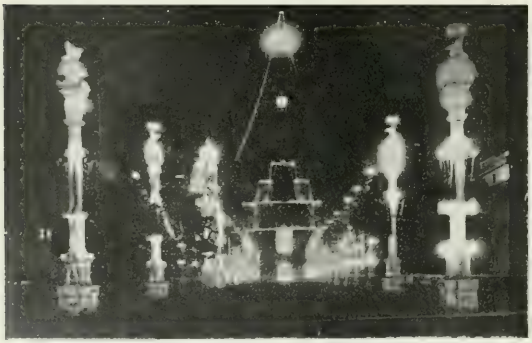


FIG. 16.—TOWER AND STREAMER EFFECT, PHILADELPHIA, 1901.

ear can best be judged by a quotation from the account of the unveiling that appeared in a Chicago daily paper:

"Six minutes past 8 o'clock the broad canvas sails hanging from the center of the roof were swiftly lowered to the floor. As they dropped downward, first the glittering apex and then the massive pillar of the tower of light was disclosed to the thousands of eager spectators that packed the main floor and galleries of the building. As the streamers of white rustled softly to the floor a band stationed in a distant gallery played the sweet strains of a well-known waltz. The instant the music began the great shaft quivered and seemed to start into life. From its massive base to the flower-like bulb at the top it became a shimmering, sliding maze of shifting color. Slowly the lines of fire crept up and around the shaft, falling, circling in and out, now blazing in a mad riot of light and color that blinded the eyes and an instant later sinking into a tender glow, subdued and motionless. Suddenly the musicians swung into a livelier strain and every jet danced a rollicking accompaniment to the air. It was a bewildering, delicious riot of sound and color so strangely blended that the two seemed to move by some common impulse. The conductor's baton controlled, not only the music, but swayed as well the intangible mass of color. As the music became slower and finally died away, the lights too disappeared, only to burst into now dazzling brilliancy at the first sound of the waltz. The operators of the keyboards and rotating switches followed the music perfectly, playing with the intangible rays of light as though they were showering them from their hands. Over 8000 incandescent lamps made up this silent but eloquent orchestra of light and color."

This Edison light tower, in order to be in harmony with the immense height of the building was 110 ft. elevation. The crystal lamp at the top, which was illuminated from within, was made up of over 10,000 separate pieces of light-refracting cut glass. To refresh the reader's memory, a picture of the tower is presented herewith. Full details of this tower are to be found in the *Electrical Engineer* of June 7, 1893. Had it been possible to have secured a dark environment or an exterior setting this column would have been still more pleasing and created still greater enthusiasm. It must be appreciated that in an electrical building there is an excessive amount of light, and semi-darkness is hard to attain.

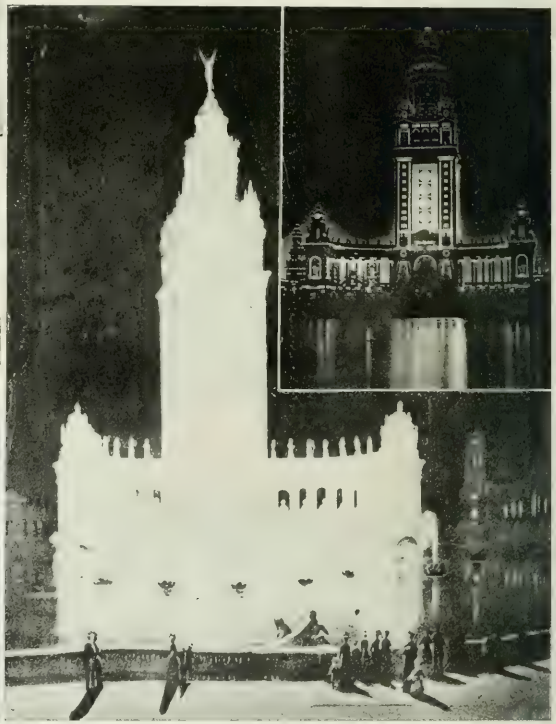


FIG. 17.—PAN-AMERICAN TOWER: THE DREAM AND THE REALITY.

The Midwinter Fair at San Francisco coming next, in 1894, had, as its main feature, a central steel tower designed by Leopold Bonet. This tower, which is illustrated herewith, contained an elevator, and was called an "electric tower," probably from the fact that it was covered with electric light.

Electric towers of recent date seem in their original conception to

rely on a figure or symbol incorporated with them for the purpose of designation, and only become "electric towers" when clothed with illumination sufficient for them to impress the public as such. The San Francisco tower in height and general construction had but one superior, the Eiffel. It was 272 ft. high. It was outlined at night

FIG. 18.—DAYLIGHT VIEW, ELECTRIC TOWER, PAN-AMERICAN.

by 2000 incandescent lamps, showing the outline proportions. On the four sides of the tower at different elevations were shields, wreaths, crowns, etc. By means of an automatic switchboard, lights that were used in the shields, etc., were made to come and go in a

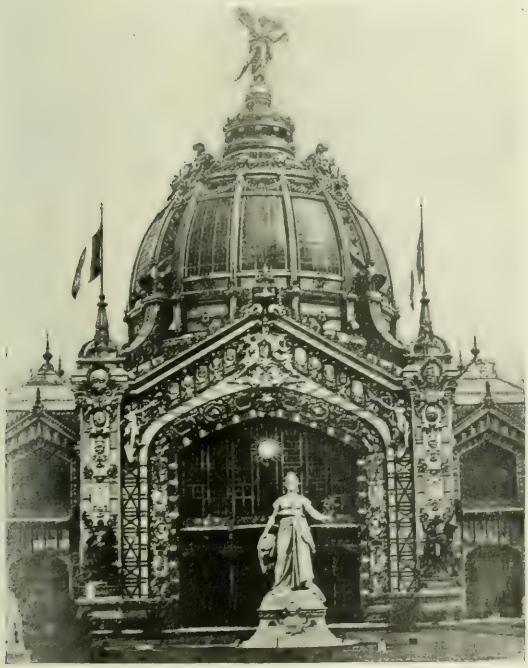


FIG. 19.—DOME AND FIGURE AT CREST, FOR SEARCHLIGHT EFFECT, PARIS, 1889.

constant play of colored lights, appearing and disappearing. There were 1200 lights connected with this automatic switch, 800 of which were colored. This tower being new in its arrangement, novel and well situated, was very much admired. It was surmounted by the largest searchlight ever built, which in the clear atmosphere of California had a marvelous range.

At the Atlanta Exposition of 1895 a special design and new application of tower lighting was shown in the form of the first tower ever built to float on the water, thus reflecting the illumination pro-

FIG. 20.—NIGHT VIEW OF THE PAN-AMERICAN.

vided on the tower. This tower had several thousand miniature lamps, many of which were in color and followed the general lines of the Lenox Lyceum and Portland towers. Even without the lights, it was an important element in embellishing the lake in which it floated. (See cut.)

The world-renowned Eiffel tower was mantained from the 1889 Exposition at Paris until the Exposition in 1900 and still stands, but was improved for last year's show by painting it a more cheerful color. It was also outlined with incandescent lamps and had a more pleasing appearance than in 1889. At this 1900 Exposition there was also shown an illumination on a 300-ft. tower of the same generic class as the tower of Seville, and Madison Square tower. The illustration shows this lighted.

There have been quite a number of permanent towers throughout this country, and the world which have on festive occasions been illuminated with symbols or designs typical of the occasion, but a

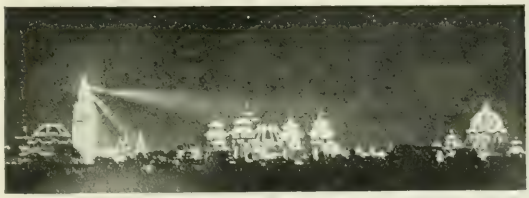


FIG. 21.—PAN-AMERICAN WITH SEARCHLIGHT EFFECTS.

recent illumination made in Philadelphia on the William Penn Tower of the City Hall on the occasion of the dawn of the Twentieth Century celebration, calls for attention from the fact that great expense was incurred and much thought given to the effort to make the illumination of this building worthy of the occasion. It will be seen from the photograph of this and the other towers submitted that the effect at Philadelphia could hardly be worse, artistically considered. This illustration had probably never been seen by a New York *Times* correspondent on art when he made the following

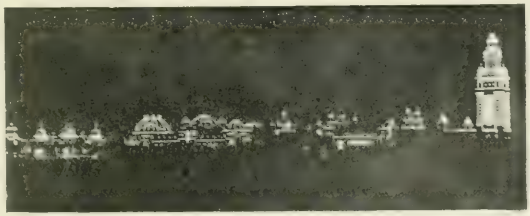


FIG. 22.—NIGHT VIEW OF ELECTRIC TOWER AND ENVIRONMENT.

suggestion as to one way to improve the Pan-American tower. "A dozen big ropes well studded with lights stretched from the electric tower to convenient near-by points would add greatly to the effect without adding to the expense, but some experience was necessary

to teach the managers that a line of lights on a dark night looks just as well strung from a long rope or a pole as from a pile of masonry." The photograph of the absurd Philadelphia effect speaks for itself as to the results of experience in this respect.

The Pan-American Electric Tower is the main lighting feature of the Exposition. The crowning feature of this tower is the "Goddess of Light." The wings are to symbolize the swiftness of light; the torch which she holds aloft in her hand, brightness. This may suggest to the refined and educated an association with electricity in the daytime. The rest of the tower and its colonnade in no way suggest an association with the subject of its title, but perchance are recognizable to the general public, if such association exists at all. Nearly all towers of this order derive their titles from the sculptural conceptions that surmount them, such as the celebrated tower of Seville, the Madison Square Tower, and most notably the William Penn Tower in Philadelphia, which is the loftiest tower of this order in existence (540 ft.), and is surmounted by a heroic figure of William Penn. A statue is usually incorporated in the design to symbolize an idea or commemorate some event; and ultimately perhaps even the Smith family will be honored in this way as a fitting recognition of its great family. In this instance a "composite" could give no offense. If the figure on the Pan-American Electric Tower manifested any electrical idea—plain or composite—beyond its name and the flambeau or torch (which torch represents but the flaming fagot of the ancient and not the embodiment of electricity so well depicted by Franklin and his kite) a connection might be seen between electricity and the surmounting statue. An old German proverb maintains that paper is very tractable and permits of all sorts of liberties. So, too, the conceptions of this tower artistically depicted in the many illustrations and lithographs freely circulated prior to the actual illumination showed a luminously electrified structure, which had the appearance of being lighted from within, as if constructed of glass, producing a translucent and luminous effect not unlike the miniature chalk towers on street sale by Italian venders some years ago. (See cut.) If such an effect were obtained by external light it could only be ensured by placing a model of the tower in an absolutely dark background so that no light would be reflected and illuminating it by powerful searchlights or projectors. This latter treatment was suggested for the "Goddess of Light" on top of the tower. It had been successfully carried out on the figure above the dome of the Palais d'Arts at the 1889 Exposition at Paris, and the same effect can be seen nightly at Buffalo when the searchlight is turned on the "pylons." Had the Goddess of Light been left light in color as recommended, instead of gold gilded (an absorbent of light), it could have been made one of the most effective features at the Pan-American Exposition, and would not have needed any other artifice at night to show that the figure held in its hand an emblem of light, which fact the bright daytime discloses on painfully close study with a telescope. The great public needs something more than an ideal to satisfy its electrical expectations. Therefore, whatever form this tower was intended to depict architecturally was of little moment except as to the advantages its construction offered for a display of the festive order that would be appreciated, thus partaking of the decorative at night instead of the structural. Lighting is not a matter strictly for architects, but a special art, and the subject of special investigation for those who have to deal in addition with the complex problem of installation. No matter what beauty the architecture may possess, if a funereal aspect is to be presented on occasion, the mourning colors of a country must be chosen to drape the structures, be that white, yellow or black. If the occasion be festive in daylight, bunting in the skilled hands of the decorator will attain a festive transformation. A festive scene at night can only be effected by the aid of illumination and in no way can it be construed as incorporated in the architecture, but it is rather associated with it, and when removed it leaves no evidence of its prior existence. Had it been possible to have treated the illumination of this tower from the inside by translucency to secure a luminous effect, it would have resulted in showing up its grim steel skeleton like an ugly radiograph or X-ray picture. A translucent and luminous appearance is produced in an entirely different way from all preconceived notions of the uninitiated. This effect was attained by placing lights so as to secure a nearly uniform illumination over its surface with all desirable points accentuated, producing an effect of brilliancy. The great height and size of this tower and the increased amount of light apportioned to this central section would have made it effective in a popular sense with almost any treatment. The white and pale green background reinforces the brilliant effect of the lights more than is generally appreciated.

This tower could have been arranged to serve the purpose of a spectacular display by arranging the lamps under sectional control and operating them at stated intervals, if such had been desired. The placing of bunting or of any emblems of mourning on a structure will not change it from the doric to the ionic or corinthian. The lights are decorative, absolutely, when used festively. When it is considered that many centuries have passed and that only recently the scientist, inventor and engineer have produced a medium of light that would permit of the arbitrary positions which the units on this tower assume, we see the great progress that has been made. When combined with the beauty that the arts may furnish for a fine background the opportunity afforded in the future for this class of illuminating work is full of suggestion to the expert or specialist who follows the development of illumination for decorative applications.

A longing weakness of human kind is to soar skyward. As an example, there is presented herewith a series of designs of steel towers (Fig. 23) that were proposed to rival the Eiffel tower. These were designed shortly after the famous Eiffel tower was erected. As shown, they suggest an exceptional opportunity for illumination.

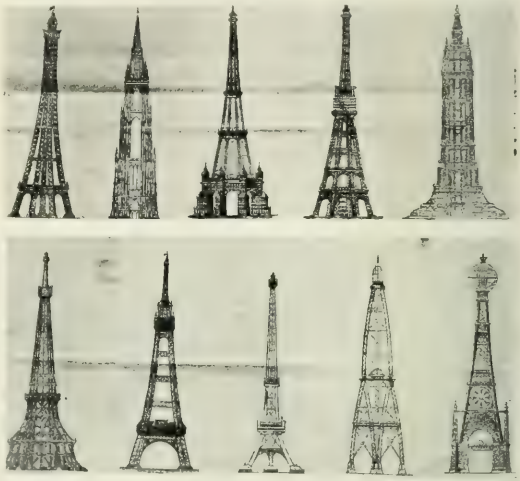


FIG. 23.—DESIGNS OF PROPOSED TOWERS FOR LONDON, FOR ILLUMINATION, ETC.

Their size and extensive outline would admit of producing an extraordinary spectacular effect. If the architectural designer could clothe the exterior of one of these tall steel towers in ornate form and make suitable provision for the association of light, a spectacle rivaling the wildest fancy of the most imaginative mind could be created.

Good Roads for Automobiles.

Of the difficulties met with in the past, cost has been the principal obstacle to the building of good roads in New York State, according to State Engineer Bond. The farmers, who have the most to gain from improved highways, but who have been slow to appreciate this fact, are now represented to be generally in favor of the movement. Applications under the Armstrong-Higbie law for road improvement are piling up in the State Engineer's office, the $420,000 appropriated by the Legislature for the year, although the largest amount yet given, being much too little to meet all the requests. With a reduction in the cost of road building, the State appropriation could cover more ground, and to this problem of a reduced cost Mr. Bond has been devoting his attention. He thinks he has found the solution in the proposed establishment of a State rock-crushing plant, near Rockland Lake, across the Hudson from Sing Sing, where the convicts could be employed in converting the trap rock, abundant there, into road metal. He regards the location as excellent for the purpose, and would expect the returning canalboats to carry loads of broken stone up into the State at cheap rates, rather than to go back light.

Electrical Supply in Bangor, Maine.

By Alton D. Adams.

PUBLIC electrical supply at Bangor, Maine, has been reduced to a condition of ideal uniformity by the Public Works Company. In other words, about 14,000 incandescent lamps, more than 200 horse-power capacity in electric motors, and several hundred enclosed arcs, are all operated by the same generators. Add to this the fact that a nearby water-power is the source of energy, and the main conditions for reliable, economical and satisfactory operation, both for the electric company and the public, seem assured. Bangor, a city of 21,850 population, the metropolis of Eastern Maine, and an important center of wholesale and retail trade, is a relatively large consumer of electrical energy, as the figures just given show. The business portion of the city is well grouped for electrical distribution, on several important intersecting streets, but an excellent class of residences, among which there is a good demand for light, are scattered over a much larger area.

A municipal electric plant, operated in connection with the city water works, for public purposes only, supplies the arc street lamps of Bangor, so that the general electrical supply system is not called on to provide for this service. Bangor also has a large electric street railway system, one of the pioneer plants in this line, having been started in operation on May 1, 1889. This railway is owned and operated by the same corporation that supplies current for private lighting and stationary motors, but the street cars are not as yet driven by the same generators on which the other parts of the system depend. The Public Works Company, with offices at 140 Park Street, Bangor, is the proprietor of the street railway and lighting systems just named. The Bangor plant of this company, consisting simply of a sub-station occupies the same building with its offices at the location just named, but its generating station is five miles above the city at a water-power on the Penobscot River. At this station, in the town of Veazie, a dam in the Penobscot, affords a working head on the turbines of 4 to 19 ft., according to the flow of the river in different seasons. So large is the amount of water available when the river is in its higher stages, that the head of 14 ft. yields about 1800 horse-power through the turbines. A small amount of this power is used for electric lighting in Veazie, and about 150 horse-power goes to pump the water supply of Veazie and Brewer. The remainder of this water-power is absorbed by the electric generators of the Public Works Company. These generators include those of direct-current type for 500-volt street car motors at Bangor, and on lines extending thence to Oldtown on the north and to Winterport on the south. Besides these street railway dynamos, there are alternators of high pressure, which supply energy to the sub-station in Bangor. Besides the turbines, the generating station is provided with a steam plant nearly equal in capacity to that of the water-wheels. The steam engines are used mainly as a reserve and during periods in the summer when the river is low.

Current is transmitted from the generating plant to the sub-station in Bangor by overhead wires on a line of poles following the general course of the river. Several years since a heavy sleet and wind storm prostrated several miles of this pole line, but the company had the wires up and lamps burning again at Bangor in a few days after the break. The construction of the transmission line is now so substantial that a break similar to the above is thought to be impossible. At Bangor the sub-station, a two-story brick building, is located just at one side of the main business district, and favorably for distribution purposes. At this sub-station, the high pressure, 60-cycle, alternating current from the water-power plant is received in transformers, and the voltage reduced to about 2000 for the local distribution lines that feed pole transformers near the premises of consumers. From these last named transformers, incandescent lamps are supplied at 110 volts, and also enclosed arcs on the same circuits. About 14,000 of these incandescent lamps are connected to the system as well as several hundred of the enclosed arcs. In order to provide for its stationary motor service another plan seemed more desirable. For this purpose a part of the high-pressure alternating current that reaches the sub-station is transformed to 550 instead of 2000 volts, and separate distribution lines at this lower pressure are run for motor service. By this practice a few large transformers at the sub-station do the work that would otherwise require a much larger number of smaller ones. The use of large transformers at the sub-station for the motor service at 550 volts saves the entire capacity in small transformers that would be necessary to supply motors from the 2000-volt lines, since the transformers at 550 volts take the place of both the small transformers and also of an equal capacity of transformers of 2000 volts at the secondaries. Because of the fluctuating character of motor loads, the aggregate capacity of small, local transformers for this service would be greater by a large per cent than the capacity now necessary in 550-volt transformers at the sub-station.

As the motors are distributed mainly over the business portion of the city, at moderate distances from the sub-station, the voltage of 550 is sufficient for a reasonable economy of copper. Incandescent lighting is conducted over a much larger area than the motor service, and the pressure of 2000 volts on its three-phase four-wire distribution lines is therefore desirable.

The compact business district of Bangor seems to offer an excellent opportunity for the use of a few large transformers on local three-wire lines, to displace small transformers for individual consumers. At present the transmission of power for the street railway, at 500 to 600 volts, must involve a comparatively large loss of energy and outlay of copper. In the future the abandonment of the direct-current railway generators and the substitution of rotary converters at the sub-station may be expected.

Rapid Telegraphy.

By Patrick B. Delany.

THE comments on automatic, or rapid telegraphy, in your issue of Aug. 3, and the presentation made of the views of those opposed to such systems, invites a few criticisms. It seems strange that in drawing comparisons between the operation of the Morse and the automatic, Morse men, who must know better, invariably assume that the Morse wire is always clear, and the operator holding his key open for the next message to be handed to him, hence the argument that a message can be sent by key in the time that it takes to prepare it for automatic transmission. Nothing could be more misleading. The main delay between the handing in of the message at the window and its lodgment in the messenger's delivery book at the distant station is at the sending end, where it hangs on the operator's hook anywhere from one minute to an hour, according to the time of day and working condition of the lines.

Any one who has ever spent a week in a telegraph operating room knows this to be the case.

The average delay in transmission of messages by the Morse system throughout this country is over 30 minutes. This is the time they hang on the operators' hooks waiting their turn.

In times of serious interruption to lines four or five hours' delay is not unusual, and the train is not infrequently resorted to for avoidance of still greater detention. Telegraph companies provide wire capacity adequate for their traffic when all the wires are in good working order. They do not maintain reserve facilities for interruption contingencies. A day's rain over an area of two or three hundred miles causes a drop in carrying capacity of about one-third. Here is where messages accumulate on the operators' hooks to be culled out by the traffic clerk who decides from their contents which will bear the most delay.

The claim that a Morse operator can send a message while another operator is punching one is, of course, true, but when there are 20 messages on the Morse man's file the last one will be delayed about three-quarters of an hour. With the rapid system affording ample facilities under all circumstances so long as there is one wire left, no such accumulation could take place, and if all the wires were stopped the idle force could be employed in perforating, so that upon partial restoration of facilities, all business could be cleared out quickly, thereby avoiding delay to fresh business coming in for hours after full repairs had been made.

Now, with reference to the estimate of the time it takes a message to get from the sender to the receiver, obviously the time it takes to get it to the office, or the time used up by the messenger delivering it has nothing to do with systems of operation. It is true, the sum of the whole transaction is what interests the customer, but to assume that in practice, one minute, or one-sixtieth of the whole, covers the transmission period, is, as every telegraphist knows, as wrong as the Scotchman's conception of extravagance.

It is all well enough to point out the half-minute transactions between stock exchanges. No one disputes them. But what about the ordinary telegram? The receiver has no means of knowing when it was lodged at the distant office. The time of its reception around the corner is plainly shown, but the "6.15 p. m." lends no suspicion of the fact that the message was filed at its point of origin at 10.20 a. m. On the contrary it inferentially conduces to the con-

clusion that it is fresh from the pen of the sender. It is claimed that telegram time has been greatly shortened of late years, and I believe it to be so; but when the companies let the receiver know how long the message has been on the way it will be a great benefit to the public, and an honest transaction on the part of the company.

Until telegraph companies are compelled to follow the post office example in this respect the best tip to those using the telegraph would be to state the time in the body of the message and pay for it. It will have a wonderful effect, although the receiver may not be impressed with it.

In view of the fact that ordinary messages average about three-quarters of an hour from the filing window to the messenger's delivery book, and that during at least two-thirds of this time it is on the operator's table, it seems like straining at the gnat to dwell upon the time consumed in perforating and transcribing. Admitting that it may take from 5 to 20 minutes, according to the number of messages upon one tape, for these two operations, is it not better to get them off this way than let them hang on the Morse hooks?

Recently, owing to two notable improvements in printing telegraphs, perforation of messages on tapes, heretofore held by Morse managers to be so serious a drawback, has, I am glad to see, been recognized as an advantage, owing to the increased speed of transmission over the line. Up to this point, then, the rapid system and the printing systems are equally handicapped. The difference now lies in the fact that at the receiving end the message is printed, either directly by the receiving instrument, or as a secondary operation by using a received perforated tape to operate a type machine automatically. In the case of the rapid system the message is transscribed on an ordinary typewriting machine from the dot and dash tape by any one knowing the Morse code, and as fast as they can read and work the keys. Transcription in this way being a local operation, gives the operator the same control of the type machine as when working from printed matter or manuscript. It is neither difficult nor uncertain. Nearly all cable telegraphy is done in this way, and this is the most difficult and urgent of all telegraph working. The perforator used by the rapid system is worked by an ordinary Morse key, and the speed of transmission is at least 20 times greater than is possible by any printing system. Any Morse operator can perforate at his best speed, and any operator can transcribe. The working force of an office is instantly available for the new system.

The rapid will work over any kind of a line, any distance without repeaters—at a speed—and in its operation is simple compared with quadruplex outfits and their repeaters. It requires practically no adjustment, being within a wide range unaffected by changes in circuit conditions; and it affords at all times absolute certainty of communication, with facilities equal to any emergency. These advantages, impossible of attainment by any electromagnetic combination, are of paramount importance, and indispensable for reliable communication and low rates.

The official reports of economical managers show that the limit of cheapness has been reached with the present systems. It is also evident from these same statistics that the numbers of messages at present charges is about at a standstill—one per head per year—at 30 cents for 10 words. Telegraph managers have contended that there would be no economy in high speeds, no increase of business by lower tolls, that the telegraph is an emergency medium, and urgency cannot count the cost. It is strange that business men should argue this way. Examples are overwhelmingly against them. One will suffice just now. It is most apposite. Sunset methods in telephony have been moved eastward to Chicago to pull the "pay high or go without" policy out of a $5,000,000 deficit.

Canadian Water Powers.

There is another big power scheme which will soon be brought before the Provincial Parliament at Toronto, Ont. It aims to develop the water power northwest of the town of Port Arthur, Ont. The capitalists behind the scheme figure out that on the completion of the Canadian Northern Railway, Port Arthur will become a great flour milling center. They have in consequence set to work buying land for a canal 22 miles long to connect with and divert the Keministikuia River. There is said to be an easy route between the high levels to a point 3½ miles north of Port Arthur, where the syndicate proposes constructing a reservoir with an area of 1500 acres. When the route has been secured, it is not expected that much influence will be required to ensure the water power of the river in West Algoma being quietly conceded by the Ontario Government to a company.

Clark on the Conditions of American Telegraphy.

LAST March Mr. Thomas F. Clark, vice-president of the Western Union Telegraph Company, appeared before the United States Industrial Commission at Washington and testified in regard to the general conditions of the telegraph in this country and abroad, and its relation to the public. We gave a digest of Mr. Clark's interesting evidence the following week. It has now been printed by the Commission and issued in pamphlet form, accompanied by the two diagrams which we show here. It may be noted that the Western Union either directly or through telephone connections operated under arrangements therewith, reaches 29,000 places of 1000 people, or less, in the United States, while the total number of telegraph offices reached by telephone connection in the United States is 39,083. There are in the United States 76,000 post offices. As Great Britain has 10,816 telegraph offices and about 40,000 post offices, it appears that Western Union reaches practically 50 per cent of United States post offices, while only about 25 per cent of Great Britain's post offices have telegraphic communication. Telegraphic statistics of 22 foreign countries were presented by Mr. Clark, including all the leading countries of Europe, as well as Egypt and Algeria, and it is shown that the United States has two-thirds as many miles of wire as all these put together, or 41 per cent of the whole, and that it has 25 per cent of all the offices and sends 24 per cent of the messages.

On the important question of rates, Mr. Clark produces the interesting map here shown on a reduced scale, and now appearing for the first time, we believe, in a public journal. The general idea as to the method of fixing a telegraph rate has been vague, but Mr. Clark showed the scientific basis employed for local purposes all through the country. The Union is laid out in a system of squares, 50 miles to the square, and then the rate is made 25 cents from any square to any two circles of contiguous squares. Each side of each square is 50 miles. Within a radius of squares the rate is 25 cents. As the business has grown and localities have become more thickly settled, direct rates have been extended, and the square system has been overshadowed by the extension of the flat rate, as in the case of New England, where business and population justify it. The highest rate they charge is $1; that is, from the Atlantic Coast to the Pacific Coast.

All this telegraph business is on the 10-word count, with address and signature free. Then there is a system of night rates east of the Rocky Mountains; that is, for messages to be transmitted during the night and delivered the next morning at about half the day rate. But there is no rate less than 20 cents.

The press rates are made on a basis entirely their own, and because of the volume of business done and because the larger part of it is transmitted at night. The business of the press associations is largely done over leased wires. The Associated Press has a system of leased wires practically connecting all large centers of the country, which the association uses as it chooses and over which it sends all its business. The company has nothing to do with that system except to take the rental for the wires, the same as from any private individual. The press rate on matter that the company handles itself is made on a basis of circuits, by which a large number of papers can be served at the same time, so that economy to each paper can be promoted as much as possible, with due regard to the return to the telegraph company. The special rates to newspapers for a single transmission to one paper are based on "the additional word rate" of the day message; that is, one-third of the additional word rate in the day-time and one-sixth at night, so that where the rate is 25 and 2, the press rate in the daytime would be two-thirds of a cent, and at night it would be one-third of a cent a word for direct transmission and delivery to a single paper.

The Western Union Company also has rates for commercial reports which are distributed to exchanges and to various subscribers throughout the country. They are made on a basis somewhat similar to the press rates for individual subscribers, in that they name a rate for certain reports that may be desired, especially where they can be transmitted over circuits, so as to give the farmers and the dealers of produce in grain all obtainable information of the markets, in order to regulate the sale of their crops and the getting of them to market. Certain people may wish to have the opening and the noon and the closing reports of certain produce from certain exchanges, and those reports are made up and sent and delivered at those hours over certain circuits, as they are called for, through the rural districts.

The table shown herewith brings out the enormous distances over

which American telegraph service operates, as compared with the short distances within which any self-contained European system has to be operative. Enforcing this point, Mr. Clark presented two maps, contrasting areas on the same scale. The area of Switzerland is 15,981 square miles, or about one two-hundredths of the area of the United States. Belgium has an area of 11,373 square miles, which is one two-hundred-and-sixtieth the size of the United States. Great Britain and Ireland have 120,678 square miles, one twenty-fifth of the size of the United States; the area of the United States, exclusive of Alaska, being 3,092,679 square miles by the census.

In Great Britain the population is about 333 inhabitants to the square mile. In Belgium it is 586. In Switzerland it is 183. In the United States it is about 24. There are in Great Britain 308,436 miles of wire, or 43,507 miles of line. In Belgium 3964 miles of line and 20,752 miles of wire; in Switzerland, 4439 miles of line and 13,100 miles of wire. In the United States the Western Union Telegraph Company has 192,705 miles of line and 933,153 miles of wire. Of course, in addition to the Western Union Company, there are the Postal Telegraph Company and some subsidiary companies connected with it, adding 29,882 miles of line and 184,933 miles of wire, which makes altogether in the United States 222,587 miles of line against 425,600 miles of line in all Europe, according to the latest statistics of the international bureau at Berne, and 1,118,086 miles of wire in the United States as against 1,585,267 miles of wire in Europe. Now, comparing the mileage of wire to population, we have in America 1 mile of wire to 130 people in Great Britain and Ireland; 1 mile to 321 people in Belgium; 1 mile to 222 people in Switzerland, and about 1 mile of wire to about each 76 people in the United States.

It must be borne in mind that the system of the United States covers the whole country, reaches every important center from New York, on the Atlantic, to San Francisco, on the Pacific, and that in order to reach these places it is necessary for the wires to cover large unproductive territories, where the cost of construction has been exceedingly high and where the cost of maintenance is rela-

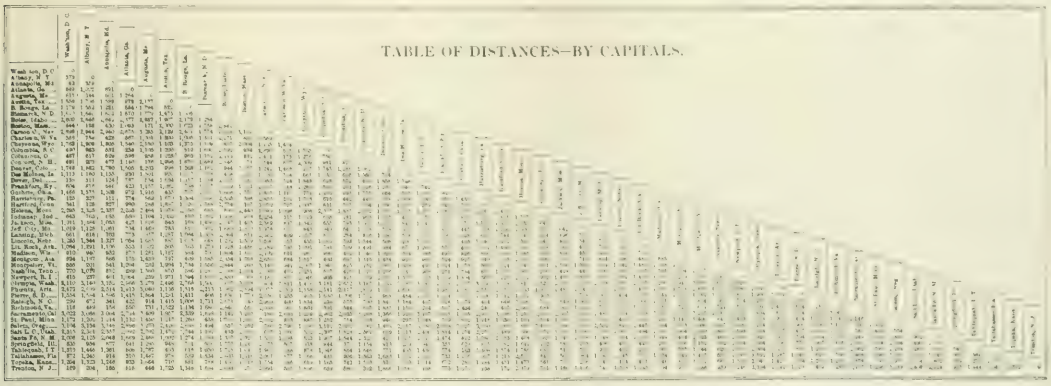


Fig. 1.—Table of Distances in American Telegraphy.

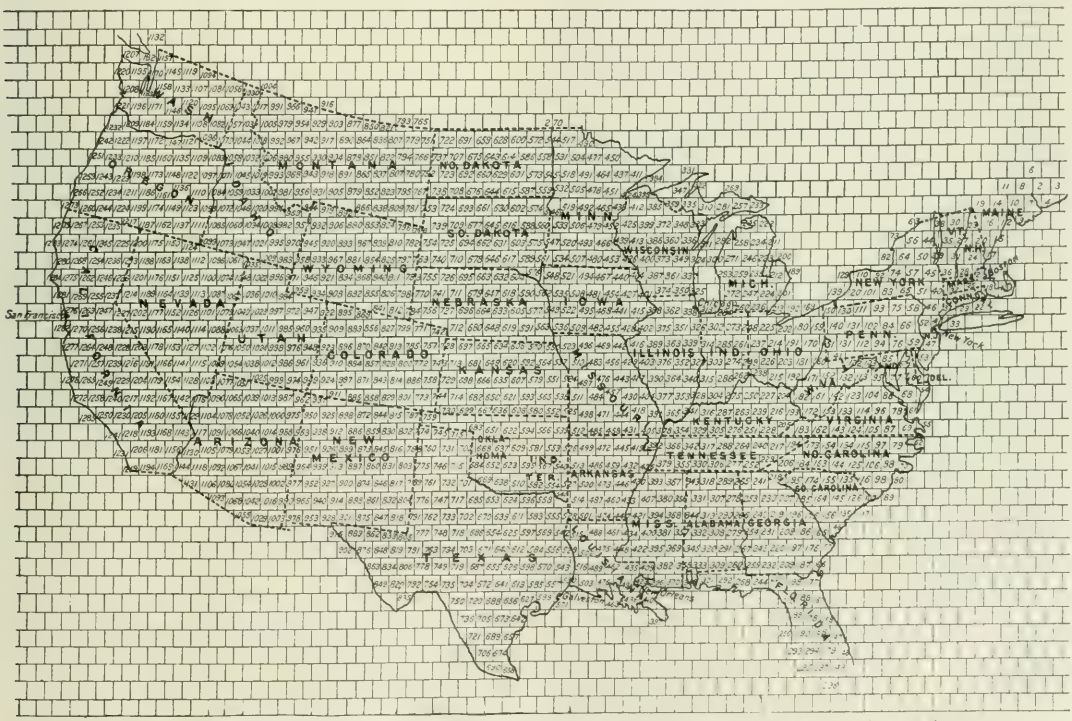


Fig. 2.—Map Showing System of Local Telegraphic Rates in the United States by the Square System.

tively higher than it is in more thickly settled places. This is shown by the fact that of the Western Union Company's wires two-thirds, or about 600,000 miles of them, are in operation east of the Mississippi River, and one-third of the whole mileage is spread over the large unproductive territory west of the Mississippi in order to reach the small towns and camps and places along the various lines of railroads to the Pacific Coast. As a foil to these conditions, Mr. Clark quoted a statement made recently of the population surrounding Manchester, in England. In a radius of 10 miles there are 3,000,000 people, and within a radius of 50 miles there are 8,000,000 people. That is Manchester; what the population surrounding London and other large centers of England in similar radii will be, Mr. Clark could not say, but there is almost a case of confluence of populations, making really one densely settled territory, while his company had hundreds and sometimes thousands of miles of line where there is scarcely any business at all. In this and other ways Mr. Clark made a most striking exhibit in favor of the telegraphs as operated by private enterprise in America, when compared with the governmental systems of Europe.

The Nernst Lamp in Germany.

By E. Kilburn Scott.

On the occasion of the recent visit of the Institution of Electrical Engineers to the Lausanstrasse Station, Berlin, the Allgemeine Electricitats Gesellschaft gave an exhibition of the Nernst lamp, and a lecture on its development and construction was delivered by Herr Bussman, chief of the experimental department of the A. E. G. The lecturer's remarks, together with the experiments, convinced most of those present of the very great possibilities of the Nernst lamp. There is no doubt that great credit is due to those who have been working at the problem, in overcoming the various initial difficulties and in producing the lamp which has now an average life of 300 hours.

The method of applying initial heat to the filament by a small spiral wire of platinum and the cutting out of this resistance when the filament has been heated up sufficiently to make it a conductor is most ingeniously worked out from the point of view of manufacture cheaply and in quantity. In order to regulate the amount of current an iron wire resistance is placed in series. At a dull red heat the rate of increase of resistance of iron wire is so great per unit increase of temperature, that the corresponding decrease of resistance of the glower is compensated for, and the current passing is kept nearly constant. This wire is put in a vacuum bulb mounted on the lamp-holder. The difficulty of making a good contact between the platinum wire and the non-conducting filament appears to have been effectually overcome.

Hitherto the cost of manufacture has kept the new lamp from being a commercial success, and now this is in a fair way of being solved. In the A. E. G. works the lamps are extensively used, and they are also employed by many private consumers, to whom a rental of 75 cents per annum per lamp fixed is charged, there being nothing extra to pay for the renewal of the filament. To buy outright the price is $1.67, and 50 cents for each extra filament. The lamp is made for any voltage up to 250, and the fluctuation of pressure which has such a detrimental effect is taken care of by a special device in the latest type of lamp.

The pleasing effect of the lamps was abundantly manifest to all the members present, and the ladies seemed to be especially impressed by the fact that by gently blowing on the filament the light could be put out.

Of the economy of the lamp over an ordinary incandescent lamp the A. E. G. have now accumulated overwhelming evidence, as well as the very interesting fact that the efficiency of the lamp is maintained practically constant throughout its life.

New Telephone Exchange for Minneapolis.

We illustrate herewith the handsome new telephone exchange designed for the Twin City Telephone Company, of Minneapolis, by the Keith Company, architects, of that city, to whom we are indebted for the opportunity to present the view. It is, we believe, quite unique, there being no other exchange like it in the country. These splendid new headquarters of the Twin City Telephone Company are being erected on the corner of Third Avenue S. and Seventh Street, rather remote for disturbing trolley influences. The building will be of brick and stone, two stories in height, and with a half-basement. The frontage on Third Avenue will be 96¼ ft., and on Seventh Street, 50 ft.

The first floor will contain the offices of the general manager, the treasurer, the superintendent, the chief electrician, the contract department, counting room, instrument room, typewriters' room, vaults and lavatories. The second floor will be devoted to the operating room, switchboard, dining-room, parlor, lockers and lavatory. The operating room, which is to be 47 by 72 ft., will be constructed in accordance with all the most modern scientific improvements. The facilities for ventilating this room will be unsurpassed by any building in the country. A huge electric fan will force fresh air through a spray of water and then through cotton bags, thereby insuring a steady current of strained, cooled, purified air. This system is the same as that in vogue in the British Houses of Parliament. The rate at which the air will be admitted will be sufficient to make a complete change of the room's atmosphere every three minutes. In the winter the air will be heated to a comfortable temperature, and with such perfection there will be no necessity of opening the outside windows. It is of utmost importance that the operators have a large and constant supply of fresh air, as there will be at least 90 in the room at one time. Then, too, it is essential that no dust should get into the delicate instruments.

The basement, which will be 10 ft. in height, will contain the terminal board, relay racks, electrical machines, engine and boiler rooms, dynamo room, chief inspector's room, lavatories, lockers, storage room and a battery room, which will be the largest in the United States, with the exception of one now being built by a telephone company in Detroit.

Copyright, Keith Co., Architects. NEW TELEPHONE EXCHANGE IN MINNEAPOLIS.

The entire building will be electric lighted and steam heated. Throughout the plans the management has placed the health of its employes first, because it realizes that first-class service can only be expected from healthy and contented employes.

In a general way the work of the Twin City Company is nearly completed. It is stipulated in the central exchange contract that it be completed and ready for the installation of the switchboard and batteries within 60 days. The switchboard will have a capacity of 7200 subscribers. It is stated also that within 40 days the south exchange will be completely equipped and ready for business, also the east side exchange. The south exchange will cover all the great territory between the river and the lakes and south of Seventeenth

Street. Its ultimate capacity will be 3600 subscribers, and not less than 1000 telephones will be in operation this fall. The east side exchange will have a total capacity of 2000 subscribers. Every one of these telephone stations is a full metallic private line. The system is being installed by the Stromberg-Carlson Company, of Chicago.

Those Pan-American Flambeaus.

NATURAL GAS FLAMBEAUS.

It is a matter of regret to many who have admired the effects in illumination produced by the use of one uniform kind of light at the Pan-American Exposition to see now introduced on each side of the pylons a number of natural gas flambeaus, surmounting the posts along the lake, and originally designed exclusively for electric light. The effect of the sickly gas flame is not in harmony with the modern illuminant immediately beneath it on the same post. The night effect cannot well be truly shown by photography, but the unsightly appearance of the gas pipe by daylight, protruding its ugly length out of the top of the handsome post can be detected from the accompanying photograph. But night and day effects are such as to be convincing as to the contentions of Mr. Luther Stieringer in his article in these columns , July 20, 1901, on ground lighting at the Pan-American and prior expositions, in favor of a uniform scheme of illumination. In an exposition which typifies modern progress, an attempt to imitate in a cheap manner the crude illuminating methods of the ancients can only result as does this in bringing into prominence the beauty and grandeur of the modern method, but at the expense of the general effect.

Elements of Illumination—XXX.

By Dr. Louis Bell.

For purely decorative purposes the miniature lamps serve a very useful purpose. Regular incandescents are made down to 6 or even 4 candle-power, but as has already been explained, the filaments for these powers at ordinary voltages must needs be very slender and fragile, and the lamps are nearly or quite as bulky at those of ordinary candle-power.

Hence it is better to make miniature lamps for connection in series, each lamp taking 5 to 25 volts to bring it to normal candle-power. Imagine a 16-cp, 100-volt lamp filament cut into four equal parts, and each of these parts mounted in a separate small bulb, and you have a clear idea of the principle involved. Commonly the miniature lamps for circuits of 100 to 125 volts are of 5 or 6 candle-power, and connected five in series across the ordinary lighting mains. Fig. 1 gives an excellent idea of the size and appearance of the perfectly plain miniature lamp. It is fitted to a tiny socket of the same general construction as the standard sockets for ordinary lamps, but taking up so little room that the lamps can conveniently be assembled in almost any desired form.

FIG. 1.—MINIATURE LAMP.

It is not altogether easy to manufacture these lamps so as to attain the uniformity necessary if the lamps are to be run in series, but, in fact, it is possible to obtain them of very good quality, and of length of life comparable with standard incandescents. They are generally not of high efficiency, since great uniformity and good life are the qualities most important.

They can be fitted with tiny ornamental shades, and may be obtained of various shapes and colors, so that very elaborate decorative designs can be built up of them. In indoor work colored lamps may be freely used, and are capable of producing some very beautiful effects, but the plain or ordinary frosted lamps are most generally used.

Owing to the small size of the sockets and fittings, the miniature lamps can be packed so closely as to produce the effect of an almost uniform line of light at comparatively small distances, so that most ornate schemes of ornamental illumination can be carried out by their aid. They are also very useful in building up small illuminated signs.

Lamps of special sizes and shapes from tiny ½-cp bulb, hardly bigger than a large pea, to the candle-shaped lamp of 5 or 6

FIGS. 2, 3, 4 AND 5.—LAMPS OF SPECIAL SHAPES FOR DECORATION.

candle-power are sometimes used with good effect in interior decoration. Figs. 2, 3, 4, 5 show some of the commoner shapes used for such purposes. When a regular electrical supply is not available these little lamps can be obtained for very moderate voltages, say, from 5 to 10 volts, and can be run in parallel from storage cells, or even from primary batteries for temporary use.

Such small lamps are sometimes used in the table decorations for banquets, and for kindred purposes. By their aid surprising and beautiful effects are attainable, which would be quite impossible with any flame illuminant. But they must be cautiously used, for their very facility tends to encourage their employment in effects more bizarre than artistic. It is well, too, to add a word of caution as regards the possible danger from fire. It is so easy to wire for incandescents that particularly when using miniature lamps there is a natural tendency to rush the work at the expense of safety. Lamps in series on a 110-volt circuit are quite capable of dangerous results if anything goes wrong, and even the battery lamps are not absolutely safe in the presence of inflammable material.

It should therefore be an invariable rule not to install a temporary decorative circuit without the same attention to detail that would be exercised in a temporary circuit of the ordinary incandescent. The same precautions are not always necessary, but all the wiring should be carefully done, joints should be fully protected and particularly lamps should be kept out of contact with inflammable material. The incandescent lamp is often commended as producing little heat, and, in fact, as compared with other illuminants, its heating power is small. But a vessel of water can be boiled by plunging an ordinary 16-cp lamp in it nearly up to the socket and cloth wrapped about such a lamp will infallibly be ignited within a comparatively short time. The fact that the cloth does not burst into flame in a few minutes does not indicate safety, for time is an important element in ignition, and even an overheated steam pipe is capable of setting a fire, low as its temperature is. A good many fires have been started in shop windows by hanging fabrics too near to incandescent lamps, and even the miniature lamps are quite capable of similar damage if in contact with anything easily inflamed. No illuminant has so high an efficiency that it produces a negligible amount of heat from the standpoint of fire risk.

In ordinary domestic illumination miniature lamps have very little place. Nothing is to be saved by using them so long as they must be used in series at ordinary voltages. Now and then a 4 or 6-cp lamp may be useful as a night lamp, but it is better to use an ordinary lamp

of moderate efficiency than to try miniature lamps. Sometimes a circuit of miniature lamps may be installed for a dining-room or ball-room with excellent artistic results. In such cases it is better to use ground than plain lamps, and, as a rule, colored lamps should be eschewed, on account of the impossibility of getting delicate tints to show effectively.

Temporary decorative circuits may, however, be very useful in domestic illumination for fetes and the like, in which case delicately colored ornamental shades can be applied, or the lamps may be used in Japanese lanterns or similar ways. Any country house fitted for electric lights can be temporarily wired for such purposes rather easily, and out-of-doors temporary wiring can be installed without the rigid precautions necessary indoors.

In all decorative lighting it is important to recognize the fact that illumination is a means to an artistic end, and not of itself the primary object. One is in these days of electric lighting far more likely to err by providing too much light than by failing to supply enough.

Great brilliancy is far less important than good distribution and freedom from glare. It is highly probable, for instance, that the effect of the illumination of the Electric Tower at the Pan-American Exposition would have been injured by the substitution of 32-cp lamps for the 8 candle-power actually used, and it is absolutely certain that a dozen arc lights, injudiciously placed would have detracted greatly from the harmonious result.

In interior illumination the same rule holds true. By the reckless use of brilliant radiants one can vary the vision up to a point where its power of appreciating values in illumination is almost entirely lost. In decorative lighting great care must be used not to approach this point, to leave the relief afforded by light and shade, and to realize the perspective in the details of the illumination.

In the absence of a foreground one's judgment of distances is completely upset, as witness the great difficulty experienced in estimating distances correctly over water on the one hand or in a thin fog on the other. In scenic illumination the distribution of luminous values can be utilized with great facility for producing illusions of distance, giving at will the effect of startling flatness or of interminable vistas. In stage illumination such devices are now and then used to heighten the effects, although other exigencies sometimes interfere with the proper development of the scheme.

The commonest cause of failure in proper illumination is the interpolation of a brilliant light between the spectator and the object to be viewed, with the inevitable result of losing detail and hurting the eyes. Brilliant diffused light is in this particular only less objectionable than direct light, and both should be assiduously avoided.

It must not be supposed that decorative lighting must necessarily be electric, since very beautiful results were attained before electric light was heard of, but electric lighting is unquestionably the most facile means of securing artistic results on a large scale.

A special department of lighting, peculiar to the electric branch of the art, is the use of the searchlight for scenic or utilitarian purposes. The searchlight is now a familiar object, consisting of a very powerful arc light, taking from 20 to 50 or more amperes, kept steadily by automatic focussing apparatus in the focus of a parabolic mirror, often with an auxiliary lens system. The material of the mirror is most often glass silvered on the surface, unless the parabolic surface is very deep, when silvered metal is generally employed. As the purpose of the searchlight is to give a parallel beam of light, the carbons between which the arc is formed are not in line, but staggered, as shown in Fig. 6, so that the crater of the arc points obliquely backward and the carbons are tilted so that this crater faces fairly the apex of the mirror instead of its aperture. An opaque disk between the arc and the mirror aperture cuts off all stray direct light so that all the light sent out is delivered from the mirror in a nearly parallel beam. The whole affair is mounted in a case having rotation about a horizontal and a vertical axis forming the familiar device shown as a whole in Fig. 7.

The mirror aperture may vary from a foot or so up to 4 or 5 ft., the searchlights most often used having from 2 to 3 ft. of aperture. The most perfect results are given by using a rather shallow parabolic mirror of silvered glass, which can be given a better and more permanent figure than a deep metallic mirror, and hence gives a beam more accurately parallel.

The searchlight, when properly constructed, will throw a dazzling beam many miles on a clear night, but in foggy weather or even in a comparatively thin haze its field of usefulness is greatly limited. It is of only casual use in ordinary forms of illumination, and its chief legitimate use is the illumination of special objects, in the manner already described in connection with the simpler reflector arcs. It is often abused by its application to advertising, and to a glaring and offensive simulation of daylight in places that have no need of it.

It is of considerable military and naval value, serving to detect movements of an enemy's troops or to pick up hostile vessels, but it is also of no small value in military signaling over long distances. For this purpose it is turned upwards upon the distant sky where its glare is visible in clear weather even up to a distance of 40 or 50

FIG. 6.—SEARCHLIGHT CARBONS.

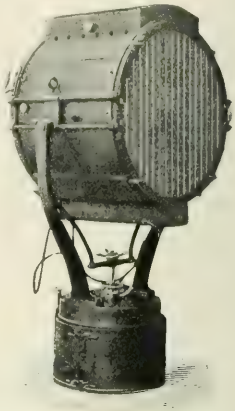


FIG. 7.—SEARCHLIGHT COMPLETE.

miles. Then, by deflections of the beam or by periodically cutting it off by a register shutter over the mirror, communication may be established by the regular Morse or heliographing code, either directly or in cipher. Its use in this fashion was especially striking during the recent operations for the relief of Kimberly.

It is also a valuable adjunct in coast defence, particularly of narrow channels and of mine fields, where it can be used both to confuse the hostile pilots and to make a clear target of hostile ships. But its range of effectiveness for such purposes is popularly much overestimated. In clear weather it would quite certainly pick up a large vessel by the time it had come within effective gun range. On torpedo boats and similar small craft, however, painted as they are for war in neutral tints, the searchlight has a useful scope of little over a mile in distance, and in hazy weather even less. It has therefore for naval, as for general purposes, a somewhat circumscribed field of usefulness, within which, however, it is undeniably of great value.

Power Development in Wisconsin.

The Black River Falls Company is making arrangements for the development of the water power at Black River Falls, 16 miles from West Superior, Wis. The development of the enormous power is now contingent upon the granting of a franchise to run wires and place poles in the alleys of the city.

The company owns 40 acres of land, and the plan is to put in a system of dams to increase the waterfall. The first dam to be built will be 25 ft. in height, and will back up the water to cover an area of 44 acres. This will be extended to the first reservoir, and the extreme depth of water in six reservoirs will be 15 ft. The falls themselves have a precipitate depth of 175 ft., so that with the dam the company will get a fall of 230 ft. in about 1500 ft., which would be at the distance from the first dam to the power house.

At certain times in the year there will be available nearly 25,000 horse-power. Several manufacturing concerns have already made application for power, but the main power will undoubtedly be used at the copper mines.

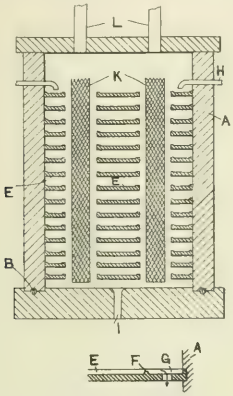
Red Indian Telephonists.

What is probably the only telephone system operated entirely by Indians is being installed in the village of Kish-Pie-Axe, in Northern British Columbia. The system is to be connected by a 20-mile telephone wire from the telegraph office at Hazelton, half way between Ashcroft and Atlin.

Modifications of the Mercury Cathode Electrolytic Cell.

Recent patent issues include several forms of electrolytic cell designed for the production of chlorine and caustic through the intermediary of a cathode of mercury. The respective patentees are Josiah W. Kynaston, of Liverpool, England; John F. Kelly, of Pittsfield, Mass.; Henry S. Anderson, of Springfield, Mass., and Brodde E. F. Rhodin, of Sault Ste. Marie, Canada, and their several cells, while quite different in form, are each designed to overcome a real defect in the type of apparatus now in commercial use. (See Electrical World and Engineer, June 8, 1901.)

Kynaston's purpose is to increase to the utmost degree the area of the mercury cathode. This he does by flanking a series of vertical carbon anodes by superposed horizontal trays, hollowed out to a uniform depth of ½ inch, to contain mercury, and communicating at alternate ends by openings whereby the mercury, fed continuously to the uppermost tray, may fall from each tray to that below and from the lowest to the cell floor, thence to be withdrawn, denuded of its sodium and returned. To insure a constant depth of mercury in the trays each opening is guarded by a narrow transverse dam, ⅜ inch in height. Accompanying Figs. 1 and 2 sufficiently indicate



FIGS. 1 AND 2.—KYNASTON CELL.

the construction of this device, *A* being the flagstone or slate walls of the cell with grooved and packed joints *B*, *K* the anodes, *LL* inlet and outlet pipes for the chloride solution serving likewise for the escape of chlorine, and *H*, *I*, the inlet and outlet, respectively, for the mercury. *EE* represent the stone or slate trays for the flowing cathode, channeled as described and provided with the dams *F* and openings *G*, as clearly shown in Fig. 2. The denuding apparatus, as patented to Kynaston in January of the current year, is substantially identical in form with this electrolizing cell, save that the carbons are replaced by rectangular boxes of stout iron wire gauze. These, in circuit with the amalgam in the trays, functioning in this case as anode, constitute, as is well known, a voltaic cell of considerable energy.

This construction affords a great increase in the cathode area, but the relative positions of the electrodes are such as would go far toward neutralizing any advantage to be derived therefrom. Such inequalities of current density as must follow so radical a departure from the simple rule of parallel working faces would be fatal to any operation of plating or refining, and it does not appear why less care should be exercised to secure proper current distribution over a cathode of mercury. The construction is, moreover, most unfavorable to the rapid withdrawal of the liberated chlorine from the neighborhood of the charged cathode. In these two respects the device would seem to present very serious defects.

In the rocking cell of the Castner type the sodium, although originally deposited upon the upper surface of the mercury cathode, becomes distributed throughout the body of the metal, less perhaps by simple diffusion than by the rolling motion attendant upon the flow of the mercury from the decomposing to the oxidizing chamber. This increases the time necessary for complete oxidation of the sodium in the latter compartment, and the purpose of the apparatus patented by Kelly is to prevent this intermingling of the amalgam and mercury by transferring the former as a supernatant layer upon the latter into the presence of water. The cell used is shown herewith (Fig. 3), comprising a stationary inverted bell *B*, supported by a suitable framework not shown, and containing a carbon anode *G*, pipes *D*, *E*, for admission and discharge of chloride solution, and duct *F* for escape of chlorine. The enclosing trough *A* is mounted upon a horizontal track *K* and provided with means *L*, *M*, for reciprocating it thereon. The mercury cathode *C* covers the bottom of this trough and operates in the usual manner as a seal between the

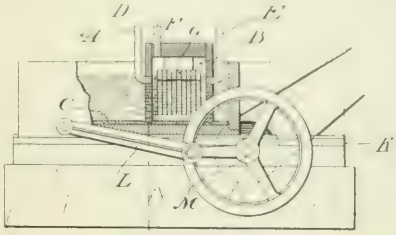
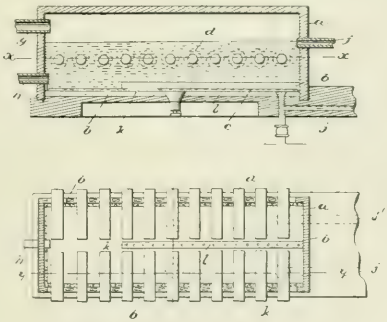


FIG. 3.—KELLY CELL.

brine in the inverted bell and the water in the external trough. In operation the slow horizontal movement of the trough carries the amalgam from the electrolytic cell to the combining chamber with the minimum of disturbance.

This idea is suggestive and perhaps valuable, but not new. The revolving compartment cells of Kellner and Rosenbaum accomplish the same result in substantially the same manner. The distinction lies in the reciprocation of the new cell with the consequent sharp arrest at the end of each stroke, of the heavy moving metal, and in certain undetailed advantages conceived to follow therefrom.

Anderson's object is to minimize the resolution of the deposited sodium by the electrolyte in the decomposing compartment of the cell—a reaction which gives rise to the formation of hypochlorites and is indirectly responsible for much disintegration of the carbons and for a dilution of the chlorine by carbon dioxide whereby its value for the preparation of bleaching powder is seriously diminished. Believing this troublesome oxidation of the sodium to be effected less by the main body of electrolyte overlying the mercury than by the thin film of liquid between the lower surface of the metal and the cell floor, he has devised a striking and original means for obviating the difficulty. Figs. 4 and 5 show Anderson's



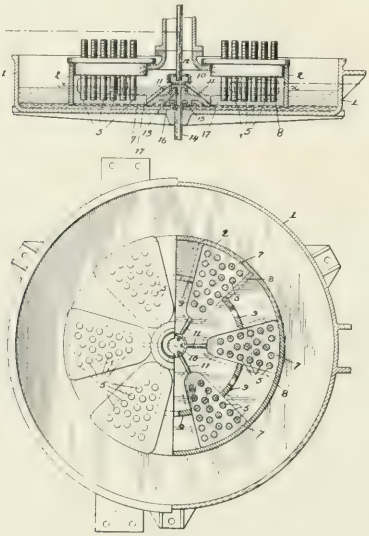
FIGS. 4 AND 5.—ANDERSON CELL.

modified cell in vertical and horizontal section, respectively, the general form being of the return flow type heretofore patented. The electrolizer is a closed chamber *a*, with inlet *f* and outlet *h* for electrolyte, and a gas eduction pipe *g*. Anodes *d* are laterally introduced, and the mercury cathode *c* entering at *j* and flowing around a central ridge *l*, passes at *j'* to the denuding apparatus. The novelty lies in the cell floor, which is a porous slab or plate *b*, preferably of pipe-clay, provided at the sides and center with flanges or extensions, rising to a height somewhat above the level of the mercury—the central extension forming the ridge *l* before referred to. These projecting portions of the slab are pierced by numerous vertical channels *k*. The effect of this construction is to give the electrolyte free access through the channels *k* and the substance of the porous bottom, to the under surfaces of the cathode, and therefore to establish with this surface an electrolytic connection sufficient to counterbalance, in effect, the solution pressure of the sodium.

No one conversant with cells of the Castner type can have failed

to remark the rapidity with which the floors roughen and disintegrate beneath the mercury. Presuming this to be due in large measure to the formation of caustic by inter-reaction of the sodium dissolved in the mercury and the moisture absorbed by the floors or trapped between them and the overlying fluid metals, it would seem that the remedy proposed—to conduct the current to the lower surface of the mercury and to thereby establish reducing conditions over its entire area—should prove an effective one.

The cell just patented to B. E. F. Rhodin and by him assigned to the American Alkali Company, of Camden, N. J., is the form, it is



FIGS. 6 AND 7.—RHODIN CELL.

understood, which has been adopted for the new installation at Sault Ste. Marie, Canada, and is a modification of the well-known revolving chambered cell invented by J. G. A. Rhodin, of Manchester, England. Figs. 6 and 7 show the general form of this apparatus, 1 representing an open iron tank for containing the mercury cathode and the water to oxidize the sodium, and 2 an inner revoluble cell of vitrified earthenware, carrying the anodes 5 and filled with the sodium chloride solution to be electrolized. The anodes are arranged as indicated in Fig. 7, in a number of distinct compartments 7, radially grouped, and each provided with a depending flange 8, dipping into the mercury and serving as a seal between the water and the brine. The electrolyte is introduced through the central pipe 12 into the cup 10, and passes thence by radial ducts 11 directly to the regions 17 of maximum decomposition beneath the anodes, the exhausted liquor escaping from the cell through the overflow

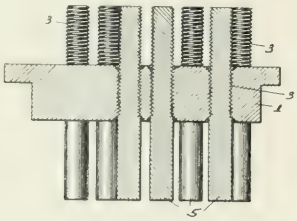


FIG. 8.—RHODIN ANODES.

13, 14. The annular groove and depending flange 15, 16, complete the separation between the liquids in the inner and outer vessels. The supports 9 are intended merely to guard against collapse of the cell during kiln-firing.

The anodes, as shown in section upon a larger scale in Fig. 8, comprise blocks 1 of graphitized carbon, flanged and fitted to the top of each electrolizing compartment 7, and carrying graphitized carbon rods 5, whose lower ends constitute the working anode faces. Block and rods are screw threaded, as shown at 3, to secure a close joint and at the same time to permit of longitudinal adjustment of the carbons to compensate for wear in use. In operation a slow movement of revolution of the bell 2 brings each surface portion of the mercury alternately under the anodes whereby it is charged with sodium, and into contact with water to effect its denudation, in a manner readily understood and familiar in earlier constructions.

This cell is the antithesis of Kynaston's, in that the object sought is a capability for the use of high current densities, thereby insuring a large output of caustic per unit of mercury. The earlier Rhodin cell has been notable in its attainment of this result, and the present modified construction, whereby is secured a sufficiency of concentrated electrolyte at the regions of maximum reaction, should make a further improvement.

The Electrical Hazard at the Pan-American.

Mr. H. K. Miller, general agent of the National Board of Fire Underwriters, in response to requests from a number of fire insurance companies for more definite information relative to the grounds of some criticisms by the board officials of the electrical conditions at the Pan-American Exposition, has sent out to underwriters a specific statement of defects, which was submitted to the board by Inspectors G. E. Bruen, E. A. Fitzgerald and J. C. Forsyth.

The transformers, in a majority of instances, are reported as being oil-filled and located in and underneath buildings and in close proximity to woodwork, so that there is a liability to overheating by short circuit and consequent ignition of the oil. The woodwork in and under the 11,000-volt transformer sub-station in the Elecricity Building is declared to be not fire-proof.

Link-fuse cut-outs are reported as not enclosed in fire-proof cabinets and as being surrounded by inflammable material, and in some cases the fuses are said to have been replaced by heavy copper wire. There is said to be a lack of proper support or protection for conductors from the power station entering the Electricity Building, and thence distributing through and underneath all of the principal buildings.

The general equipment of the power house is declared to be hazardous, exposing the structures of the Midway.

The inspectors conclude by saying that they regard these conditions as dangerous, adding that "there are also numerous minor defects throughout the Exposition buildings which, while not of sufficient importance to warrant specific mention, are of such a nature that trouble is likely to arise unless corrections are made."

CURRENT NEWS AND NOTES.

BAUXITE IN NEW SOUTH WALES.—The United States Consul at Sidney, N. S. W., reports that there are many large deposits of bauxite in New South Wales. Nothing in the shape of a systematic examination of the deposits has been made, however, but analysis shows that there is from 35 to 60 per cent of alumina in bauxite from different localities. With one exception the proportion of ferric oxide is large, ranging from 20 to 40 per cent, and silica from 3 to 35 per cent. All the deposits analyzed contain phosphoric and titanic acid.

CANADIAN CABLES.—The Department of Public Works at Ottawa has been advised that the government steamer "Tyrian," now at Gaspe, Que., has completed repairs to the cable between St. Paul's Island and Meat Cove, Cape Breton, which had been interrupted for some time past. The "Tyrian" has now left Gaspe for the purpose of laying the cable across the Strait of Belle Isle, which is to connect the Belle Isle station with the government telegraph system on the mainland of Labrador. By the end of August, the coast signal service will be in permanent operation to Belle Isle, which is a most important point on the summer route between European ports and the St. Lawrence. Steamships will, hereafter, be reported by telegraph 760 miles below the port of Quebec. This will mean that a 20-knot vessel, taking the summer course, can communicate her arrival on this side of the Atlantic in less than four days' out from Liverpool, England.

WIRELESS FOR LABRADOR.—At the close of the Newfoundland Legislative sessions the Governor, Sir Cavendish Boyle, announced that the Marconi system of wireless telegraphy would soon be installed along the Labrador coast.

WIRELESS TELEGRAPHY FOR THE LAKES.—The superintendent of the Pere Marquette system announces that his company will soon install wireless telegraphy between Manitowoc and Ludington, over 156 miles of open water. Later on the Pere Marquette Company expects to equip all of its steamers with the system.

WIRELESS TELEGRAPHY.—A dispatch from Nantucket, Mass., of Aug. 14, says: Communication by wireless telegraph has been established between this island and South Shoal Lightship, and the system is working to the entire satisfaction of Commander J. D. J. Kelley, who has been in charge of the installation. Numerous messages have been exchanged between Siasconset and the lightship.

THE WANE OF THE OMNIBUS.—From financial statements recently issued by the operating companies, the passing of the London omnibus seems to be at hand. Electric trams and tube railways have diverted traffic away from the 'bus in a startling manner. The London Road Car Company has had to appropriate $12,500 from general reserve fund to pay a 3 per cent dividend, the lowest for a June half year in a decade, while the North Metropolitan Tramways Company, to make up its dividend to 4 per cent, had to take $50,000 from its reserves.

MORE STEAM ROAD TROLLEY.—Chicago & Great Western Railroad officials contemplate the installation of electric motive power for the road's suburban service as far south as Randolph, a distance of 30 miles. Estimates and plans for the proposed change from steam power have been prepared by the chief engineer, and he has already submitted two plans to the company, one calling for the third-rail system and the other for an overhead trolley with a return circuit. The Great Western has a heavy suburban business between St. Paul and Randolph and other suburbs within 30 miles of here. The rapid growth of the packing house industries in South St. Paul promises to swell the traffic to twice its present size, and the road is seeking more economical and effective means for handling its increased business.

A SIMPLE COULOMB INDICATOR.—A patent issued Aug. 13 to Samuel E. Doane describes a very simple form of coulomb meter for the indication of the relative amount of current used by two incandescent lamps connected in multiple. The apparatus consists of two glass tubes closed at the upper end, which may be entirely filled with a dilute solution of sulphuric acid, both of the tubes plunging into a common receptacle. Into the bottom of each tube extends a pair of thin, flat electrodes, one pair for each lamp to be compared. Mounted between the tubes is a scale, which, in the illustration, reads downward from zero to 150. When current is turned on the two lamps to be compared, which are in multiple, gas is electrolytically disengaged in each tube and rising to the top, depresses the level of the liquid. When this level in one tube reaches, say, the mark 100, current is turned off and the reading of the height of the liquid in the other tube will give the amount of current used in the second lamp as a percentage of that used by the lamp connected to the first tube.

GRAND CENTRAL TUNNEL.—In discussing the New York Central tunnel problem at the terminus in this city, the *Railroad Gazette*, a well-known authority in its field, treating the subject from the railway point of view, says: "We do not feel at all sure that, up to the present time, the actual 'state of the art' would have made it practicable to do materially better than has been done. Now, however, the development of the art of electric traction and of the art of ventilating long tunnels appears to have reached a state where radical improvement is not only possible, but practicable. The improvement of the tunnel may be made along two lines. It may be ventilated or it may be worked by motors which make no smoke or gas. * * * We guess that it will not be a ventilation plan at all, but a plan which will get rid of possibly 80 per cent of the products of combustion; possibly of all of them. The suburban zone will be electrified. All local trains, serving that zone, will be replaced by electric trains. Each of these latter will be a motor car and a trailer in the middle of the day, and longer trains will be built up by multiples of these, for the busy hours."

MUNICIPAL ELECTRICIANS.—For the International Association of Municipal Electricians, at its sixth annual convention, Niagara Falls, Sept. 2, 3 and 4, the following programme for entertainment for the members and guests has been arranged by M. J. Donohue, chairman of the executive committee: Monday afternoon, Sept. 2, carriage ride for the ladies through Island Park. Monday evening, trolley ride over gorge railroad, with electric searchlight effects. Tuesday afternoon, Sept. 3, excursion "Maid of the Mist." Tuesday evening, reception and hop at International Hotel, the headquarters. Wednesday afternoon, visit to Niagara Falls electric light station and power house. That day the convention will adjourn and the delegates and guests will visit the Pan-American Exhibition at Buffalo on Thursday, Friday and Saturday. President McFarland, of the Old-Time Telegraphers' Association, has arranged for one fare for round trip excursion from Toronto to Montreal for all those who wish to attend the Old-Timers' and U. S. Telegraph convention at Montreal the following week.

SELENIUM TELEPHONY.—It is well known that a selenium cell when continually exposed to the action of light will decrease in sensitiveness, its resistance not varying in accordance with the intensity of the light thrown on it, and that if exposed too long the resistance becomes practically constant. To obviate this objection is the object of a patent granted Aug. 13 to Joseph Poliakoff, of Charlottenburg, Germany, which also describes an apparatus for phototelephony. Two independent selenium cells are used, and by means of a mirror on a vibrating lever the working beam of light is thrown alternately on the two cells, which are separated by a partition. The telephone circuit is simultaneously changed from one cell to the other by means of the same vibrating lever, or an arrangement of condensers employed with the two cells arranged in multiple in the telephone circuit. With the arrangement shown, a photographic sound record is obtained by passing a sensitized ribbon past a slot, where it is exposed to light, whose vibrations are varied by a polished diaphragm spoken to. This negative is developed and a positive made from it which is fed at the same rate past the same slot; a beam of light is passed through the ribbon to the vibrating mirror, and the resulting waves of varying intensity are then reflected to the cells and sound thus transmitted to a distant receiver.

PATENT OFFICE "SAFEGUARDS."—Edwin V. Shepard, chief clerk of the Patent Office, in a recent paper on "Safeguards," discusses the means that are taken to prevent the disclosure of inventions and the loss of papers and remittances after they have been given into the custody of the Patent Office. To remove all temptation on the part of an employe to make use of any idea suggested to him by any paper filed; to prevent even his unconsciously absorbing an idea and later innocently developing the same idea as his own —a section of the Revised Statutes prohibits the grant of a patent to an officer or employe of the Patent Office. The office does its best to employ only reliable men and women, and so complete is the system of records within the office that it can be told to a certainty who has handled any particular case up to its date of issue, so that detection would almost surely follow disclosure, and the likelihood of any wrong on the part of the office force is thus reduced to a minimum. The loss of papers is effectually guarded against by the system of charges, a paper taken from a division or sent there for report being charged, so that an examination of the slip shows where to look for the missing paper. As a further precaution the waste paper of the office is examined every night and the windows of the file rooms are all screened. When a paper is pronounced "lost," the "official searcher" is armed with authority by the Commissioner of Patents to look in every possible place and all desk drawers and other places generally regarded as private must be thrown open for his inspection. No losses of remittances can occur, Mr. Shepard says, after the first entry has been made on the books of the office. The principal losses occur in transmission, the reports of the office showing that about one letter in 2000 in the ordinary mail is reported missing, and about one letter in 10,000 in the registered mail, which means an average of only three or four complaints a week received by the Patent Office.

TRADE RECIPROCITY.—President Search, of the National Association of Manufacturers, has called a meeting of the executive committee of that organization at Philadelphia for Sept. 4 for the purpose of taking up the question of reciprocity. The subject will be considered in all its phases. A call will then be issued for a national reciprocity convention. Congress, at its next session, will be asked to give the desired relief. The sentiment of the manufacturers, Mr. Search says, is in favor of securing treaties of commercial reciprocity with other countries. Within the past few months, he says, Russia, Italy and some other countries have dealt heavy blows to our foreign trade by the levying of countervailing duties. An attempt will be made to show Congress that American industries have suffered by the present tariff laws and their interpretations.

THE ROTATING CATHODE FOR ELECTRO-DEPOSITION.—Cowper-Coles has just patented a modification of his oft-described apparatus for obtaining tough and smooth deposits of metal upon a rapidly revolving cathode, the improvement lying in the use as motive agent of a jet of the electrolyte itself, impinging upon a wheel of the Pelton type, secured to the top of the revolving mandrel which constitutes the cathode. To prevent the electrolyte from developing a movement of rotation with the cathode and thereby diminishing the surface friction relied upon to burnish the deposit, the anodes are arranged around the mandrel in the form of an annular grid of radiating bars, which act as baffles as regards movement of the liquid. A circumferential speed of 1000 ft. per minute insures the instant detachment of hydrogen bubbles and permits the use of extremely high current densities. Mr. Henry Wilde, one of the pioneers of electro-metallurgy, has warmly contested the Cowper-Coles claims to originality as regards the invention of the spinning cathode, pointing to patents of his own of nearly 20 years' standing. The modified construction, however, is distinctly novel.

WORKSHOPS IN ENGINEERING EDUCATION.—Mr. R. D. Summerfield, writing in our London contemporary, *Electrical Engineer*, expresses the opinion that to provide a workshop for a technical school is a simple waste of money; that it is not only useless, but in many cases actually harmful, as the students have to unlearn much of what they were taught there when they become connected with an engineering concern. It is quite right, he considers, to have laboratories, and such plant as a boiler, steam engine, pump, dynamo, etc., on which tests for horse-power, steam and fuel consumption, efficiency, etc., may be carried out by the students, as such tests are probably the most important part of the school teaching, if they are carefully carried out, and the value of the results clearly and fully pointed out by the teacher; but to fit up a workshop in imitation of an engineer's shop, and to set the students to make small engines, lathes, etc., he pronounces to be little less than a farce, as far as such training is of any use to them in after life. The work turned out of these college workshops, he adds, is often very well done, but it is done with no regard to time or cost; the students spend hours in filing up two or three nuts or in polishing surfaces which would be better left unpolished, etc. The consequence is that when they leave school and go into an engineering works, where economy in production is considered of the first importance, and the theoretically best form of any machine can only be approximated to for good practical reasons, they have quickly to unlearn the out-of-date method of working taught in the school workshop, and they will usually not be long in coming to the conclusion that the time spent there was, to say the least, wasted.

REGULATING ALTERNATORS.—A patent granted Aug. 13 to Harold Edwards describes several methods for compensating the objectionable effect due to variations in the speed of alternators, all of the methods depending upon the use of an induction motor as the principal regulating device. In one arrangement the induction motor rotor is mounted on the shaft of the alternator to be regulated, and with its inducing circuits connected to a small auxiliary three-phase alternator which is driven at constant speed. In series with each of the three loads between the motor and auxiliary generator is a transformer. The secondaries of the three transformers are connected to one side of a rectifier driven by the auxiliary machine, the other side being connected with an auxiliary winding on the alternator to be regulated. When the speed of the main and auxiliary generators is identical, a comparatively small current only will pass through the transformers. If, however, the main machine drops in speed, the induction motor will fall out of synchronism with the auxiliary machine, whereupon current flows from the latter to the induction motor, the amount of which will depend upon the deviation in speed. E. m. f.'s of corresponding value will be set up in the transformer secondaries and the rectifier will deliver a corresponding direct current to the regulating field winding of the main machine. Should, however, the main machine rise in speed above the normal, a direct current of opposite sign will be delivered. In another arrangement the auxiliary alternator is dispensed with and the induction motor is driven at constant speed. In a third arrangement the rectifier is dispensed with and alternating regulating currents supplied to a Rice compensating winding.

PAN-AMERICAN EXPOSITION SEARCHLIGHT SIGNALS TO TORONTO.—Signals from 30-inch searchlight, on the Electric Tower of the Pan-American Exposition, were sent to Niagara Falls, July 25, by Professor George F. Sever, superintendent of Electrical Exhibits, in the presence of the electrical jury, thus again demonstrating the feasibility of this method of signaling at night. Since that time searchlight signals have been sent from Buffalo to Toronto, a distance of 58 miles, through arrangements completed by Professor Sever in co-operation with Mr. William S. Aldrich, consulting electrical engineer, of Toronto. The first trial was made, 9 to 10 p. m., Aug. 9, with clouds over Toronto. The local illumination of the overhead sky by the electric arc lights in the streets of Toronto effectually prevented any discrimination being made between the local and the Buffalo illumination of the clouds. The second trial was made 9.50 to 10.15 p. m., Aug. 13, with a perfectly clear atmosphere. Owing to the smoke settling down over the city no signals could be discerned from the top of the Municipal Hall tower, Toronto, but all of these signals were very clearly discerned during this trial by Mr. C. H. Rust, city engineer, Toronto, with a party located on Centre Island, two miles off shore from the city. Special long-distance communication was arranged between the top of the tower and the Electric Tower, at the Pan-American, through the courtesy of the Bell Telephone Company, represented by Mr. Dunstan, of Toronto, so that every detail of the experiment could be followed. The special instructions were to depress the searchlight to the lake horizon, bearing on the Municipal Hall tower, Toronto, then to sweep the horizon a definite angle, to the right and left of this bearing, and later to elevate and depress the light on the original bearing.

PIPERIDIN BY ELECTROLYTIC REDUCTION.—Piperidin, a powerful stimulant well-known to the medical profession, and one of the series of strong aromatic bases originally prepared from black pepper, has of later years been synthetically produced by the reduction by means of sodium in alcoholic solution, of the base pyridin, a constituent of Dippel's oil and the type of those medicinal agents, powerful for good or ill, known collectively as the "alkaloids." Pyridin is a compound bearing a general structural relation to benzene, but differing in the substitution of nitrogen for one of the triad groups, CH‴. Piperidin differs from pyridin in that it contains six additional hydrogen atoms, and is easily prepared by subjecting pyridin in acid solution to strong reduction. The reaction is therefore typical of many to which the electric current, with its ease of control, and freedom from by-products, has been so successfully applied, and it is not surprising to note that this reaction, too, has fallen under the domain of electro-chemistry. The conditions under which the electrolytic reduction of pyridin best proceeds were first studied by Ahrens who stated that 95 per cent of the theoretical yield could be obtained by employing a cathode solution of pyridin dissolved in 10 times its weight of 10 per cent sulphuric acid, an anode solution of dilute acid and electrodes of lead. This high claim seems, however, not to have been fully warranted, for the method never passed into commercial use, and now Wilhelm Pip, of Darmstadt, in reviewing the entire subject of the electrolytic reaction, finds the conditions under which the best results are attained to be quite different. They are thus formulated by him: The sulphuric acid must be strictly pure, and must be present in the proportion of at least three equivalents to one of pyridin, or largely in excess of the quantity specified by Ahrens; the electrodes may be of lead, silver, mercury or carbon, but not of platinum; the diaphragm must be carefully freed from traces of salts of metals other than those specified above. The Ahrens process, restricted to these essential conditions, patented to Pip and assigned to the firm of E. Merck, of Darmstadt, has doubtless now entered upon its commercial life.

LIGHT RAILWAYS FOR INDIA.—Lord George Hamilton, English Secretary of State for India, stated last week in regard to that country that it was the Indian Government's intention to appoint a trained expert to assist the Government in developing the railways of India on the most modern practical lines. This expert would immediately visit the United States, and would prepare an exhaustive report upon the railway system there, especially concerning light railways, with a view to determining how far the American system would be applicable to conditions in India. The rapid extension of country trolley systems here thus appears to have attracted attention in India as well as elsewhere.

Letter to the Editors.

"Moblodge."

To the Editors of Electrical World and Engineer:

Sirs.—In your Aug. 3 issue, p. 185, London asks for a correct word for a private collection of automobiles equivalent to "stable," as referring to a number of horses. As "stable" is defined as "a lodging place for beasts," why not use the word "moblodge," a lodging place for automobiles?

Grosvenorsdale, Conn. Milton A. Darbie.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

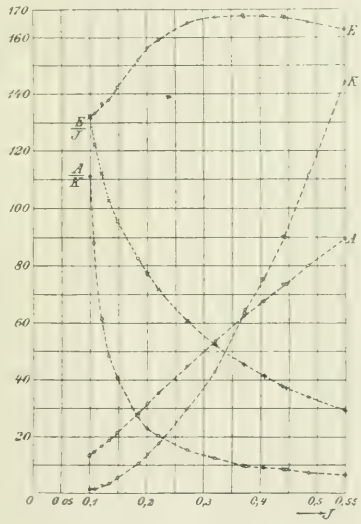
Three-Phase Induction Motor.—Trylski.—A well illustrated description of large three-phase induction motors which have been made by the Alioth Company for a French plant, where they are direct connected to compressors which compress air from 6 kilograms per square centimeter to 100 kilograms for traction purposes. Each motor has a normal power of 500 horse-power at 100 revolutions, the voltage being 5000 and the frequency 25. At a load of 500 horse-power the current is 50 amperes, the efficiency 92 per cent, the power factor 0.93, the slip 3 per cent. For a load of 1100 horse-power the motors fall out of step. The efficiency is 90 per cent for 160 horse-power, increases to 93 per cent at 370 horse-power and then decreases slightly.—*Elek. Zeit.*, July 4.

REFERENCE.

Stray Field in Induction Motor Armatures.—La Cour.—Some critical remarks of purely theoretical interest on some points in a recent paper of Niethammer.—*Elek. Zeit.*, July 4.

Lights and Lighting.

Commercial Nernst Lamps.—Wedding.—An illustrated account of what seems to have been an extended series of tests of commercial Nernst lamps of the Gen. Elec. Co., of Berlin. The first purpose of the tests was to control the correctness of the numerical values, given by the company. They were found to be correct. The time required for heating the incandescent body was found to be about 30 seconds or less. From his experiments he concludes that the lamp can be further developed so as to consume only about one watt per candle. In several lamps this has already been nearly accomplished. He then gives the results of extended photometric tests in several tables and 12 diagrams. For a suspended Nernst lamp with horizontal filament and clear glass globe for 220 volts and 0.184 ampere he found a mean illumination of 17.6 c. in a vertical plane above the horizontal plane, 26.5 c. below the horizontal plane, and 19.7 c. in the horizontal plane. In another suspended lamp with vertical filament for 220 volts, he found the lower hemispheric candle-power 108.4 candles for a lamp without a globe and 91.3 candles for a lamp with globe, hence the globe causes a decrease of the candle-power in the lower hemisphere by 15.8 per cent. For determining the absorption of the ground glass globe and the mean spherical intensity, he tested a lamp for 220 volts, 0.88 ampere, 150 candles; without globe the mean illumination for the lower hemisphere was 110.3 candles, for the upper hemisphere 96 candles, for the total sphere 103.1 candles; with globe the mean illumination for the lower hemisphere was 93.6 candles, for the upper hemisphere 83.4 candles, and for the total sphere 88.5 candles. A comparison of the Nernst lamp with the carbon filament incandescent lamp shows that the consumption in watts per spherical illumination in candles of the former to the latter is as 1 to 2.1. He then gives a very interesting account of an investigation of the behavior of an incandescent filament under various voltages. The main results are given in the adjoining dilagram. The abscissas J represent the current in amperes, the curve E is the voltage, K the candle-power, A the watts, $E \div J$ the apparent resistance, $A \div K$ the power consumption in watt per candle. The normal voltage is 165. The E curve has a maximum of 168 volts for an abscissa 0.38 amperes. This is very important, as it represents a critical value. Should this critical value be exceeded during a variation of voltage, then the filament would no longer consume 0.27 ampere, but 0.51 ampere at 165 volts, i. e., nearly double the previous current. It would not be able to stand this high current for a long time, and would soon be destroyed. It is therefore necessary that an auxiliary resistance be placed in series with the filament, and its action must be to keep the current constant. That this is fulfilled by the resistance used in series with the commercial Nernst lamps, is shown in a curve. He finally gives the results of photometric tests in which a 192.5-watt lamp was suspended at three different heights—



NERNST LAMP CURVES.

2.5, 3 and 4 meters—above a horizontal plane. The distribution of the illumination of this plane was investigated. The maximum illumination is 1.25, 1.5 and 2 meters distant from the point exactly perpendicular below the lamp, when the lamp is 2.5, 3 or 4 meters above the plane, respectively. The illumination of the horizontal plane is much more uniform, the higher the lamp is above it. When two lamps are placed at a distance of 12 meters both 4 meters above a horizontal plane, the point of the plane in the center between the two lamps has an illumination of two candles, while the maximum illumination is three candles. The distribution of the light thus becomes quite uniform. It can be still more improved with the aid of a reflector.—*Elek. Zeit.*, Aug. 1.

Power.

REFERENCE.

The Practical Application of Superheated Steam.—Hutchinson.—An abstract from a paper read by the author at the Milwaukee meeting of the American Society of Mech. Engineers.—*Am. Elec.*, Aug.

TRACTION.

High-Speed Electric Traction Between Milan and the Italian Lakes.—The many available water powers in Northern Italy have led the steam railroad companies of that district for some years to contemplate the transformation of many of their shorter lines into electric systems. The latest development of this kind is the line running between Milan and the Italian lakes, the road being some 73 km. in length, and obtaining power from a hydraulic central station at Tornavento. The Government has placed all the water power at the disposal of the railroads so that no other companies can be formed for its development until the railroads have decided that they do not need certain portions of it. The development of the water power at Tornavento will be sufficient to operate the new line throughout its whole length, five sub-stations having been constructed to transform the high-tension alternating current at which the electricity is generated into the ordinary direct current at 600 to 650 volts that is used on the line. The road is to be of the third-rail type, and two-car trains will be operated, consisting of a motor car and trailer, during periods of heavy traffic, the motor car alone being used at other times. The hydraulic station has not yet been completed, but a steam plant has been constructed immediately adjoining the site of the hydraulic station, which will supply current until the latter's completion and will afterwards be held in reserve as an auxiliary station. The alternators have a normal output of 760 kilowatts each, with a non-inductive load, and will stand an overload of 25 per cent for two hours and 40 per cent instantaneously. They are of the three-phase revolving field type, and generate 13,000 volts directly. The transmission lines running to the sub-stations are all in duplicate, being run ordinarily in parallel. A schedule has been prepared which provides for a remarkably efficient service. The sub-stations, of which there are five, are equipped with air blast transformers of 180 kilowatts normal output each, which reduce the high-tension voltage of 12,000 volts to 420 volts. This is then passed through reactive coils and rotary converters, where it is transformed to direct current at a tension of 650 volts. The direct current is taken directly to the third rail, no feeders being used. The conductivity of the rail is as 1 to 11, as compared with that of pure copper. At one of the sub-stations a battery of accumulators has been installed and a motor-driven booster inserted for charging. The cars are equipped with four 160-hp motors, which develop sufficient power to run the cars at about 96 km. per hour, a speed which it is necessary to attain in order to comply with the schedule laid out.—*St. R'y Jour.*, Aug. 3, and Inter. Ed., Aug.

Electric Railways of Ohio.—DAVIS.—An elaborate map showing the electric railway lines in operation, those under construction and the projected roads in the State of Ohio. This State now has about 9000 miles of steam roads in operation. At present there are about 900 miles of electric railways in the cities and towns, and nearly the same length of interurban and suburban lines, while those in actual process of construction aggregate 1435 miles. New roads are constantly being organized, some of which will be built, but many not. The interurban lines are usually built over their own right of way, and the more conservative and successful are satisfied with a speed of about 35 miles per hour. The feeling that these roads will be largely competitive for traffic with the steam railroads is not so strong as it was, as many of the trunk lines are willing to allow the local traffic to go over the suburban lines. The shorter steam lines, however, are feeling the competition in traffic.—*St. R'y Jour.*, Aug. 3, and Int. Ed., Aug.

Atlanta Rapid Transit Company.—The lines of this company are operated by power obtained from the electric light plant of the Georgia Electric Light Company. The current is generated by alternators and transformed by rotary converters at the lighting station and at a sub-station. Within certain districts, known as the fire limits, the feeders are placed underground in conduits, but outside these districts they are supported on the poles. The overhead trolley is used throughout and both wooden and iron poles are employed. —*St. R'y Jour.*, Aug. 3, and Int. Ed., Aug.

Toledo and Monroe Railway.—CONANT.—A description of this high-speed electric railway, 18 miles in length, forming a link between Toledo and Detroit. The power is distributed by the three-phase system with rotary sub-staions. There is at present one 400-kw three-phase alternator. There are two sets of bus-bars on the switchboard connected by switches so that the generator can supply either set of bus-bars The high-potential bus-bars connect with three auto converters, which add 20 volts to the initial e. m. f. of the generator. The transformers are directly above the switchboard. The sub-station is 12 miles distant from the power station. The railway poles also carry the high-tension transmission wires. A barbed wire is carried along the tops of the poles and grounded at every fifth pole to the rail, and also to a tinned copper plate buried 5 ft. in the ground. Telephone wire is also carried on iron brackets attached to the poles.—*St. R'y Jour.*, Aug. 3, and Int. Ed., Aug. (See ELECTRICAL WORLD AND ENGINEER, Aug. 3.)

The Naples-Aversa-Caivano Interurban Electric Railway System. —PIO.—A description of this road, which was opened on April 1, and presents many interesting features. The price of coal in Naples is high, and it was important that the loss in transmission should be reduced as much as possible. Three-phase high-tension current is used between the single power station at Naples, and a sub-station located near Melito, the only one so far built. When the service requires it, a sub-station will be erected at Afragola. The present installation in the power staion consists of three steam engines of 350 horse-power each, directly connected to the generators. These consist of one 5000-volt alternator and one direct-current railway generator, which are in regular service, and to the third engine are connected duplicates of both machines, so that this engine could be used in an emergency to supply either direct or alternating current. The transmission line is supported on the same iron poles as the trolley wire, and is attached to the poles by clamps. Each section between poles is separate, and if the wire breaks the clamps immediately release the two pieces in that section, allowing them to fall to the ground and preventing danger from live wires. The rolling stock consists of 10 Rutelli cars, seating 52 persons each, and about 11 meters long. They will be operated with three or four trailer cars.—*St. R'y Jour.*, Aug. 3, and Int. Ed., Aug.

Canal Traction.—FABRE.—A brief article on a new monorail electric system of canal traction devised by Fabre. The tractor runs on the towpath and hauls the canal boats. The tractor is provided with four oblique driving wheels, running on the monorail. The entire tractor can oscillate around the circular-shaped rail as an axis. On the canal side a supporting wheel keeps the tractor upright. The electric motor sets the driving wheels in motion by means of worm or conical gears. He claims that his arrangement enables him to use very light tractors. In the application of this system, which is to be made in France, three-phase currents will be used, the rail being taken as a conductor. "Two normal speeds will be available with only one motor, a three-phase motor running at half-speed when two phases of its secondary are open circuited."—*Elec. Rev.*, Aug. 10.

The New York Central Tunnel Problem.—LOUIS BELL.—A discussion of the question of the handling of the cars in the N. Y. Central tunnel by electricity. The situation is much more complicated than that at Baltimore, where only four locomotives are used, because the train service is not only very much greater, but the terminal facilities and switching yards at each end are extremely limited. Experience has shown that electric traction is entirely adequate to meet the traffic conditions of the tunnel, and also for the suburban traffic which extends out in several directions to a distance of some 50 miles. The only serious engineering problem is the arrangement of the working conductors in the tunnel and on the suburban sections. For elevated and underground work the third-rail system in its simplest form has proved entirely adequate, but for surface roads it has not proved to be entirely economical and trustworthy. Several roads of moderate length have been operated with some considerable measure of success, but full data as regards leakage, interruptions of service, etc., are not available, and there are no signs that the number of such roads will rapidly increase, nor has any one yet installed a third-rail system in a complicated switching yard. The writer believes that the protected third rail is entirely unsuited to such a location. He thinks that with a reasonable amount of engineering skill a third-rail system can be made safe and secure, though he is by no means convinced that it is the best way out of the difficulty. The experience with sectionalized third-rail systems has not been reassuring, and they will be accepted by engineers only after a long and patient demonstration of their success.—*St. R'y Jour.*, Aug. 3, and Inter. Ed., Aug.

REFERENCES.

Multiple Unit System.—KUBIERSCHKY.—A well illustrated description of the system of the Union Elec. Co., of Berlin, of controlling the motors of all motor cars which form a train, from one point. This method is in principle similar to the well-known Sprague method of control, and differs from it only in details.—*Elek. Zeit.*, July 11.

Three-Phase Traction in Italy.—Bignami.—An illustrated article on the Lecco-Colico-Chiavenna line where the "Ganz system" is to be used, as noticed repeatedly in the Digest.—*Elec. Rev.*, Aug. 10.

Energy Consumption of Electric Railways.—Sieber.—A communication referring to the recent article of Volkers. While he agrees in general with Volkers, he makes some critical remarks on several special points.—*Elek. Zeit.*, July 4.

Calculation of the Current Distribution of Electric Railways.—Pforr.—A communication in which he replies to the criticism of Brandt and corrects an error in a diagram of his own article.—*Elek. Zeit.*, July 11.

How to Make Non-Paying Roads Pay.—Cooper.—A continuation of his serial in which he discusses this question in relation to the standardizing of apparatus.—*St. R'y Jour.*, Aug. 3, and Int. Ed., Aug.

Installations, Systems and Appliances.

110 versus 220-Volt Installations.—Mueller.—A communication in which the writer, the chief engineer of Schuckert & Co., discusses the question of why engineers build plants with 220 volts at the consumers' terminals? The only point in their favor is that less copper in the line is required so that the total plant is 10 to 20 per cent cheaper than a 110-volt plant. On the other hand, there are many disadvantages of the 220-volt pressure, especially where the current is used mainly for incandescent lighting. A comparison of 110 and 220-volt incandescent lamps shows that the latter consume in the average ⅓ watt more per candle and have a shorter life besides. Moreover, the smallest 220-volt lamp is a 16-cp lamp. For arc lighting in general 110 volts are better, as many consumers burn only two or three arc lamps, while to use up 220 volts four or five arc lamps are required. Although the 110-volt pressure is not at all dangerous, this cannot be said, under any circumstances, of 220 volts. Some accessories in the wiring are therefore more expensive for the latter pressure. Only in plants where many motors and comparatively few lamps are in use is the higher voltage of 220 volts preferable. He says that in many cases where the installation had been made at 220 volts, great hopes were entertained that in a short time 220-volt lamps would be just as good as 110-volt lamps. He thinks that this will never be the case, as the thicker carbon filament of the 110-volt lamps will always be stronger and therefore stand a higher temperature and give a better efficiency. Any improvements would affect the 110-volt lamp just as much as the 220-volt lamp. "The Nernst lamp is still an unhatched egg in practice, and should not play any part in cautious deliberations." He concludes that 220-volt installations have become a fashion (in Germany).—*Elek. Zeit.*, July 18.

REFERENCE.

Protection Devices Against High Voltages.—Benischke.—An illustrated paper, read before the Elec. Soc., of Berlin; also an account of the discussion which followed. He describes a lightning arrester with a special magnetic device for making the interruption of the arc extremely rapid; also a protective device protecting against high voltages due to resonance phenomena.—*Elek. Zeit.*, July 11.

Wires, Wiring and Conduits.

REFERENCE.

India Rubber.—A long and quite detailed article on the preparation and treatment of india rubber.—*Archiv. f. Post. u. Teleg.*; abstracted at some length in *Elek. Zeit.*, July 4.

Electro-Physics and Magnetism.

Electric Suction.—Lemstroem.—The blackening of a field of buckwheat blossoms by a thunderstorm is said to be a well-known but hitherto unexplained phenomenon. The researches of the present author on the transportation of water in capillary tubes under the influence of an electric current passing through the surrounding air, shed a new light upon it. He mounted a capillary tube in a beaker full of water which was connected to earth. At a few centimeters above the capillary tube he fixed the pointed negative pole of an influence machine whose positive pole was put to earth. When the machine was worked water was sucked up along the walls of the tube and formed drops near the top. The formation of drops was observed even when the distance between the pole and the level of the water was 75 cm. The suction of water continued at even greater distances. The amount of water sucked up is proportional to the current intensity, and that, again, is inversely proportional to the square of the distance between the point and the meniscus. The amount is also, for about the first three minutes, proportional to the duration of the current. Salt soltuions act like water when dilute, but the amount sucked up is smaller. The connection with plant life is obvious, since all the vegetable humors rise through capillary tubes.—*Ann. der Phys.*, No. 8; abstracted in Lond. *Elec.*, Aug. 2.

Electro-Capillary Phenomena.—Palmaer.—An account of an extended series of experiments made to examine the rival theories of Warburg and Nernst. His main results are as follows. In contradiction to the views put forth by Helmholtz, the electro-capillary observations made up to the present time do not lead to the conclusion that the time necessary for charging is of any influence. Warburg's explanation of the "drop electrode" leads to impossibly high concentrations of the mercury salt in the condensed layer. It is not possible by means of Warburg's theory to explain the descending branch of the capillary electrometer curve. By means of Nernst's theory many of the most important electro-capillary phenomena are satisfactorily explained by the application of the general theory of electrolytic solution pressure, without the use of new hypotheses. But this theory cannot yet explain all phenomena in the region of electro-capillarity. Some unexplained questions are, for example, the unsymmetrical shape of the capillary electrometer curve, different values of the maximum surface tension, the potential difference between mercury and solution at the point of maximum surface tension, etc.—*Ofvers. Afkgl. Vetensk. Acc. Forhandl.*, 1901, 2, p. 139; abstracted in *The Elec. Chem. and Met.*, July.

Theory of Ions in the Conduction of Electricity Through Metals.—Riecke.—A brief account of an experiment which he made in order to investigate whether positive metallic ions play a part in the conduction of electricity through metals. The apparatus which he used consisted of three equal cylinders, two of copper, the third of aluminum, the latter being placed between the two copper cylinders and the whole system being inserted in the charging circuit of a storage battery for a year. During this time 958 ampere-hours had gone through the cylinders. In an electrolytic cell they would have caused the deposition of 1.14 kg. of copper. Careful determinations of the weights of the single parts at the beginning and at the end of the year showed no variation of the weights. "The supposition, that in the conduction of electricity through metals movable positive metallic ions play a part, is therefore not correct."—*Phys. Zeit.*, Aug. 3.

Analogy Between the Nernst Incandescent Filaments and Gases.—Kaufmann.—He has shown that the electrodynamic behavior of conducting gases may be deduced from an empirical curve, the so-called "characteristic," which gives a relation between the e. m. f. at the ends of the gaseous interval and the intensity of current. For stability of equilibrium the condition must be fulfilled that the resistance of the remainder of the circuit is greater than the negative differential quotient of this e. m. f. to the current. Since these results are obtained independently of the unknown mechanism of discharge, it follows that they must be applicable to any conductor whatever. Thus a solid body possessing a "characteristic" similar to that of a gas, must show the same peculiarities, such as discharge potentials, minimum currents and intermittent discharges. The existence of these peculiarities in a Nernst lamp filament is proven, and the numerical data of the "characteristics" of this filament are given.—*Am. der Physik*, No. 8; abstracted in Lond. *Elec.*, Aug. 2.

Top Factor.—La Cour.—A brief critical remark on Benischke's suggestion to introduce the term "top factor" for the ratio of the maximum value and the effective value of an alternating wave for the characterization of the wave form (Digest, Sept. 8, 1900). He is not in favor of this suggestion, and tries to prove that the use of the form factor for the calculation of the maximum induction in some cases leads to wrong results. He also criticizes a special point in Benischke's calculations.—*Elek. Zeit.*, July 4.

Benischke.—A reply to La Cour's criticism, which he endeavors to refute.—*Elek. Zeit.*, July 18.

Magnetic Action of Cathode Rays.—Von Geitler.—While a magnet deflects a beam of cathode rays, the latter does not exert any corresponding action upon a magnet. There is an action, in fact, without a reaction. It has been explained by supposing that the return stream of cathode particles exactly neutralizes the action exerted by the cathode beam. Even if the cathode beam filled practically the whole of the tube, the return stream might pass along the wall and constitute an "inductionless winding." If, in such a case, a small magnet could be suspended in the cathode stream itself, it would prob-

ably show some deflection. That this is actually the case, has been proven by the present author who suspended a small magnet in a long and wide tube, in the center of the stream, and found a deflection such as would have been produced by the current passing if an ordinary conductor had been substituted for the tube. On bringing the magnet near the wall of the tube, a contrary deflection was observed.—*Ann. der Physik,* No. 8; abstracted in Lond. *Elec.,* Aug. 2.

Influence of the Form of the Pole-Pieces of Magnets Upon the Tractive Force.—Beneke.—A discussion of the question for which form of the pole pieces of a magnet the tractive force is a maximum. He assumes magnet poles with conical surfaces, the cross-section being shown in the adjoining figure. The question which he discusses

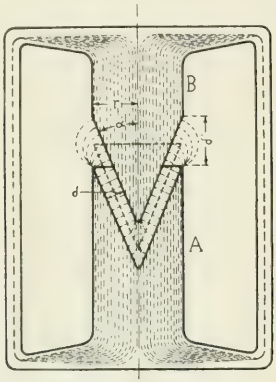


FIG. 1.—POLES WITH CONICAL SURFACES.

is: In what way does the tractive force depend upon the angle α shown in the figure? For which angle α is the tractive force a maximum? The case that the surfaces of the poles are plane and parallel is evidently a special case of this general case, namely, when the angle α is equal to 90 degs. He gives the analytical solution of the problem and applies it to a numerical example, the total ampere turns being assumed to be 7000. The results are given for cast steel and cast iron in the curves in the adjoining diagram. It will be seen that for plane parallel pole surfaces the nature of the material is of no influence ($\alpha = 90$ degs.), but for angles up to about 40 degs. cast steel gives a considerably higher tractive force than cast iron. The maximum of the tractive force is obtained for $\alpha = 20$ degs. with cast steel and for $\alpha = 28$ degs. with cast iron. The two curves represented by lines drawn out are calculated theoretically, the dotted line has been

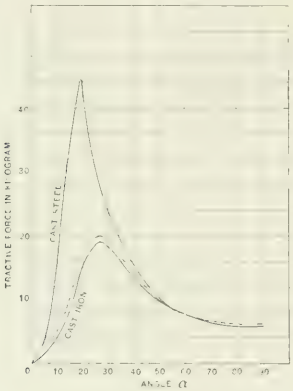


FIG. 2.—TRACTIVE MAGNET CURVES.

determined by experiment, and is in good agreement with the theoretical curve. Magnets based upon this principle are built by the Gen. Elec. Co., of Berlin, for many purposes, and have the advantages of smallness and great power. The ampere turns and the consumption of watts for a given tractive force are very small. Cast steel is used as the material.—*Elek. Zeit.,* July 4.

REFERENCE.

Terrestrial Magnetism.—The July number contains the programme of the international co-operation in researches on terrestrial magnetism in 1902 and 1903. A paper by Eschenhagen on a new form of the Lloyd scale. A paper by Neumayer on the mean secular change of magnetic declination for epoch 1890 to 1900. A brief paper by Cady on Wild's new metheod for determining the variation of magnetic inclination. A paper by Fraser on the unifilar magnetometer of the magnetic survey of India. A note by Watson on a graphical method for determining the *P* correction in the deflection experiment. A note by Bauer on the secular motion of the earth's mean magnetic axis, and a biographical sketch with portrait of Professor E. Mascart.—*Terr. Magn.,* July.

Electro-Chemistry and Batteries.

The Best Structure of Carbon Electrodes.—Haerden.—An article with illustrations showing microscopical photographs of the structure of carbon electrodes. The first picture shows a carbon, obtained from an American firm, which "is about the best that can be had in this line." Specific gravity 1.92, specific resistance 12 (referring to 1 square millimeter, 1 meter length, internat. ohm), conductivity 0.083; the loss in a 2 per cent sodium chloride solution 0.01 gram per square centimeter and per hour at 0.1 ampere. He further experimented with an electrode which had been made from a coarse anthracite mass with an addition of 30 per cent of tar, compressed under 250 atmospheres and baked. Later it was carefully graphitized in the absence of air. Specific gravity 1.44, specific resistance 27.75, conductivity 0.036, loss per square centimeter and hour at 0.1 ampere, 0.032 gram. He then experimented with an electrode which had been made in the same way as the one just described, but which had not been graphitized. Specific gravity 1.4325, specific resistance 69.91, conductivity 0.014, loss 0.0675 gram; this shows that by graphitizing the resistance is reduced to one-third its former value and the loss of to one-half. The figures show that the best structure, that of the American carbon, is one in which the single grains are well embedded in the intermedium. The main material and the intermedium are attacked equally and very little. This is not the case in the other carbons which show large pores, especially the graphitized carbon. He concludes that ordinary tar alone is not a suitable intermedium. He is experimenting to find out what material must be added to the tar. Experiments in which he tried to use molasses obtained from sugar plants as intermedium were not successful. Experiments in which he reduced the amount of intermedium by the application of high pressures gave better results. At a pressure of 350 atmospheres the amount of intermedium could be reduced by 40 per cent; but it was found that the following mechanical treatment became much more difficult. "The American carbon has been prepared without doubt under a very high pressure, and with a small amount of ordinary intermedium. This explains the uniform and small loss." Graphitizing alone, even when done very completely, is not sufficient.—*Elek. Zeit.,* July 18.

Effect of Gravity and Pressure on Electrolytic Action.—Ramsey.—He refers to the effect of gravity upon a cell, made in the form of a tube with the electrodes in the ends, the anode being dissolved and the cathode plated by the current. When the tube is vertical, the energy required for the transportation of metal from the anode to the cathode is greater than when the tube is horizontal. This effect must be visible in the counter e. m. f. He gives a review of the experimental work done in this direction, and also of the experimental work on the effect of pressure upon the e. m. f. The looked-for effect in the case of gravity has been obtained with a considerable degree of accuracy by using the chlorides of the metallic earths and with a much less degree of accuracy by using cadmium iodide. The effect of pressure on the more common forms of commercial cells gives results which accord with theory in a very remarkable manner. He then describes experiments of his own. He has investigated the effect of gravity in zinc and cadmium sulphates, and the effect of pressure upon cadmium cells and Clark cells.—*Phys. Rev.,* July.

Law of Mass Action for Strong Electrolytes.—Steinwehr.—A German Electrochem. Soc'y paper. It is well known that Ostwald's formula for the relation between conductivity and concentration (which is a direct consequence of the law of mass action) has been found to be in diagreement with the measurements in the case of strong electrolytes (KCl, NaCl, etc.). This has been considered as one of the weakest points of the dissociation theory. The present author starts from thermodynamical considerations and applies experimental results, obtained by Fanjung on electro-striction (i. e.,

the contraction of the solvent, due to the dissolution of an electrolyte), and those obtained by Arrhenius on the effect of the presence of neutral salts in the inversion of cane sugar. His purpose is to correct the values of the equilibrium constant for KCl and NaCl, determined by measuring the conductivity. While these values should be constant, they are found quite different. After he has applied his correction, however, the agreement is much better.—*Zeit. f. Elektrochemie,* June 6.

REFERENCE.

Electrolytic Reduction of Organic Compounds.—Hewitt.—A continuation of his serial on "Applications of electrolysis to organic compounds." In this part he deals with the large amount of work which has been done in the direction of electrolytic reduction of organic compounds. It has been carried out both in acid and alkaline solution, the results corresponding with those obtained by chemical means, but in some cases, for instance, the conversion of nitrobenize into paraminophenol, the electrolytic method is far preferable to the direct chemical method.—*The Elec. Chem. and Met.,* July.

Units, Measurements and Instruments.

Measuring the Energy of Three-Phase Motors.—Stern.—Measurements of the energy of three-phase motors are often based upon the assumption that in general the three phases of a motor have equal current and phase difference. The construction of meters more especially becomes simpler under this assumption than that of meters in which the energy of an unbalanced three-phase system is measured. He discusses two approximate methods: The "zero point method" and the "three-wire method." He shows that the error of a measurement with the three-wire method, with the use of two-line currents, is equal, but of opposite sign, to the error of a measurement with the zero point method, when the third-line current is used. He gives long calculations and an account of a series of measurements which he has made. He finds that both methods are very inexact, and the construction of meters or wattmeters should not be based upon them.—*Elek. Zeit.,* July 4.

Standard Cells.—Rupp.—A long account, with many tables, of an experimental investigation of the Clark cell and the Weston cell. He investigated the e. m. f. and internal resistance on open circuit, and the effects of small currents being taken out for a short time. He finds that, on the whole, the Weston cell is a more reliable standard cell than the Clark cell. A Weston cell is not injured when a current of 0.0001 ampere is taken out of it for several minutes; but this must not be done repeatedly, as otherwise the e. m. f. and still more, the internal resistance is changed.—*Elek. Zeit.,* July 4, 11, 18.

Electrical Black Body.—Lummer and Kurlbaum.—A description of their electrically heated "ideal black body," with which they proved that the total radiation of such a body is proportional to the fourth power of the absolute temperature. It consists of a double cylinder, the outer one being of platinum, which is electrically heated, while the inner one is of porcelain lined with a mixture of chromium, nickel and cobalt oxides, which resist temperatures of over 1500 degs. A thermocouple is introduced into the center of the inner tube to determine its temperature. A series of diaphragms, getting narrower towards the end, "lines the same tube." Thus the essential condition is fulfilled of having a hollow body with walls at a uniform temperature. If necessary, the inner tube is surrounded by two successive air chambers, the last being contained in an asbestos tube. Then a temperature of 1560 degs. may be obtained with a current of less than 100 amperes. At that point the porcelain used by the royal. Prussian porcelain factory begins to soften and acquire a conductivity which interferes with the readings of the thermocouple.—*Ann. der Physik,* No. 8; abstracted in Lond. *Elec.,* Aug. 2.

Prize Offered for a Speed Indicator.—The Grosse Berliner Strassenbahn has offered two prizes of $750 and $375 each for the first and second best speed indicator for electric cars. The conditions which have to be fulfilled include the indication of two or three maximum speeds by a visible or audible sign, simplicity of transmission motion from the axle of the car, low maintenance and easy adjustment. The device is to remain the property of the inventor, but the railway company is to have the right to have any number of them built for use on its cars, and of those of the companies controlled by it in Berlin, by paying a royalty of 10 marks each.—*St. R'y Jour.,* Int. Ed., Aug.

Telegraphy, Telephony and Signals.

REFERENCE.

Multiplier.—Seibt.—An article on "The theory of the multiplier for quick electric oscillations." The multiplier is a coil used by Slaby in his wireless telegraphy experiments for increasing the effect of the electric waves. The present author investigates its action mathematically.—*Elek. Zeit.,* July 18.

Miscellaneous.

REFERENCES.

British Electricians in Germany.—Continuations of the serials on the recent visit of the Brit. Inst. of Elec., Eng. to Germany. A well illustrated description of Siemens & Halske's cable works near Berlin, in Lond. *Elec.,* Aug. 2. Descriptions of the Nuremberg municipal electric station, the plant of Lahmeyer & Co. in Frankfort, the municipal stations of Frankfort, Bockenheim and Weisbaden in Lond. *Eng'ing,* Aug. 2.

Paris Exposition.—Reyval.—An illustrated description of a 60-kw. three-phase alternator of the inductor type, exhibited by Shutter & Harle. The e. m. f. at the terminals is 5200 volts.—*L'Eclairage Elec.,* June 22.

Reyval.—An illustrated description of machines exhibited by Smit & Co., of Slikkerveer. Direct-current dynamos of 65 kilowatts and of 28 kilowatts, direct-current motors of 4 horse-power and 13 horse-power, a 40-kilovolt ampere, three-phase transformer, and a 10-hp three-phase induction motor.—*L'Eclairage Elec.,* June 29.

Reyval.—Illustrated descriptions of a 1000-kw, 550-volt direct-current dynamo of Siemens & Halske, of Vienna; also of machines exhibited by Rieter & Co., of Winterthur; a 45.5-kw direct-current dynamo, a 25-hp railway motor, a 30-kw three-phase transformer, and two three-phase induction motors, the one of the "variable resistance in armature" type with brushes, the other of the short-circuited armature type.—*L'Eclairage Elec.,* July 6.

New Books.

Nature's Miracles. Familiar Talks on Science. By Elisha Gray, Ph.D., LL.D. Vol. III. Electricity and Magnetism. New York: Fords, Howard & Hurlburt. 248 pages, illustrated. Price, 60 cents.

This is a very readable little volume that requires no trained technical mind for its enjoyment. It is a sort of historical sketch of different electromagnetic industries made with considerable accuracy, some autobiography and a plentiful suspicion of humor. The author was the inventor of the harmonic multiplex telegraph, and a distinguished worker in the early development of the telephone. It was the author, in fact, who contested with Bell the first development of the telephone in the United States. This and a number of interesting stories elucidate and render agreeable the description of electrical apparatus and its modes of operation. It is pleasing to see how much amusement and vivacity may be scattered through the text of a really instructive volume without marring its style or palling upon the reader.

The authorship of the following is not stated, perhaps from modesty:

"Time was when one must hold his ear
Close to a whispering voice to hear,
Like deaf men nigh and nigher;
But now from town to town he talks,
And puts his nose into a box,
And whispers through a wire."

It is impossible to take the book up without being interested, and it is impossible to take an interest in the book without being instructed.

Practical Electrical Testing. By G. D. Aspinall Parr, Asso. M. I. E. E. London and New York: Longmans, Green & Co. 392 pages, 231 illustrations. Price, $2.50.

This work is intended to be used in connection with a systematic course in that part of electrical laboratory work which, in this country, is generally carried on in the physical laboratories. The testing of dynamos, motors, transformers and other engineering apparatus is not dealt with. The book is about equally divided into two parts—the second part being termed an appendix.

The first part gives directions for performing 120 experiments. The experiments consist in absolute measurements, or comparative determinations of resistance, of e. m. f., of current, of quantity, of

capacity, of specific inductive capacity, of permeability, of hysteretic loss, and of self and mutual inductance. To this list should be added the determination of those terrestrial magnetic elements whose uncertainty of magnitude and direction is, to a large extent, responsible for the ever increasing adoption of the D'Arsonval galvanometer.

The directions for performing the experiments are in each case given under the following four heads: Introduction, Apparatus, Observations and Inferences. Under "Introduction" is given a discussion of the theoretical considerations which pertain to the test. Under "Apparatus" is given a description of the apparatus to be employed in the test. Its proper magnitude or sensitiveness is often mentioned. Under "Observations" is given a diagram of the connections, specific directions as to the routine of performing the test, and a tabular blank to be copied and filled in as the test progresses. Under "Inferences" are given a few suggestions as to where a student should direct his thoughts.

The appendix is divided into three parts. The first gives the mathematical deduction of all those formulas which have been previously employed and were at all obscure. The second part describes the apparatus which is used in performing the tests. These descriptions are illustrated by means of half-tones or wood cuts. Some of the apparatus is that constructed in or for the author's laboratory. Some also is well known through the catalogues of instrument dealers. The third part consists of a few tables of physical constants. The subjects of these are resistivities, specific heats, electro-chemical equivalents, e. m. f.'s of Clark cell, e. m. f. and internal resistance of cells, relation between practical and absolute units, molecular conductivity of solutions and useful data. There is also appended a table of logarithms, natural tangents, squares of numbers, reciprocals of numbers, and double square roots.

The methods described in this book are in nowise original. The book as a whole, because of its arrangement is admirably adapted to its use as a laboratory handbook. The use of blank forms, to be filled in by the student, seems to be the only practical method where large classes abound. It would be better if the student could be made to do his own tabulating. It is questionable, however, if he does not learn more from filling in the blanks of a well designed table than from poorly designing his own table.

BOOKS RECEIVED.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Vol. XVII. New York: American Institute of Electrical Engineers. 822 pages, illustrated.

DENTAL ELECTRICITY. By Levitt E. Custer. Dayton, Ohio: U. B. Publishing House. 531 pages, 208 illustrations. Price, $4.

HIGH-TEMPERATURE MEASUREMENT. By H. Le Chatelier and O. Boudouard. Translated by George K. Burgess. New York: John Wiley & Sons. 230 pages, 52 figures. Price, $3.

HOW TO BECOME A GOOD MECHANIC. By John Phin. New York: Industrial Publication Company. 68 pages. Price, 25 cents.

A HAND-BOOK FOR APPRENTICED MACHINISTS. By Oscar J. Beale. Providence, R. I.: Browne & Sharpe Manufacturing Company. 141 pages, illustrated.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Buffalo, Sept. 10, 11 and 12, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September 2,3 and 4, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

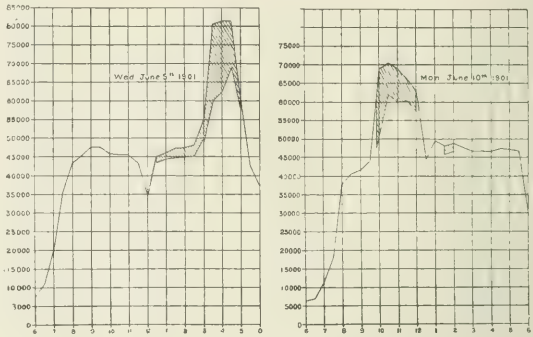
OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., October, 1901.

Storage Batteries in Central Stations.

Among the many problems which confront the manager of a central lighting station, one of the most troublesome, especially during the summer season, is that which is caused by the sudden load thrown on the station by a thunderstorm—the overcast sky causing thousands of lights to be turned on for a period of from half an hour to possibly several hours. This creates a peak for which no preparation has been made necessitating firing up an extra boiler and starting additional generating units—all of which takes considerable time and possibly by the time steam is generated, the storm has broken, and the necessity for extra work has passed.

In no way can the usefulness of an installation of chloride accum-



FIGS. 1 AND 2.—CURVES SHOWING OPERATION OF BATTERY.

ulators be better shown than in just such an emergency load, and the accompanying diagrams, which show their operation in the battery stations of the Chicago Edison Company on a dark day, are striking illustrations of the manner in which the battery "helped them out."

Fig. 1 is a curve showing the operation of the battery on June 5, 1901, and Fig. 2 that of June 10. Both of these curves show in the shaded portions the work done by the battery.

Another instance of the instant availability of the storage battery to tide over sudden emergencies in central stations was described and illustrated on page 254 of last week's issue. Oddly enough, the same plant was concerned in both cases. These records show the value of a storage battery plant in connection with an electric lighting system.

Eight Horse-Power Gasoline Carriage.

Mr. A. L. Riker has worked out for the Electric Vehicle Company, of New York City, a new form of gasoline automobile for touring purposes, herewith illustrated. It will maintain, if needed, a speed of 25 miles an hour on level roads, and is good for any hill on the low gear. It is freely used for runs of 100 and 150 miles.

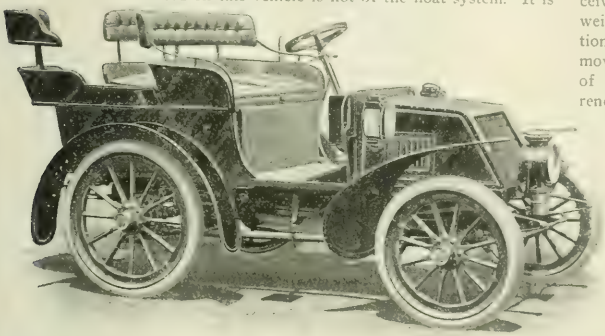
This vehicle is equipped with a Riker vertical, double-cylinder, water-cooled gasoline engine, developing 8 horse-power at 900 r. p. m. The engine consists of two 4 by 4 cylinders, attached directly to the body at its forward end, and covered by the usual form of engine bonnet. All moving parts are thoroughly protected from dust and dirt, and are easily accessible for inspection and adjustment. Enough gasoline, lubricating oil and cooling water are carried on board for a run of 150 miles under ordinary conditions. The complete weight of the vehicle with tank all full is approximately 1700 lbs. The main seat is of ample width for two occupants, and the projecting platform behind the seat is arranged to take a tonneau body, accommodating two passengers or a rumble seat for an attendant. If desired, however, this rear space can be used for carrying touring trunks. The change gear system provides for three speeds ahead and one backward. The reductions are approximately 16 to 1, 7 to 1 and 4 to 1. Any gradation of speed between zero and the maximum can be obtained by means of the clutches and the igniter and throttle levers carried on the steering wheel spindle.

The body is carried from the main running gear on two full elliptic springs in front and two half elliptic spring behind, and is of platform, angle iron construction, so made that the seats can be

stripped off without interfering with the operating levers, leaving a plain platform. The transmission gearing is contained in one housing, which is also slung from the body immediately in the rear of the engine, being coupled to the engine shaft by a flexible coupling, relieving both the engine and gear shafts of any cramping due to springing of the body. The system of gearing used on this vehicle is of the friction clutch type, and is entirely pedal-operated. There are two pedals located on the floor capable of being oscillated forward or backward by the toe or heel of the operator's foot. A forward motion on the left pedal operates the high gear and a backward motion operates the middle gear. These are the only two that have to be used on all ordinary running, as the vehicle has an engine of such power for the weight of the vehicle that it is very rarely the low gear has to be resorted to.

The system employed is of the usual type, including the pump, water tank and radiating coil. The construction of the cooling coil is so arranged that individual tubes can be readily removed and replaced in case of a leak, which is not the case with most types of cooling coil. The lubrication of the entire motor is automatically taken care of from one oil valve which feeds oil into both cylinders and crank case. No attention other than the opening of this valve to a certain fixed point and keeping the oil tank full is necessary. The gear case is oil tight, and when once supplied with oil will run for weeks without any attention. The outboard sprocket bearings are automatically ring oiled.

The atomizer used on this vehicle is not of the float system. It is



8-HP GASOLINE AUTOMOBILE.

said to be simpler, has fewer working parts, and overcomes the difficulty sometimes met with in the float type of atomizer on variable speed engines where the limits of variation of speed are very wide. The engine on this vehicle can be run from 200 to 2000 r. p. m. without any appreciable variation in the quality of the mixture obtained from the atomizer. The ignition is obtained by means of a jump-spark, and permits the advancing or retarding of the point of ignition as may be desired by the operator. Primary batteries with an improved and perfected type of induction coil are used, there being two coils, one for each cylinder.

This vehicle is equipped with two brakes; one, pedal, working on drums on each of the rear hubs, the second hand operated and working on a band around the balance gear on the counter-shaft.

The steering is accomplished by means of a wheel. The main controlling levers, aside from the two which are pedal operated for change gears consist of one for varying the time of ignition and one for operating a throttle on the engine. These two levers are located at the side of the steering post immediately below the steering wheel —the left hand one operating the igniter and the right hand one the throttle.

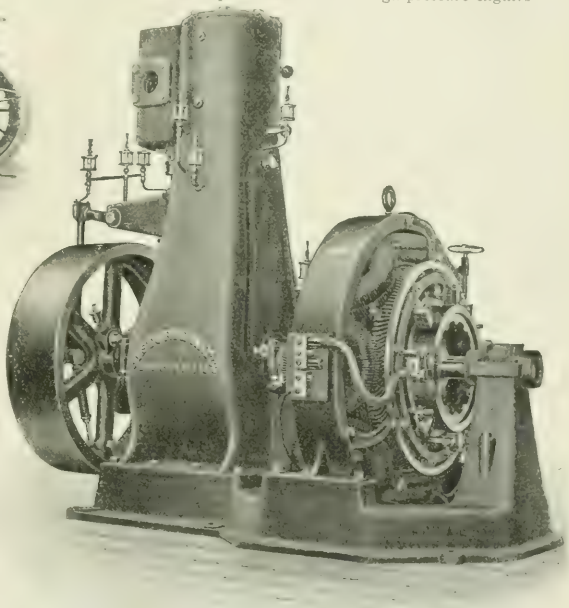
No attempt has been made on these vehicles to time the point of ignition automatically by means of a governor. For high speeds, of course, it is necessary to advance the point of ignition beyond this, so called, neutral point, and the igniter lever then gives a very easy means of obtaining any desired speed. The lubricating oil tank is located at one side of the engine, and is so arranged as to be very easily filled. The water tank stands immediately in front of the dash inside of the engine bonnet, but can be filled without removing the latter. The gasoline tank is in the body under the operator's seat. The vehicle is equipped with wooden wheels throughout with 28 by 3-inch double tube tires in front and 32 by 3-inch double tube tires in the rear.

New Railway Signal.

George W. Cohen, of Allegheny, last week gave a practical demonstration of a new electric railway signal system before a number of prominent railroad officials, which is claimed to be likely to revolutionize signaling in the future. Mr. Cohen's plan provides for a signaling apparatus operated by electricity without a continuous track circuit. He uses a metal shoe, which comes in contact with the wheels and operates the signals. When this shoe comes in contact with the wheels it also operates a telephone system, by which the train dispatcher is enabled to communicate with the conductor or any trainman on the moving train, so that the work of clearing the main line in case of a wreck or any other accident can be greatly facilitated. The demonstration took place in a large hall in Allegheny City, which Mr. Cohen had had fitted up for this occasion. Several railroad men witnessed the test.

A New Sturtevant Generating Set.

A new design of generating set built by the B. F. Sturtevant Company, of Boston, Mass., is illustrated in the accompanying cut. The engine is of the single-cylinder vertical type, and of very substantial construction. The frame and cylinder are cast and bored in one piece, the design being such as to combine the maximum of rigidity and accessibility. The valve is of the balanced-piston type, and receives its motion through a rocker, from a pin on the governor weight, which is so pivoted to the wheel that a change in the position of the weight causes the pin to swing across the shaft. This movement changes the travel of the valve and regulates the points of cut-off and compression, and the perfect balance of the valve renders such action both rapid and effective. High-pressure engines



GENERATING SET.

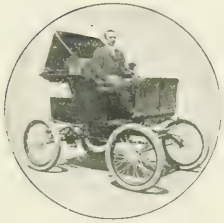
of this type are built in seven sizes, and designed for 90-lb. boiler pressure. A similar line of four sizes of low-pressure engines designed for 40-lbs. pressure are also built.

The generator is of the eight-pole type, primarily designed by the Sturtevant Company as a motor for direct connection to centrifugal fans. The large diameter and relatively low speed of rotation particularly fits this design for attachment to an engine of this type. The entire arrangement is rendered very compact, the length in the direction of the shaft being reduced to a minimum. With the exception of the smallest size; wrought iron field cores are used in these generators. These cores are secured to the frame by bolts and are readily detachable, thus rendering the removal of the field coils a

very simple matter. In the smallest size the field cores are cast solid to the frame and the pole shoes only are removable.

The armature is usually of the barrel wound toothed, hollow drum type, the laminations of special steel plate being mounted on a cast-iron spider, the hub of which is extended to support the commutator, thus making the armature and commutator self-contained and specially adapted for direct connection. These generators when subjected to exhaustive tests have shown that after a full-load run for a sufficient length of time to attain the maximum temperature, the latter rarely exceeds 30 degs. C. on the hottest part. The open type and ample ventilation serves to keep the temperature at a minimum.

A Record Automobile Run.



A remarkable automobile endurance run was recently made from Chicago, ending Aug. 7, in which a distance of 187½ miles was made on one battery charge, the rig weighing 1200 lbs. and the battery 600 lbs. The motor-running gear, including the ball bearings, were made by the Baker Motor Vehicle Company, of Cleveland, Ohio, the motor by the Elwell-Parker Electric Company, of the same place, and the battery by the Porter Battery Company, of Chicago.

The accompanying illustration shows the vehicle, which is an electric Stanhope. The battery is of the pasted plate type and indicated a total discharge of 396 ampere-hours for the trip. The run was begun at 5.38 a. m. of Monday, Aug. 5, and there was a stoppage of four hours for sleep and five hours for meals and to repair a punctured tire. On a previous trial in July with the same vehicle and a battery weighing 350 lbs., a run of 151 miles was made on one charge at an average speed of 10.91 miles per hour. On this run the average grade is stated to have been 3 per cent, with strong head winds at times, and some of the distance was made with a punctured tire.

The manufacturers of the Porter battery, with which this run was made, state that its weight is but 52.2 lbs. per horse-power hour, and they offer a guarantee of five years' life at $34 per year.

Exhibit of Exhaust Steam Utilization.

Managers of electric and power companies are showing much interest in the exhibit of the American District Steam Company, located in the north end of the Machinery and Transportation Building at the Pan-American Exposition, as shown in the accompanying

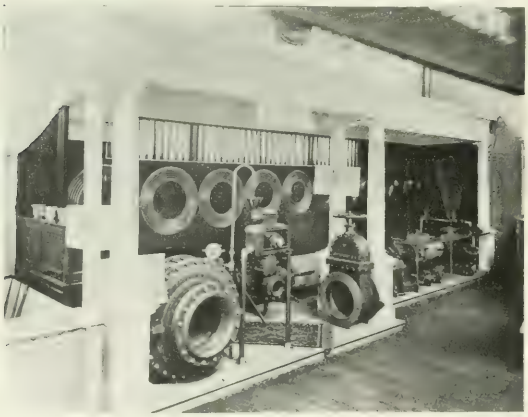


EXHIBIT OF EXHAUST STEAM APPLIANCES.

illustration. The above company is the pioneer and patentee of this system of underground steam distribution, and has had years of experience in constructing plants in different cities of this country and abroad. It has in operation over 200 of these plants, with apparatus of the nature exhibited at Buffalo.

During the past year its business has increased to such an extent that it has found it necessary to enlarge its manufacturing facilities, and has just now completed a very large factory at North Tonawanda, N. Y., within sight of the Exposition.

The company has gotten out a very good map of the Pan-American grounds, and visitors calling at its exhibit are furnished with a copy. The main office and works of this company are at Lockport, N. Y., with branch offices in Chicago and New York.

McRoy at the Pan-American.

The McRoy Clay Works, of Brazil, Ind., exhibits at the Pan-American some of its 6-ft. length conduit laid and joined to a manhole wall as in actual work. The attractiveness of the exhibit has

UNDERGROUND CONDUIT EXHIBIT.

also been greatly increased by the addition of a number of large photographs showing important work under construction in various cities with McRoy conduit duct. John T. McRoy, president of the company, has been a frequent visitor since the Exposition opened.

A Historical Exhibit of Motor Controlling Devices.

The Cutler-Hammer Manufacturing Company, from a historical standpoint, has the most interesting commercial exhibit at the Pan-American Electricity Building. Although the historical collection of rheostats and motor-controlling devices goes back only about 10 years the early types look exceedingly crude to modern eyes, nearly all being enclosed in wood boxes. From 1890 to 1893 the advance was rapid, but since that time changes have not been so pronounced.

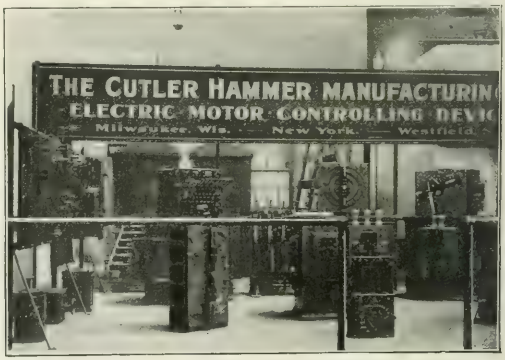


EXHIBIT OF RHEOSTATS AND CONTROLLING DEVICES.

Among the modern apparatus made by the company, motor starters with time element attachments are prominent. The exhibit, though occupying considerable space, is unobtrusive, and likely to be missed by the casual observer, though it is well worth spending some time on.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2@3 per cent; time money, on mixed collateral, 4@4½ per cent, and commercial paper, which was more active, 4½@5 per cent for prime double names. In the stock market prices were not materially affected by the extension of the steel strike, the transactions being, in the main, of a professional character. United States Steel stocks were the principal features of the market. Tractions were firm, though not especially active. The sales of Brooklyn Rapid Transit for the week were 13,615 shares, the range of prices being between 73 and 75¾. Metropolitan Street Railway was quiet at figures ranging between 164 and 168¼. General Electric was rather inactive, the sales amounting to only 3600 shares, quotations ranging from 249¼ to 264, the latter being the closing figure on Friday. Interest in Western Union was maintained, quotations ranging between 91½ and 93¾. Following are the closing quotations of Aug. 19:

NEW YORK.

	Aug. 13.	Aug. 19.		Aug. 13.	Aug. 19.
American Tel. & Cable..			General Carriage	1	[illegible]
American Dist. Tel.....		-	Hudson River Tel....	120	120
Brooklyn Rapid Transit..	74½	74¼	Illinois Elec. Veh. Trans.		-
Commercial Cable.....	-		Metropolitan Street Ry	166	166
Electric Boat.....	17	18	N. E. Elec. Veh. Tran ..		—
Electric Boat pfd.....	40	40	N. Y. Elec. Veh. Tran...	10	10¼
Electric Lead Reduc'n...	1½	1½	N. Y. & N. J. Tel	170	168
Electric Vehicle.....	5½	5½	Tel. & Tel. Co. of Am...	3	3
Electric Vehicle pfd.....	10	10	Western Union Tel.....	93	93⅛
General Electric.....	253	263			

BOSTON.

	Aug. 13.	Aug. 19.		Aug. 13.	Aug. 19.
Am. Tel. & Tel.....	160	161	Mexican Telephone..	2	2⅛
Cumberland Telephone...	—	—	New England Telephone.	-	
Edison Electric Light...	*255	*256	Westinghouse Elec.....		
Erie Telephone.....	46	48	Westinghouse Elec. pfd..		
General Electric pfd.....	—				

PHILADELPHIA.

	Aug. 13.	Aug. 19.		Aug. 13.	Aug. 19.
American Railways.....	40	40	Phila. Traction.....	95¼	95¼
Electric Storage Battery.	70	75	Philadelphia Electric.....	5⅞	5
Elec. Storage Batt'y pfd.	70	75	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	7⅛	7¼	Pa. Elec. Veh. pfd..	4	3¼

CHICAGO.

	Aug. 13.	Aug. 19.		Aug. 13.	Aug. 19.
Central Union Telephone	—		National Carbon pfd.....	83	83
Chicago Edison.....	160	155	Northwest Elev. com....	47	36
Chicago City Ry.....	201	201	Union Traction	15⅝	15½
Chicago Telep. Co.....	*273	*273	Union Traction pfd.....	58	59
National Carbon.....	17	17			

*Asked.

WESTERN UNION RUMORS.—The *Mail and Express* says: "The reports about a possible consolidation of Western Union, Postal Telegraph and Bell Telephone interests are based on the following facts which are vouched for by a high authority: Recently persons understood to represent the American Telephone & Telegraph Company, which is the name of the general Bell Company, made an informal proposition to the Western Union Telegraph Company to merge the three great companies above referred to. The Bell people, it is said, realized that independent telephone movements were making serious inroads into their particular field and something must be done to check this rivalry. It was thought that an alliance with the telegraph companies would present such a strong front that independent telephone projects would thereafter be unable to make any progress, while the Bell Company, Western Union and Postal Telegraph companies would all benefit from the union. Mr. Gould did not think well of such an alliance with telephone interests, but it is believed that if anything is done it will be a merger of Western Union and Postal Telegraph properties. It is said he is satisfied that if it desires to, the Western Union can easily branch out into the telephone field on its own account. For some time there has been a plan on foot for the Western Union to establish a long-distance telephone service, and some of the new bonds are believed to have been issued for this purpose." The *Mail and Express* does not seem to see that such a telephone alliance scheme would do far more to fan to fever heat the "independent telephone" enthusiasm than to quell it, and would probably hurt the Western Union most seriously.

PARALLELING NEW YORK CENTRAL.—The Utica, N. Y., City Common Council, after a number of protracted discussions and several public hearings, has granted a franchise to the Cleveland, Ohio, syndicate, which recently acquired control of trolley lines in and around that place, whereby that corporation is placed in a position to offer the New York Central road serious competition. The Council granted permission to lay a double track in Bleecker Street, the main highway running eastward through the city. This means the paralleling of the New York Central tracks from Little Falls on the east to Oneida on the west, a distance of 50 miles. Four hundred men are at present engaged in extending the line westward from Utica, while 250 laborers are building a roadbed eastward from the city line. On the west the new road will pass through Oriskany, Rome, Verona and Oneida, and on the east, Frankfort, Ilion, Mohawk, Herkimer and Little Falls. Eighty pound rails are being laid and $75,000 worth of new rolling stock has already been ordered. The men who control this enterprise are in Standard Oil, and are interested in the Wabash Railroad, which now has a line east to Buffalo. Ever since the completion of the road its owners are said to have been embroiled with the Vanderbilts over the connections with New York and Boston.

BOSTON LIGHTING CONSOLIDATION.—Changes made in the board of directors at the annual meeting of the Boston Electric Light Company, held last week, practically completed the consolidation of the Boston Company with the Edison Electric Illuminating Company under the name of the latter. Instead of re-electing the old board the stockholders chose C. L. Edgar, W. C. Baylies, T. J. Coolidge, Jr., George Dexter, C. Minot Weld, Henry B. Cabot, Edward B. Maltby, Isaac T. Burr, and Edward W. Burdett. Of these the first six represent the Edison Company, the last three were president, vice-president and treasurer and counsel of the Boston Company. Mr. Burdett was elected treasurer and clerk, of the Boston Company. He will also be retained as counsel in the Edison Company. The Boston Electric Light Company presented to the stockholders a balance sheet showing assets of $5,646,377 on June 29, and liabilities of $1,396,377, in addition to $3,000,000 capital stock and mortgage bonds aggregating $1,520,000. The gross income of the old company for the year was just over $1,000,000, and the net profit $491,000.

PHILADELPHIA UNION TRACTION.—The report of the Union Traction Company for the year ended June 30 will show an increase in passengers carried of about 10,000,000, which would bring the figures up to over 302,000,000. It is probable that the actual figures will be in excess of these. For the 1899-1900 year the receipts from passengers were $12,996,291, or over .0444 per passenger. The present average receipt per passenger is about 4½ cents, and 10,000,000 additional fares should increase the gross receipts by $450,000, making the total passenger receipts around $13,500,000. Operating expenses last year were 42.28 per cent. Taking 32¼ per cent for convenience in figuring, as the operating ratio, the expenses would be $5,700,000, leaving a net of $7,800,000, compared with $7,371,393 for the preceding year. A surplus rather less than $1,000,000 will be shown. The estimated number of passengers carried last year, 302,000,000, compared with the city's population of 1,293,697, shows that every person in the city rode 233 times during the year.

WESTINGHOUSE ELECTRIC.—An official of the Westinghouse Electric Company is quoted in Boston as saying: "It is impossible to give any accurate figures at the present time, but our company during present fiscal year will make an exceptionally fine showing. Earnings during the six months were by far the largest in our history and there is every reason to believe that a new record will be established during the next half year."

ELECTRIC COMPANY OF AMERICA.—Announcement is broadly made of the purchase of the Auburn, N. Y., Electric Light Company, for which negotiations were about completed by the Electric Company of America at the time of the recent purchase of the Canton, Ohio, plant. It is stated on official authority that the information that the U. G. I. Company has liquidated its remaining interest in the E. C. A. Company is correct.

CENTRAL UNION TELEPHONE directors have decided to reduce the present issue of capital stock one-half, and increase the capital stock so reduced 100 per cent, which will bring into the treasury substantially $3,500,000 in cash. The matter will be put before the stockholders at once for the necessary action.

AMERICAN ELEVATED RAILROAD stock is being pushed on the curb in New York City. It is alleged that the company has something to do with a franchise for an electric elevated line from downtown to Harlem, along Broadway, with a single rail method of operation. Osborn Conjelton is the president of the company.

DIVIDENDS.—The Metropolitan West Side Elevated, of Chicago, has declared a dividend of 2 per cent on the preferred stock, payable Aug. 31. American Railways Company has declared a dividend of 1 per cent, payable Sept. 16, to stock of record Aug. 30.

RAILWAYS COMPANY GENERAL.—A meeting of the Railways Company General stockholders will be held Sept. 30 to vote on the proposition to reduce the capital stock from $1,500,000 to $1,200,000. The plan is to give four shares in a new $10 paid stock for 10 shares of the present $5 paid stock; or, in other words, to exchange on the basis of 80 per cent for each 100 per cent of present holdings. This means:

Reduction of capital	$300,000
Present capital	1,500,000
New valuation	$1,200,000
Old.	
Capital (par $5)	$1,500,000
Shares (par value)	300,000
New.	
Capital (par $10)	$1,200,000
Shares	120,000

The company earned a dividend last year, and if the reduction in capital plan is authorized, a dividend of 4 or 5 per cent will probably be declared on the new capital. An inventory of the company's property as of June 30 showed assets valued at $1,220,133. The proposed reduction in capital is merely for the purpose of bringing the stock liability down to this basis.

CHICAGO ELEVATED ROADS.—It is stated from Chicago that reports are in persistent circulation that the Metropolitan and South Side Elevated Railroad companies will be consolidated within a brief period in an alliance for mutual advantage and protection against the Northwestern Consolidated. The two roads are now said to have in contemplation a joint invasion of the Stock Yards district, and both companies are known to have made surveys and secured estimates of the cost of lines to that territory. The rumored scheme, while not admitted by the officials of the roads, is asserted by persons in touch with the companies to consist of a plan for an extension by the Alley Elevated from Thirty-ninth Street to the yards at Halsted Street, and by the Metropolitan from the turn of the Douglas Park Division southward, crossing the river at Ashland Avenue and connecting with the South Side at Halsted Street, where the two lines are to combine with a stem running two or three miles south into Englewood. Both the elevated railroad companies see a menace in the quiet efforts of the American Railway Company to get into the Chicago transportation business. The application for a franchise, pending in the City Council, has aroused this concern.

HUDSON VALLEY TROLLEYS.—A certificate of consolidation of the Glens Falls, Sandy Hill & Fort Edward Street Railway Company, the Warren County Railway, Stillwater & Mechanicville Street Railway Company, Greenwich & Schuylerville Electric Railway Company, Saratoga Traction Company and Saratoga Northern Railway has been filed with the New York Secretary of State. The title of the consolidated company is the Hudson Valley Railway Company, and its capital is $2,600,000. The company will control the electric railway systems from Troy to Lake George. The officers of the company are Addison B. Colvin, president; Senator George E. Green, vice-president; Thomas O'Connor, secretary, and F. B. Cowles, treasurer.

THE GENERAL ELECTRIC COMPANY has extended the period for the exchange of preferred stock for common stock up to and including Aug. 31. There is remaining outstanding but a very small amount of preferred stock, but it is considered very advisable that all owners of the preferred stock should exchange for common stock and there may be no further opportunity to do so after Aug. 31.

Commercial Intelligence

THE WEEK IN TRADE.—Reports to the Mercantile agencies indicate a satisfactory condition of trade generally. There was an improvement in both tone and demand, and fall trade may be said to have opened actively. Reports of the crop conditions were more cheerful, and the outlook is now more satisfactory. The Steel strike caused some dulness and cancellations, but not to the extent feared earlier. The industrial situation, if not better as regards the steel strike, is certainly no worse. Railway gross earnings for the first week of August show a gain of fully 11.4 per cent over last year, which points to the increase of 13.3 per cent on roads for July being maintained in the current month. *Bradstreet's* reports the number of failures for the week at 178, against 185 the previous week and 168 the corresponding week last year. *Dun's Review* computes the liabilities of the concerns failing for the two weeks of August at $1,785,466, against $1,510,177 the corresponding week last year. In the metal market copper was very quiet. Consumers, generally, are holding off with purchases in the hope that later on they will be able to secure supplies at lower figures. Consumption in this country is very heavy, and it is likely that manufacturers have nearly worked up their stock. Lake is quoted at 16½ cents; electrolytic, in cakes, bars or ingots, 16¼ cents; cathodes, 16 cents; casting stock, 15⅞ cents.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended Aug. 15: Antwerp—32 packages electrical material, $635; 33 packages electrical material, $4,121. Berlin—2 packages electrical machinery, $28. British Africa—1 package electrical material, $13. Brussels—1 package electrical material, $25. Bilboa—2 cases electrical material, $215. British East Indies—8 packages electrical material, $183. Bolton—1 case electrical material, $16. Barcelona—70 packages electrical material, $2,145; 1 case electrical machinery, $27. British West Indies—50 packages electrical material, $677; 2 packages electrical machinery, $39. Central America—19 packages electrical material, $69. Cuba—1 case electrical machinery, $60; 36 cases electrical material, $1,402. Chili—42 packages electrical material, $1,120; 8 packages electrical machinery, $450. Ecuador—1 case electrical material, $75. Glasgow—1 case electrical material, $50. Hamburg—55 packages electrical material, $2,024. Hayti—3 packages electrical material, $31. Havre—42 cases electrical material, $1,084; 2 cases electrical machinery, $50. London—80 packages electrical machinery, $3,070; 44 cases electrical material, $742. Leicester—2 cases electrical machinery, $75. Lisbon—2 cases electrical material, $188. Liverpool—82 packages electrical machinery, $7,980; 50 packages electrical material, $3,524; 1 package auto parts, $150. Mexico—4 packages electrical machinery, $325; 26 packages electrical material, $1,174. Manchester—6 packages electrical machinery, $410. Milan—17 packages electrical material, $350. New Castle—11 cases electrical machinery, $1,500. Nova Scotia—9 packages electrical material, $31. Peru—31 packages electrical material, $684. Santo Domingo—11 packages electrical material, $122. U. S. Colombia—16 packages electrical material, $282.

SPRAGUE APPARATUS ABROAD.—The Sprague Electric Company is receiving many orders for its apparatus from all parts of the country and abroad. Among a few recent orders are the following: Ninety-kw split-pole generator, shipped to Bailey, Walker & Co., Buenos Aires, S. A.; 125-kw split-pole generator, Steelton Light, Heat & Power Company, Steelton, Pa.; 37½-kw split-pole generator, Ft. Wadsworth, Staten Island; 37½-kw engine type generator, Ft. Hancock, N. J.; 80-hp motor, American Linseed Company, Staten Island; 100-kw engine type split-pole generator, Geuder & Paeschke Manufacturing Company, Milwaukee; 50-kw generator and 15-hp motor, Roe & Conover, Newark, N. J.; 85-hp motor, John Stephenson Company, Elizabeth, N. J.; 75-kw split-pole generator, Chase Rolling Mill Company, Waterbury, Conn.; 75-kw split-pole generator, Fred Miller Brewing Company, Milwaukee; 100-kw, 550-volt split-pole belted type generator, Plymouth Mills, Plymouth, Mass.; 100-kw belted type split-pole generator, C. S. Ashley, Toledo, Ohio; 100-kw, 550-volt, belted type split-pole generator, and various motors up to 50 horse-power, T. C. Keller, Chicago; a quantity of motors for the mines and refining plant of the Arlington Copper Company, Arlington, N. J.; 100-hp motor, American Locomotive Company, Cooke Works, Paterson, N. J.; 60-kw split-pole generator, Fahys Watch Case Company, Sag Harbor, L. I.; two 25-kw engine type split-pole generators for Madison Square Garden, New York, and 100-kw split-pole engine type generator, Leland Hotel, Chicago.

THE NATIONAL ELECTRIC LAMP COMPANY, manufacturer of incandescent lamps, has opened a fine suite of offices in the Electric Building, Cleveland. J. B. Crouse is president of the company, and he is also president of the Crouse-Tremaine Carbon Company and the Fostoria Incandescent Lamp Company, of Fostoria, Ohio. H. A. Tremaine is vice-president, F. S. Terry secretary and B. G. Tremaine treasurer. There is naturally a good deal of interest in this concern, to which we have already alluded more than once; but one of the officers says: "The National Company is not yet ready to announce its plans and purposes."

TELEPHONE CONTRACT.—Mr. S. C. Platt, representing the Kellogg Switchboard & Supply Company, of Chicago, has closed a contract with the Richmond Telephone Company, Richmond, Va., for a new switchboard of 5600 subscribers' capacity, and for new telephones. The amount involved is said to be $50,000. The switchboard will be operated on the common battery system, and will be a fine example of the company's well-known system, now operating in several of the largest independent telephone exchanges in the country.

DEVELOPMENT IN IDAHO.—Mr. Walter Hovey Hill, member of American Society of Civil Engineers, of Grangeville, Idaho, is preparing plans and estimates for an electric railroad from Lewiston, Idaho, to Grangeville, Idaho, 80 miles. Water power is available at reasonable cost of development. Mr. Hill would like to hear from capitalists interested in such a road. The Grangeville Board of Trade and Lewiston Commercial Club are taking the matter up, and the project is meeting with hearty approval along the entire road.

THE SNOQUALMIE FALLS POWER COMPANY, of Seattle and Tacoma, has placed an order with the Pittsburg Reduction Company for 250,000 lbs. of aluminum wire cable, which will more than double the capacity of their transmission system. Co-incident with this the enlargement of the generating station at the head works is under way, and an additional pen stock will be installed, having 50 per cent more capacity than the first one. This pen-stock will feed three waterwheel sets, each one of which will drive a direct connected Westinghouse 5000-hp generator. The underground cavity will be extended eastward about 150 ft. to accommodate the increase. Contracts have been let also for terminal sub-station structures in Tacoma and Seattle, which will be occupied and in use about Jan. 1. The present quarters for distribution purposes are rented premises. Mr. Charles H. Baker, president of the company, in whose charge the engineering and construction work is, estimates that this increase of capacity will be available in about 10 months. The Snoqualmie plant when this increase is made will have a capacity of 25,000 horsepower, and will therefore, it would seem, be the largest water-power plant in the United States outside of Niagara. All the electric street cars, all the municipal and domestic lighting, flour mills, machine shops and industries where electric motors are employed in Seattle and Tacoma, are run by the Snoqualmie plant, and effort is now being made to induce the company to extend its lines to Everett, Wash., to handle the paper mill and smelter there and to improve the local lighting service.

JAPANESE ELECTRICAL TRADE.—United States Minister Buck has sent from Tokio a copy of a report on trade in Japan prepared by the British Legation. One part of it says: The United States continues to encroach on spheres of trade which were formerly considered under the exclusive control of the United Kingdom or other nations. American competition is now a permanent feature of the import trade of Japan, and is worthy of the carecul attention of British manufacturers. The geographical situation of the United States with regard to Japan and the eagerness with which American manufacturers are seeking a market in this country will make her a competitor more and more formidable as time goes on. In 1900, Americans again secured a number of valuable contracts for the delivery of goods in 1901, including one for rails, which was estimated at £72,000. Among the reasons for the very large figures to which the import trade from the United States into Japan rose in 1900 was the fact that the extensive orders, the execution of which was undertaken there in the preceding year, included 20,000 tons of rails, which at the high price then prevailing would account for, say, £160,000. A large quantity of electrical machinery for tram lines and electric lighting and bridge work and wire, as well as flour, are also included in the returns. Telephone cable was at one time a United States monopoly, but now German makers are fulfilling large orders for it. British manufacturers, owing to the high prices asked for, have so far been unsuccessful in obtaining any contracts for this material.

LONDON UNDERGROUND ROADS.—A special dispatch from London of Aug. 17 says: While Charles T. Yerkes has gone to Budapest to investigate the Ganz electrical system on behalf of the District Railroad, George Westinghouse, who sails for New York to-day on board the American line steamer "St. Paul," has gone home partly in the interest of the American capital of the Metropolitan Underground Railroad. The deadlock between these companies appears not to have been due to differences between Mr. Yerkes and the English owners of the Metropolitan Railroad, but the contest is between the two Americans for the control of either or both of the roads. Mr. Westinghouse, though not known here as a large stockholder of the Metropolitan Railroad, has the confidence of the managers, and suggested schemes for the electrification and enlargement of the road, that took hold of their imagination, as far more splendid than those of Mr. Yerkes. The shrinkage in British railroad dividends, consequent upon the steady and uncheckable depreciation of shares, is discussed by Robert P. Porter, in a letter to the *Times*, from the standpoint of electrical railroads, which already cause reduced profits. Mr. Porter finds that the only salvation is in electricity. He says: "For the purposes of concentrating the population in the morning and distributing it at night, the steam locomotive must give way to the electric. It is like putting a steam hamher in motion to crack a nut."

EXPORTS TO SOUTH AMERICA.—Mr. Frederic Emory, chief of the Bureau of Commerce, gives, in an article on "Our Trade with Latin-America," in *The World's Work*, the following statement of exports to South America: Barbed wire from the United States is one of our largest items of import into Argentina, and we have all the market in this line in certain sections of Brazil. Our sugar-mills and saw-mills are also winning the trade in Brazil, and our hardware, as well as our plows and reapers, are popular. The largest items of our exports of manufactures to Argentina consist of agricultural machinery and implements, railway and electric material; our motor cars are being introduced. In Chili also our trade in railway supplies is reported to be promising. In Colombia our coffee and sugar machinery, our hoes and machetes are preferred to all others, and our glassware and hardware, as well as our beer and wines, are popular. To Peru we are sending agricultural and mining machinery, clocks and watches, electrical apparatus, nails, bolts and screws, typewriters, bicycles, cotton goods. In Ecuador our axes, shoes, butter, brooms, bedsteads, canvas, clocks, perfumery, cutlery, stationery, hardware, firearms, scientific instruments, locks and canned goods compete well with those exported by other countries.

COAL EXPORTATIONS from the United States during the fiscal year just ended, as shown by the Treasury Bureau of Statistics, amounted to $22,317,496, against $19,502,813 in the fiscal year 1900, $13,661,028 in 1899, $11,008,643 in 1897, $10,646,062 in 1896, and $8,391,026 in 1891. Thus the value of coal exportations from the United States has doubled since 1897, and nearly trebled in the decade. These figures relate to values. Measured by quantity the increase has been even greater, the exports in 1901 being 7,676,149 tons, against 2,399,039 tons in 1891, thus making the total exports of 1901 in quantity more than three times as much as in 1891. The Unted States now stands third in the list of coal exporting countries of the world, coming after England and Belgium. The coal export figures of the principal countries of the world in 1899 show that while Belgium slightly exceeded the United States in the total number of tons exported, her imports were more than one-half as great as her exports, making her net exportation of coal much less than that of the United States.

OHIO DEVELOPMENT.—Mr. J. L. White, of the White Improvement Company, of Newcomerstown, Ohio, reports that he has closed successfully the negotiation of capital for the Uhrichsville, White City & Newcomerstown Electric Railway. Mr. George M. Beerbower, C. E., who recently completed the plotting of White City, has been recalled from New York City to begin the work of making the final survey and profile of the electric-line between the two cities. It is expected that this necessary work can be completed in time to have considerable of the construction work on the road done before winter sets in. In addition to this, during Mr. White's sojourn in the East, he also negotiated for the location at White City of another large manufacturing plant, employing 250 hands, on a plot of 20 acres adjoining the works of the Dithridge Steel Car Company and the White Locomotive Works.

POWER IN MEXICO.—Mr. John W. McKay, secretary of the North American Beef Company, of Chicago, and James H. Davidson, a lawyer of Chicago, are in Mexico investigating the recent purchase of the packing concessions at Uruapan, State of Michoacan, which is well located for the business, as it is contiguous to the States of Jalisco, Guerrero and Oaxaca, the largest cattle States in Mexico with the possible exception of Cupatizo Falls. Mr. McKay says that the company expects to start operations with 50,000 cattle a year, and to put in a water-power plant of 8000 horse-power at Cupatizo Falls.

LARGE TELEPHONE CONTRACT.—Mr. P. C. Burns, president of the American Electric Telephone Company, of Chicago, who is now in New York City, announces that he has just closed one of the most important telephone exchange contracts ever taken. The Keystone Telephone Company, of Philadelphia, the "independent" concern which Mr. Wilson and friends have been organizing so actively, putting in subway conduits, etc., has just given Mr. Burns the order for a complete modern exchange equipment of no fewer than 8000 numbers. The work of construction and installation is to begin as soon as possible.

SALES OF TELEPHONE APPARATUS.—The Haines & Noyes Telephone Company, Chicago, reports a growing business. Among the contracts it has recently closed for exchanges may be mentioned Elma, N. Y., and two other towns in the vicinity of Buffalo, which it will equip some time in September. It has also closed the contract for equipping complete a 20-mile telephone line in Las Cruces, N. Mex., for the M. & M. Mining Company.

WESTINGHOUSE ELECTRIC MANUFACTURING COMPANY has just concluded a purchase of pig iron, for which it paid $177,000, the largest purchase ever made by the concern. The iron was of the grade known as foundry iron, and was taken at $14.75 per ton.

BALL ENGINE ORDERS SOUTH.—The Roanoke Railway & Electric Company, Roanoke, Va., recently installed a 300-hp Ball engine, built by the Ball Engine Company, Erie, Pa., and the Merchants' Cold Storage & Ice Company, Richmond, Va., has recently purchased a 70-hp Ball engine for electric service.

WESTON ELECTRICAL INSTRUMENT COMPANY has ordered a batch of about 25 plain and universal milling machines from the Cincinnati Milling Machine Company, for its new factory at Waverly, N. J.

ELECTROLYTIC COPPER.—The Orford Copper Company is to have a large electrolytic copper plant, with a capacity of about 1000 tons per month, at its Constable Hook, N. J., smelter. Considerable appartus will be needed.

General News.

THE TELEPHONE.

FORT SMITH, ARK.—Mr. John N. Eberhart, of Charleston, has just completed a line for the Franklin County Telephone Company, which embraces the following route: From Charleston to Vesta; thence to Dahoma, Peter Pender, Sub Rosa, Cecil, Meg, Webb City, Ozark and back to Charleston. The line is a strictly local affair, and has been put up by the people who live along its route.

MODESTO, CALIF.—The Sunset Telephone Company is running its lines through the Valley along the Santa Fe right of way.

SAN FRANCISCO, CALIF.—The Sunset Telephone Company, of San Francisco, has bought the local telephone system of the Petaluma Telephone Company of Petaluma, Cal., and the Bay Cities Power & Light Company is negotiating to buy the Petaluma electric and gas plant. If it succeeds the company will make Petaluma the center for distributing light and power to Sonoma and Marin counties, California.

ROME, GA.—The Southern Bell Telephone Company has begun work on a new telephone system. About $30,000 will be expended.

COVINGTON, GA.—A new local telephone system incorporated under the name of the Covington Telephone Company is to be established here. Work is being rapidly pushed on the new line, and it will be completed and ready for service soon.

CUL DE SAC, IDAHO.—The Inland Telephone Company is contemplating an extension of its line to Cul De Sac.

ROCKFORD, ILL.—A new telephone line is being erected between Hampshire and Burlington.

SALEM, ILL.—A telephone exchange is being put in at Sandoval, Ill., by the Salem Telephone Company.

WAUKEGAN, ILL.—The Chicago Telephone Company is stringing about 6000 feet of new cables in this city.

WOODSIDE, ILL.—L. L. Colburn is preparing to put up a telephone line to connect with the Springfield main line.

ALTON, ILL.—The Kinloch Telephone Company will begin the work of constructing its telephone system in Alton.

PEKIN, ILL.—The Home Telephone Company, of Sidney, is extending its lines. The improvements will cost about $1,000.

WEST POINT, ILL.—I. P. Kilgore has organized a telephone system to extend through the neighborhood about five miles west of this town.

STERLING, ILL.—The Whiteside-Harrison Telephone Company is going to rebuild its system in this city and throughout Whiteside County.

RUTLAND, ILL.—The capital stock of the La Salle & Marshall Telephone Company, of Rutland, has been increased from $30,000 to $100,000.

CENTRALIA, ILL.—The Central Union Telephone Company announces that a free service is to be extended to all subscribers to the towns and villages in this vicinity.

MACOMB, ILL.—The National Telephone Company (parent company) has secured for its Illinois State Company, the Kurtz National Telephone Company, a 30-year franchise with 200 five-year contracts.

OTTAWA, ILL.—At the last meeting of the Putnam County Board of Supervisors the Central Union Telephone Company was given permission to erect poles and lines on any of the roads of Putnam County.

CHICAGO, ILL.—C. G. Hellick has completed plans for a building to be erected in North Boulevard, near Wisconsin Avenue, Oak Park, for the Chicago Telephone Company, at a cost of $15,000. It will be two stories, of pressed brick.

BLOOMINGTON, ILL.—The Palmer-Darnall Electric Company, of Atlanta, has purchased the telephone lines and exchange belonging to Dr. J. H. Banks, and will consolidate it with its extensive telephone system recently incorporated.

COLLINSVILLE, ILL.—The Central Union Telephone Company has issued a new directory. It contains the numbers of 190 local telephones, and in addition the lists of subscribers at Collinsville, Highland, Alhambra, Marine, New Douglas, Saline, St. Jacob, St. Morgan and Troy.

CHICAGO, ILL.—Judge George Brown has ruled against the Chicago Telephone Company in its suit with the Northwestern Telephone Company. He ruled that the contention of the Chicago Company, which sought by injunction to preserve a monopoly of the use of all streets already occupied by the Chicago Company, could not be maintained.

CHICAGO, ILL.—The nickel-in-the-slot telephone, which has lately been placed in police stations, has been declared a failure by Inspector Max Heidelmeier, of the North Side. When an employe of the telephone company went to the Chicago Avenue police station to collect the money which should have been in the repository to pay for calls he found pieces of flattened brass.

GLEN HALL, IND.—The Odell Telephone Company has been formed; capital stock, $10,000. Directors: Samuel B. Lutz, H. G. Lutz and W. B. Foresman.

ELKHART, IND.—The Western Union Telegraph Company is placing on the south side of the opera house block a large clock, to be regulated by electricity, and surrounded by advertising cards.

ELKHART, IND.—The Central Union Telephone Company announces that it will rebuild its Elkhart system. It will put in an exchange at Vakarusa to compete with an independent plant there. The independent concerns are strong in this section.

NEW ALBANY, IND.—The annual convention of the Southern Indiana Independent Telephone Association at its recent meeting elected the following officers: President, G. A. Kienle, Huntingburg; Vice-President, C. D. Knoefler, New Albany; Secretary, E. W. Pickhardt, Huntingburg; Treasurer, T. M. Thom, Lamar.

CEDAR FALLS, IOWA.—Otto Wetstine, of Laporte City, has secured the contract for the erection of the building for the Interior Telephone Company of Grinnell.

MARIETTA, I. T.—The telephone line from Marietta, I. T., to Burneyville, I. T., has been completed. This is part of the proposed line of the Red River Company, which will run from McAlester to Ryan on the Rock Island. It is said the construction of the line is to be rushed.

NEW ORLEANS, LA.—The City Council has refused the privilege to the Cumberland Telephone Company to string its long-distance wires, now being put up to Monroe from Shreveport over the city traffic bridge. The present ten-wire cable will be replaced with a hundred-wire one at a cost of $1,000 or more.

BOSTON, MASS.—The Erie telephone system made a net gain of 788 subscribers in July. Net gain since January 1, 10,804. Total connected July 31, 152,403. Awaiting connection 2,473.

BOSTON, MASS.—The New England Telephone Company has begun its special exchange service to bankers and brokers Monday. Twenty instruments have already been installed, and the company has contracts signed for about 30 more, which are to be put in as fast as possible.

LONDONDERRY, MASS.—Recently the Melendy Brothers, of Londonderry, built a telephone line extending from the village of South Londonderry to Bondville, a distance of some eight miles, connecting on the way with many farmhouses. At South Londonderry the line connects with the Green Mountain telegraph system, extending from Manchester, Vt., through the towns of Peru, Londonderry, Weston, Grafton, to Bellows Falls. This line has recently installed telephone instruments. An annual charge of from $5 to $15 is made to subscribers. Another company has been formed, and is building a telephone line from Peru to the towns of Landgrove and Weston through Londonderry, and installing instruments for from $5 to $12 per year.

BALTIMORE, MD.—The Municipal Telephone Exchange has been put in operation in the City Hall. Twenty-one telephones are connected with it.

IONIA, MICH.—E. B. Fisher, of Grand Rapids, has asked the Common Council for a franchise for the Citizens' Telephone Company.

WASHINGTON, MICH.—The Valley Telephone Company has been given permission to erect poles on North Sidney, from Washington to Jefferson.

SPARTA, MINN.—The Mesaba Telephone Company is stringing another wire between here and Eveleth.

DULUTH, MINN.—The Hibbing-Virginia telephone system has been completed and every town on the Mesaba is now connected but Buhl and Chisholm.

GREENWOOD, MISS.—The charter of the Yazoo Valley Telegraph & Telephone Company has been approved; capital $150,000. The incorporators are Harvey Myers, F. C. Smith, C. E. Wright, W. D. Crist, A. F. Gardner and W. T. Rush.

MONTANA.—The Yellowstone Park Telegraph & Telephone Company has commenced the work of building a line south from Livingston, through the Livingston Canyon up Paradise Valley to Fridley and Chico

PLATTSMOUTH, NEB.—A new independent telephone company has been incorporated, with a capital stock of $50,000, to be known as the Home Telephone Company, and will have its headquarters at Papillion. The incorporators are J. D. Clarke, Papillion; C. F. Calhoun and J. M. Elwell, Springfield. The work of constructing exchanges at Springfield, Papillion and Gretna will begin at once.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has recently completed another long distance line between Atlanta and New York by way of Charlotte. A reduction of about 40 per cent has also gone into effect from the South to all points east of Pittsburg and north of Baltimore. The time limit has been reduced from five to three minutes.

ELIZABETH, N. J.—A meeting of the stockholders of the Elizabeth Telephone Company has been called, and it is expected that a proposition will be made to them from the promoters of the Interstate Telephone Company for the consolidation of the local system with the big rival to the New York & New Jersey Telephone Company that is projected.

ALBANY, N. Y.—A certificate of reduction of the capital stock of the International Bell Telephone Company, Limited, from $750,000 to $500,000, has been filed with the Secretary of State.

ALBANY, N. Y.—The controlling interest of the Citizens' Standard Telephone Company of Kingston has passed to the American Construction & Trading Company, of Elyria, Ohio. It is proposed to improve the telephone system and to extend it.

LYONS, N. Y.—The Interocean Telephone & Telegraph Company, which was recently incorporated to oppose the Bell corporation, has been inspecting the Wayne and Lyons plants, and will absorb them both. Both towns will now have a first class long distance service.

BERLIN HEIGHTS, OHIO.—The Buckeye State Telephone Company has begun work on its plant at Berlin Heights.

BELLEFONTAINE, OHIO.—The Independent Telephone Company, of Bellefontaine, will extend its lines to Zanesville, Ohio.

CHAGRIN FALLS, OHIO.—The Central Union Telephone Company (Bell) has been defeated in a three years' fight to secure a franchise in this place.

SPRINGFIELD, OHIO.—The Home Telephone Company of Cleveland has secured a franchise to operate in this city. It is claimed a plant will be put in to cost $200,000.

DAYTON, OHIO.—The Home Telephone Company, of this city, has increased its capital stock from $100,000 to $750,000 upon application to the Secretary of State.

BARBERTON, OHIO.—The People's Telephone Company is increasing the

capacity of its lines to accommodate 800 subscribers in Barberton, 200 in Cuyahoga Falls and 5,000 in Akron.

URBANA, OHIO.—The Urbana Telephone Company has decided to install new cable at a cost of $10,000. The company has recently increased its subscriber list to 325, and the business demands the installation of much new equipment.

ASHTABULA, OHIO.—The stockholders of the Madison Telephone Company have elected officers as follows: C. DeVoel, president; C. S. Fenton, vice-president, and E. E. Howe, treasurer. Directors: the above, with L. R. Parker, E. J. Clapp and Dr. H. M. Fenton.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company, which has been competing with three other companies for a franchise for an independent exchange, has secured its grant. The company is promoted by Cleveland and Springfield people, and I. N. Dreyfus and H. M. Wolf, both of Cleveland, are president and treasurer, respectively. This ends one of the longest fights in the history of the independent telephone movement in Ohio.

HUNTINGDON, PA.—The Juniata Union Telephone Company, capital $1,000, has been incorporated.

JOHNSTOWN, PA.—The Johnstown Telephone Company is now operating an entirely new system—new underground cable, new telephones, new switchboards and new building. Nearly 1400 telephones has been connected up.

SHAMOKIN, PA.—The Shamokin Valley Telephone Company has decided to extend its telephone line to the farming village of Irish Valley this summer. The company will later extend a branch to Seven Points, thence to Augustaville, connecting on the other end at Sunbury.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company, organized for the purpose of operating long-distance lines and securing other systems in the State, has so far secured nearly sixteen hundred subscribers in twenty-three different towns. Further extensions are to be made.

MITCHELL, S. D.—F. W. George, the superintendent of the lines of the Western Electric Company, is making arrangements for the extension of the long distance telephone line from Mitchell to Woonsocket.

SIOUX FALLS, S. D.—Work has begun on a farm telephone system in Beulah Township, Hanson County. Nineteen farm houses will be connected, and will have connection with the telephone system of Alexandria.

JACKSON, TENN.—A franchise has been granted to the Jackson Home Telephone Company. The Cumberland Bell system is already established here. The Jackson Home Telephone Company has secured a franchise here and forty-six subscribers at $1 per month rental. The company will put in an exchange at an early date.

DOVER, TENN.—The Luke T. Walker Telegraph & Telephone Company has filed articles of incorporation at Nashville. The company sets forth in its charter that it proposes to conduct a telephone business by local exchanges and long distance lines.

MEMPHIS, TENN.—The Memphis Telephone Company (independent), it is stated will erect a three-story exchange building, costing about $30,000. The first floor will be used for office purposes, the second for the use of employees, and the third for the switchboard, which will be equipped for 3600 private wires.

EDNA, TEXAS.—The Southwestern Telephone Company will open a local exchange in Edna.

SAN ANTONIO, TEX.—The Texas Construction Company is constructing the long-distance line for the Commercial Telephone Company, the latter being a corporation organized May 5 under the laws of the State of Texas, and being capitalized for $500,000. No bonds have as yet been issued. The present contract embraces a line over the Southern Pacific from San Antonio to Orange, Tex.; over the Santa Fe from Galveston to Houston and over the H. & T. C. from Houston to Dallas and Fort Worth. The contract calls for red cypress or red cedar poles, 30 feet in length, 6 inches diameter top, two circuits, one of No. 10 and one of No. 12 copper wire; all other material and workmanship to be the very best possible. There are now two gangs of men at work, and the work will be pushed as rapidly as possible. This line is designed to cover the southern and eastern part of the State of Texas and will operate as a feeder for the independent plant just completed in San Antonio, for that at Houston, Waco, and some minor points, and for those now in the course of construction by the Texas company at Austin, Tyler, Taylor Temple, Beaumont and Orange.

NORFOLK, VA.—The Long Distance Telephone Company, of Virginia, has completed the lines connecting Richmond with a big stretch of territory in Southside, Va., including the city of Petersburg.

MILWAUKEE, WIS.—The Citizens' Telephone Company will be organized with a capital stock of $1,500,000. Incorporators: Judge Pereles, Michael Carpenter, Patrick Meehan, Joseph Bach and Phillip Schmitt.

BARABOO, WIS.—William J. Bell, manager of the Baraboo Telephone Company, has secured a franchise to erect poles and string wires in Kilbourn and establish a telephone exchange. A new line between Baraboo and Kilbourn will be erected.

MILWAUKEE, WIS.—A. B. Ferdinand, president of the Northwestern Telephone & Electric Company and the Sheboygan County Telephone Company, claims the right to build a telephone line into Milwaukee without first obtaining a franchise, and Milwaukee's City Attorney upholds him in the contention.

RHINELANDER, WIS.—A stock company is being organized to build a telephone line from this city to Eagle River, Vilas County, taking in Robbins and Three Lakes. Enough stock to build the line has already been subscribed. The line will be extended to Tomahawk after it is on a firm financial basis.

MARINETTE, WIS.—Applications for telephone franchises in Marinette and Menominee have been made by former Governor Edward Scofield, of Oconto, and A. L. Hutchinson, of Weyauwega, Wis. They agree to have the systems in operation within a year, and will make them part of the independent telephone systems of Wisconsin.

RACINE, WIS.—The question of locating telephone and electric light poles where they will occasion the least inconvenience to property owners and the least expense to the corporations using, was raised in recent damage suits at Racine to fix the amount of damage. The finding of the Racine jury fixed the cost to be assessed on each pole at from $20 to $25 according to the street occupied.

MARSHFIELD, WIS.—The first step toward the consolidation of all the independent companies in Wisconsin into one circuit with long distance service has been taken. The Neillsville Company has purchased the line between Marshfield and Medford and will at once commence operations towards perfecting the line between the two places. The move will form complete connections between the cities of Marshfield, Wausau, Black River Falls and La Crosse, and will be made more complete in a few months.

ELECTRIC LIGHT AND POWER.

MONTEREY, CALIF.—The electric light company of Monterey will extend its lines to Pacific Grove and New Monterey on one side and Oak Grove on the other side of Monterey.

SANTA ROSA, CALIF.—The Merchants' Lighting Company of this city has sold its plant to the California Central Gas & Electric Company, which has a franchise to run wires through Sonoma and other counties of California.

LOS ANGELES, CALIF.—As the result of a rate war between the San Gabriel, El Reno and the East Side Lighting Company, the latter concern has been furnishing its patrons electric light currents free of cost. Notice of such action was given. The San Gabriel officials say they will not follow the example of the East Side Company, but will allow their rival a monopoly of the free service.

WASHINGTON, D. C.—Plans for an electric light and steam heating plant for the Fort Totten, N. D., Indian school have been completed at the Indian Office, and the contract will be given out shortly.

GRIFFIN, GA.—The city of Griffin has let a contract for the installation of $31,879 worth of additional machinery in its electric light plant.

AUGUSTA, GA.—The city has declared that all concerns in the future must pay for franchises. Stewart Phinizy and others had petitioned for street rights for a gas and electric light plant. This petition was granted on the above condition.

MASCOUTAH, ILL.—This city is about to make a new contract for electric street lighting. Bids are called for on Sept. 16.

SCOTTSBURG, IND.—The city authorities have taken favorable action toward installing an electric light plant, and are now prepared to receive bids.

LEWISTOWN, ILL.—County Treasurer H. F. Townsend has bought of Banker W. H. Rhodesn the Lewistown electric light plant.

KANKAKEE, ILL.—Initial steps have been taken for the transmission of power from dams in the Kankakee River to Chicago, where, it is stated, it will be utilized by some of the electrical companies for lighting, traction, etc. E. R. Beardsley, of Waldron, inventor of an improved dam system, is President of a company capitalized at $150,000, which will build seven dams between Altorf, five miles down the Kankakee from this city, at the junction of the Desplaines and Illinois Rivers. It is estimated that 15,000-horse-power will be obtained.

SOUTHAMPTON, L. I.—The Suffolk Light, Heat & Power Company, of Southampton, has been formed, with a capital stock of $25,000, the directors being P. Tillinghast and H. N. Stuart, of New York City, and B. C. Clark, of Brooklyn.

PORTLAND, MAINE.—The Burrows Light Company has been formed; capital, $500,000. Incorporators: S. E. Young, A. M. Cole, Portland, Maine.

WESTBROOK, MAINE.—Two large machines for station No. 1 of the Westbrook Light & Power Company have arrived from the General Electric Company.

PORTLAND, MAINE.—The Smith-Sturtevant Light & Power Company, of Newport, Maine, has been incorporated, with a capital of $10,000. Incorporators: C. E. Smith, Newport, Maine; C. O. Sturtevant, Detroit, Maine.

OTTAWA BEACH, MICH.—The new electric light plant is now in operation, among its largest users being the Laullord Pautlinds magnificent new Beach Hotel. Current is also furnished to cottage owners at very reasonable rates.

HASTINGS, MICH.—The Thornapple Electric Company has a capital of $100,000, and operates an electric light and power plant by water power. It has 20 miles of aluminum and 12 of iron wire. President, A. S. Kopf, vice-president, H. A. Thornton.

GRAND RAPIDS, MICH.—The "city fathers" are seriously contemplating lighting all the public buildings, schools, engine houses, etc., from the municipal lighting plant. An appropriation of nearly $12,000 is thought necessary to carry the work to completion.

MUSKEGON, MICH.—Work on the new buildings of the Muskegon Traction & Lighting Company, which will consolidate the electric lighting plant and the street railway power house, is to be begun within two weeks and in operation in October. The new plant will cost between $75,000 and $100,000.

GRAND RAPIDS, MINN.—The municipality will own the electric light plant.

MINNEAPOLIS, MINN.—The plant and appurtenances of the Minneapolis International Electrical Company have been sold under a judgment decree. The debts for which the property was sold aggregated $148,120, and the amount realized at the sale was $400,000. C. F. Weed, of Boston, Mass., was the purchaser.

EAST GRAND FORKS, MINN.—A court has granted a temporary injunction restraining the city from issuing bonds to the extent of $15,000 for an electric light and power works system, on the grounds that the assessed valuation of the property in East Grand Forks was not sufficient to warrant the increase in the corporate indebtedness of the town.

KANSAS CITY, MO.—The Kansas City Electric Light Company's brick smokestacks will be by nearly twenty feet the tallest chimneys in the city. They will be built at the company's new plant on the east bank of the Kaw River, near the elevated railway bridge. Each will be 243 feet high and each will cost $11,000. Their interior diameter will be ten feet.

NORTH PLATTE, NEB.—The North Platte Electric Light, Heat & Power Company has been formed by J. Henry, Fred. C. Adams and Charles M. [illegible].

OMAHA, NEB.—Articles of incorporation of the City Electric Light & Ice Company of Grand Island have been recorded. The company proposes to manufacture gas, electricity and ice. It has a capital stock of $200,000.

RALEIGH, N. C.—Mr. W. G. Andrews, president of the Raleigh Electric Company, informs us that, in spite of newspaper reports to the contrary, Raleigh is not raising $7,000 for electric light bonds. Nothing is known about the plan locally.

ORANGE, N. J.—A special dispatch from Orange, N. J., says: "People in the Oranges are interested in the question whether Thomas A. Edison is at the head of the National Electric Light, Heat & Power Company, which has submitted a bid to light the streets of Orange. The bid was signed by William E. Gilmore, as president. Mr. Gilmore is manager of the Edison phonograph works and is intimately associated with Mr. Edison in numerous business ventures. Mr. Edison is at Chautauqua and Mr. Gilmore left last week for a trip to Mexico. In their absence others of the Edison officials decline to talk about the matter. It is said the company has obtained options on property on which an electric lighting plant will be erected in time to take over the street lighting business should the contract be awarded to it.

SOUTHAMPTON, N. Y.—The Suffolk Light, Heat & Power Company, of Southampton, Suffolk County, has been incorporated; capital stock, $25,000.

ROSLYN, N. Y.—A certificate showing the increase in the capital stock of the Roslyn Light & Power Company, of Roslyn, Nassau County, from $50,000 to $100,000, has been filed.

ALBANY, N. Y.—A certificate of increase of the capital stock of the Consolidated Electric Company, of Greenwich, Washington County, from $50,000 to $75,000, has been filed with the Secretary of State.

CLYDE, N. Y.—The Board of Trustees has accepted the offer of the Clyde Electric & Power Company to furnish the streets of Clyde with light at $50 per lamp, the lights to be extinguished at 1 o'clock A. M.

ROCHESTER, N. Y.—Announcement is made that the contract for the construction of the new power plant of the Citizens' Light & Power Company has been awarded to A. Friederich Sons & Company, of this city. While no figures were given out as to the detailed contracts that have been awarded, it has been stated that the aggregate cost of the new plant, with its equipment, will be nearly $2,000,000.

AKRON, OHIO.—Mr. M. Spitzer is preparing plans for an electric light and power plant, 60x210 feet, ground dimensions, for the Canton-Akron Electric Railway Company, at Akron, Ohio, at a cost of $50,000.

SPRINGFIELD, OHIO.—The Springfield and Xenia branch of the Pennsylvania Railroad Company will be made into an electric road at once. The distance is about twenty miles and the road passes through Yellow Springs, famous as a summer resort. Clifton Springs is also along the route. The changing from steam to electricity is attributed to economy.

PITTSBURG, PA.—The Keystone Electric Company, of Braddock, has been formed, with a capital stock of $100,000, and will build a plant to compete with the Monongahela Light & Power Company.

PAWTUXET VALLEY, R. I.—New electric wires are to be placed upon the square poles in many of the valley villages and the trolley wires are also to be placed upon them.

DAVOS, SWITZERLAND.—The well-known Swiss health resort of Davos is said to be about to utilize electricity for all industrial and domestic purposes. An extensive generating plant will be constructed at a confluence of two mountain torrents from which the necessary water-power will be derived. The initial expenditure, it is estimated, will reach some $1,700,000.

LANCASTER, S. C.—The new cotton mill at Lancaster, S. C., is well under way. This mill is a four-story, 52,000-spindle mill, 1600 looms, and will be run by electricity.

LAWRENCEBURG, TENN.—It is said that a project is on foot for installing an electric light plant on School Creek, two miles from town.

GALLATIN, TENN.—The City Council at a recent meeting decided to issue bonds to the amount of $6,000, for the electric light and water plants.

ROSEBUD, TEX.—Judge Henderson, M. M. Kemp and others of the Cameron Water Works Company have purchased the water system at Rosebud and will also put in a good electric light system at that place. Mr. John Thomas, expert electrician, will have charge of the plant.

BEAUMONT, TEX.—The Beaumont Light, Heat & Electric Motor Power Company has been formed; capital stock $100,000. Incorporators: T. W. Shepherd, S. F. Cooper, I. D. Polk, W. W. Pope, of Beaumont; J. H. Kirby, of Houston, and M. A. Orlopp, of New York.

SALT LAKE CITY, UTAH.—A new company has just been organized, with a capitalization of $50,000, to furnish light to the city. Its incorporators promise that it shall be in operation by November 1. It is known as the Merchants' Lighting Company and has heavy Eastern backing.

McMECHEN, W. VA.—The poles for the electric light plant have arrived and the work of putting them in place will be pushed as rapidly as possible,

WINCHESTER, VA.—On account of the death of two persons by touching live wires, the city of Winchester is endeavoring to compel the Winchester Gas & Electric Light Company to renew its plant, it being alleged that the company has not complied with the terms of its contract by which new wires, new poles and a new plant were to be installed.

NORFOLK, VA.—A first mortgage loan of $100,000 has been negotiated by the Old Dominion Street Railway with the Colonial Trust Company, of Philadelphia. The mortgage covers the proposed Deep Creek extension of the Old Dominion Railway, and the bonds, which are gold bearing, with interest at the rate of 5 per cent, are extended for twenty years.

MONTESANO, WASH.—Chester H. Kiel has commenced work on the electric light system, for which he was granted a franchise last year. The plant will be run by water power obtained at the Sylvia Falls. The machinery and other materials necessary have been ordered. It is expected the plant will be ready to begin operations during the month of September next.

GRAND RAPIDS, WIS.—The Electric & Water Company, organized in 1899, has a capital of $40,000, and operates two dynamos. They are in the market now for copper wire and stepup transformers. P. L. Utley is manager.

CHEYENNE, WYO.—The Boston-Wyoming Smelter Company will put in an electric power and lighting plant at the mill. The power will also be used in lighting the town of Grand Encampment. The electric equipment of the mill will include machinery for the reduction of the copper matte to copper pig of 98 per cent. bullion.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—A. L. Sweeney, who has secured the Huntsville Railway, Light & Power Company's plant for New York capitalists, has arrived in Huntsville to complete details and take charge of the plant.

ANNISTON, ALA.—A new electric railway may be built between Anniston and Montgomery. J. B. Rees, secretary of the Anniston & Montgomery road, which did not materialize, may dispose of the road's charter to J. W. Watts, president of the Montgomery Northern Railway.

OAKLAND, CALIF.—It is announced that W. G. Henshaw, who recently acquired a controlling interest in the Oakland, San Leando & Haywards Electric Railway Company, has transferred the same to the Oakland Transit Company. The Transit Company, which has been for the past five years buying and consolidating the Oakland street railway lines, and has just acquired the last independent line, is backed by the Realty Syndicate, which owns large tracts of city and suburban land.

HULL, CAN.—The Hull Electric Railway, which now operates between Ottawa and Aylmer, Que., has practically passed into the hands of the Ottawa, Northern & Western Railway Company. The basis of agreement of sale has, it is learned, been agreed upon, but before all the papers can be finally signed and delivered, legislation to overcome some provision in the charter will have to be obtained. This will be applied for at the next session of the Dominion Parliament. The consideration is said to be over $1,000,000 in cash and bonds.

MONTREAL, CAN.—The Montreal Park & Island Railway has now passed into the control of the Montreal Street Railway Company. The directors of the former road have resigned and the election of all the Montreal Street Railway directors immediately followed, Hon. L. J. Forget being elected president and Mr. James Ross vice-president. The purchase price of the Park and Island Railway is $1,100,000.

HAMILTON, ONT.—It is understood that the Everett syndicate, with Messrs. H. A. Everett, of Detroit, Mich., and W. Caryl Ely, of Buffalo, N. Y., as the chief promoters, has approached the Cataract Power Company, of Hamilton, Ont., with a view to including it in the big scheme of consolidating all the electric railways between Detroit and Toronto and between Hamilton and Niagara Falls. The probability is that negotiations will soon be begun for the acquirement of the Hamilton Power Company's numerous electric railways, there being an understanding, it is said, that this will come about sooner or later.

HARTFORD, CONN.—The Hartford & Springfield Street Railway Company has succeeded in securing a strip of land on the main street in Enfield, which was needed to straighten the road.

WATERBURY, CONN.—Judge Roraback in the Superior Court has granted permission for the extension of the Connecticut Railway & Lighting Company's trolley lines from Ansonia to Seymour, and from Waterbury to Watertown.

WATERBURY, CONN.—Judge Gager, of the Connecticut Superior Court, has issued an order that public necessity and convenience require the construction of an electric street railway from Waterbury through Prospect and Cheshire, to Mount Carmel, in the town of Hamden, where connection can be made with the New Haven trolley system. The order was granted on the petition of the Connecticut Railway & Lighting Company, and the company's intention is to link Waterbury and New Haven by trolley as soon as possible.

WILMINGTON, DEL.—The People's Railway Company has begun the work of building a railway in King Street from Sixth to Sixteenth. The company already has a line in King Street from Water to Sixth, which is operated in connection with the Sixth Street line.

GAINESVILLE, GA.—The stockholders of the Dahlonega & Gainesville Electric Railway have increased their bond issue from $600,000 to $750,000. The company has also secured Dunlap Shoals, near Gainesville, for $20,000. Five thousand horse-power is said to be available here. W. A. Carlisle is engineering the right of way.

GRANITE CITY, ILL.—A franchise has been granted to the Venice, Granite City & Madison Electric Railway Company.

SPRINGFIELD, ILL.—The stockholders of the Springfield-St. Louis Electric Railway have organized, and elected officers. The officers chosen are: President, D. H. Littel, of Buffalo, N. Y.; Vice-President, W. Gaulbert, of Louisville; General Manager, H. S. Reardon, of Springfield; Secretary, C. K. Minary, of Springfield; Treasurer, H. C. Hamilton, of Girard.

CHICAGO, ILL.—The Detroit & Chicago Traction Company, the lines of which are now rapidly being completed into Detroit, will be, when finished, the longest single electric railroad line in the world. It has already completed a section between Jackson and Ann Arbor, and is rapidly pushing the work between Ann Arbor and Detroit, by way of Plymouth. West of Jackson the

company has private rights of way through the country lying between that city, Albion, Marshall and Battle Creek, and has friendly relations with the railway company which operates between Battle Creek and Kalamazoo, and is now arranging for rights of way west of Kalamazoo and into the city of Chicago.

WABASH, IND.—The Wabash River Traction Company was formally opened for business recently. The line is seventeen miles long and connects this city with Peru.

GREENWOOD, IND.—Work on the interurban electric road from this city to Shelbyville has commenced. It is planned to have the road in operation by next Spring. The length will be 20 miles, and the estimated cost $350,000. The power-house will be erected at Sugar Creek, midway between Greenwood and Shelbyville.

INDIANAPOLIS, IND.—Officials of the Pennsylvania Railway Company have given out notice of their intention to equip the Indianapolis and Vincennes road between this city and Martinsville with electric trolley cars. The plan is to place the wires at the side of the track, so as not to interfere with the regular steam trains. The main track will be used for the trolley cars. It is estimated that the cost of fully equipping a steam railroad with the trolley system, including power-house and cars, will not exceed $7 a mile.

RICHMOND, IND.—The Eastern Indiana Traction Company, a new interurban railway company, has filed articles of incorporation with the Secretary of State. The company is capitalized at $10,000, the greater part of which is owned by Mr. Schwab. The officers and directors are: President, Peter Schwab, Hamilton, Ohio; Vice-President, Henry P. Lane, Franklin, Ohio; Secretary and Treasurer, Elias Folk, Franklin, Ohio. The announced intention is to construct an interurban road starting from Richmond to run to Portland, Ind., a distance of about fifty miles.

MANSFIELD, MASS.—In all probability this town before another year will be connected with North Attleboro and vicinity by electric railway.

LYNN, MASS.—President Poor, of the Haverhill & Southern New Hampshire Electric Railroad, has announced that the road has been sold to Wallace D. Lovell, of the Exeter and Hampton road, who is also the promoter of the network of electric roads through Rockingham County.

WACHUSETT, MASS.—The Wachusett Street Railway Company has organized by electing the following officers: President, F. S. Coolidge, Fitchburg; Vice-President, E. F. Glodgett, Leominster; Clerk and Treasurer, James A. Stiles, Gardner. These officers, with W. S. Reed and George R. Damon, of Leominster, constitute the Board of Directors. The most feasible plan considered is to build a trolley road as far as the grade will permit of running trolley cars, with safety, then the line will go straight to the summit, using cable power. In fact, the line to ascend Mt. Wachusett will be very much after the plan in use to get to the top of Mt. Tom.

BATTLE CREEK, MICH.—The Michigan Inter-Urban Railway Company has been formed; capital, $100,000.

BENTON HARBOR, MICH.—The West Michigan Traction Company has been incorporated, with $1,000,000 capital. The company proposes to build an electric line from the vicinity of Benton Harbor to Dowagiac, Cassopolis, Decatur, Pawpaw and Kalamazoo, a distance of 80 miles. The incorporators are Eastern capitalists.

CHARLOTTE, MICH.—The Common Council has granted a franchise to Congressman Robert Gordon, of St. Mary's, Ohio, to construct a street railway through this city, the line extending from Battle Creek to Lansing. The entire right of way has now been secured under the terms of the franchise. The power house must be located here and the line be running within 25 months.

GRAND RAPIDS, MICH.—A new electric road is being planned to connect this city with Ada, Lowell, Ionia and Belding. The capital of $100,000 has all been subscribed and the promoters are now getting out articles of incorporation. It is understood that active work will be started at once. The officers are Thos. F. Carroll, president; Wallace Franklin, vice-president, and Joseph Kerwin, secretary and treasurer.

MACON, MO.—The St. Joseph Traction Company is making arrangements to bring the coal at Bevier to the bottom of the shaft by means of electric motor cars. Heretofore it has been done by mule power. The underground electric line will be nearly a mile in length.

WEST PLAINS, MO.—At Bakersfield, twenty-five miles south of this city, representatives from Mount Homer, Ark., West Plains and other places have met to offer inducements for the building of an electric line from West Plains into the North Arkansas mineral belt. The right of way and depot grounds in each town through which the proposed road will pass have been guaranteed.

GREENSBORO, N. C.—The new electric street railway company may extend its line to Pomona, two miles west of Greensboro.

DURHAM, N. C.—The Durham Traction Company has accepted its new power plant. Eight miles of electric railway will be completed. J. S. Carr, J. S. Manning and H. A. Fansher are a committee to manage the affairs of the company.

PORTSMOUTH, N. H.—The directors of the Portsmouth & Exeter Street Railway, which has been granted a situation in Stratham on the main highway between Portsmouth and Exeter have applied for additional locations on two cross roads leading to North Hampton.

TRENTON, N. J.—The Lackawanna & Wyoming Valley Rapid Transit Company, incorporated about a year ago, has filed papers increasing its capital stock to $6,500,000.

NEW YORK, N. Y.—Examination will be held by the Municipal Civil Service Commission on August 14 for the position of assistant engineer, second grade, for the rapid transit tunnel. The compensation will be between $900 and $1,200 a year.

JERSEY CITY, N. Y.—The Raritan Traction Company has secured a franchise from the Metuchen Borough Council. The trolley line between Perth Amboy and Metuchen will now be finished and direct communication will be established with New Brunswick.

ALBANY, N. Y.—The Amsterdam Street Railway Company has purchased two acres of land on the Mohawk turnpike at the foot of Tribe's Hill and thereon will erect a station at which power will be generated for the operation of the electric lines in Gloversville, Johnstown and Amsterdam and for the road to this city.

LITTLE FALLS, N. Y.—The Mohawk Valley Traction Company has been incorporated to operate an electric road from Little Falls to Herkimer. The directors are Timothy Dosey, J. Judson Gilbert, Fred. G. Teall, James D. Feeter and Myron G. Dronner, of Little Falls; Henry Churchill, I. B. Nevendorf and Henry G. Munger, of Herkimer, and J. D. Smith, of New York City.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit has placed orders for 12 large steam automobiles, to be used as repair wagons, for delivery by Oct. 1, at a cost of from $2,200 to $2,500 each. These are to be operated by steam generated from gasoline fuel. Two engines are to be placed in each wagon, giving them 24-horse-power and making the vehicle capable of carrying great weight.

PORT CHESTER, N. Y.—A certificate of consolidation of the Port Chester Street Railway Company and the Larchmont Horse Railway Company, forming the New York and Stamford Railway Company, has been filed with the Secretary of State. The new corporation has a capital of $500,000, and the directors are: W. H. Campbell, William Murray, Charles A. Singer and John Neilson, of Larchmont; N. H. Heft and G. S. Heft, of Bridgeport, Conn.; R. J. Welsh, of Greenwich, Conn.; W. A. Ward, of Port Chester, and W. H. Trumbull, of Salem, Mass.

WHITE PLAINS, N. Y.—The New York & Stamford Railway Company has been formed at White Plains, with a capital of $500,000, to build a through trolley line to Boston. The company represents the consolidation of the Larchmont and Port Chester electric companies which now operate trolley systems from Larchmont to Port Chester. The new company is now building a road to Greenwich, and as soon as this line is completed the road will be extended to Stamford and afterward to Boston. The Golden's Bridge Electric Company has begun work on a new line to connect Stamford with Danbury and Golden's Bridge. This will form a transcountry system with connecting lines to New York and New Haven, covering seventy-five miles.

MARTIN'S FERRY, OHIO.—The City Council has granted a franchise to the Ohio Rapid Transit Company.

ASHLAND, OHIO.—The Norwalk Council has granted a franchise to the Norwalk, Ashland & Southern Electric Railway.

HAMILTON, OHIO.—Peter Schwab, of Dayton, is promoting a new road which will extend from Hamilton to Richmond, Ind.

RAVENNA, OHIO.—Work on the extension of the Northern Ohio Traction Company has been stopped by an injunction. An effort is being made to compromise.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has made application for a franchise over certain city streets to enable its cars to reach the center of the city.

YOUNGSTOWN, OHIO.—Application has been made to the County Commissioner for a franchise for the Star County Electric Railway Company between this city and Alliance.

AKRON, OHIO.—The Northern Ohio Traction Company is rebuilding nearly all its present city cars with heavier equipment, and 15 new city cars will be purchased for use next winter.

MARIETTA, OHIO.—A franchise granted to Daniel H. Buell by the County Commissioners, calls for an electric road from Marietta to St. Marys landing, a distance of fifteen and one-half miles.

CANTON, OHIO.—William H. Hoover, Charles H. Kolp and John C. Welty have purchased the franchise from T. L. Childs for the Canton-Akron Railway Company and have transferred their interests and rights to the company.

CLEVELAND, OHIO.—W. H. Gabriel and others of this city are interested in the Interstate & Leavenworth Railway Company, which has recently been incorporated with $500,000 to build a road from Leavenworth to Kansas City.

UPPER SANDUSKY, OHIO.—The Wyandot County Commissioners have granted a franchise to O. T. Stutz for an electric railway from Upper Sandusky through Sycamore and Melmore to Tiffin. Eastern capital is said to be interested in the road.

BUCYRUS, OHIO.—The Crawford County Commissioners have granted a franchise through the county to the Buckeye Traction Company, which proposes to build from Bucyrus to New Washington and Norwalk; also to construct a spur line to Tiro.

YOUNGSTOWN, OHIO.—It is reported that the Mahoning Valley Railway Company has purchased from the Quay-Cameron syndicate the road now in operation from New Castle to Mahonington. This would give the Youngstown road an entrance to New Castle.

COLUMBUS, OHIO.—The City Board of Equalization has raised the valuation of the Columbus Railway Company from $10,000 a mile to $21,161 per mile. This increases the total tax valuation of the company to $2,048,642 instead of $1,500,000 as it was last year.

HAMILTON, OHIO.—The Dayton & Germantown Traction Company has applied to the Butler County Commissioners for right of way through Madison Township to Heno. Construction work is to commence by March 1, 1903, and to be completed within six months.

HAMILTON, OHIO.—The promoters of the Hamilton & Lebanon Railway Company have secured an extension of one year from August 3, in which to commence construction work. Also an extension of one year in which to complete the road after work has been started.

EAST LIVERPOOL, OHIO.—A new party of Cleveland promoters are figuring on building a road from Salem to East Liverpool by way of Lisbon. The franchise over this route held by Haite & Smith, of Cleveland, has expired, because of failure to commence work.

BARNESVILLE, OHIO.—A proposition has been made to the Barnesville, Ohio, Council for a franchise to build six electric lines from Barnesville in as many different directions. The one company would thus receive practically twelve franchises and be master of the field.

CLEVELAND, OHIO.—The project of a new city cross town line to operate on Dean Street has been revived. Horace A. Wood is the promoter of the new project, and he has applied to the Council of Glenville for a franchise. If he secures this, he will apply to the City Council.

CINCINNATI, OHIO.—The Cincinnati Traction Company is planning to put its feed wires under ground so that there will be no danger of traffic being interrupted in case of a big fire. The work will practically free the city from overhead wires with the exception of the trolley wires.

PAINESVILLE, OHIO.—The Cleveland, Painesville & Eastern Railway has completed the right of way for its extension to Ashtabula, and 100 teams will commence construction work this week. No agreement has been reached with the Geneva Council, and the road will run a mile south of that place.

CANTON, OHIO.—The Stark County Commissioners have granted a franchise to the Canton-Massillon Railway Company for the extension of its line to Navarre. The road is nearly completed to that point, the company having commenced construction work without a formal grant from the county.

SPRINGFIELD, OHIO.—Harry Frey, Jr., has been granted a franchise over several city streets, giving entrance to the city for his proposed line to Clifton, Cedarville and Jamestown. He claims that construction work will start at once. The franchise of the Little Miami Traction Company was extended 45 days. The road is practically completed into Springfield.

CLEVELAND, OHIO.—O. P. McIlrath, who claims to be backed by prominent capitalists of this city, is securing right of way for a second line from this city to Chardon. It is stated that the road will follow the Pleasant Valley, which is claimed to be a shorter route to Cleveland than the one now used by the Cleveland & Eastern Railway. The road would open up new territory.

YOUNGSTOWN, OHIO.—The Stark County Electric Railway Company has applied to the Mahoning County Commissioners for a franchise to permit it to build a line across the southwestern section of the county. This indicates that the road is to be extended to Salem instead of only to Sebring, as has been announced. Construction work has been started on the western portion of the road.

SANDUSKY, OHIO.—Incorporation papers for the formation of a new electric line, known as the Sandusky, Clyde, Tiffin & Southern Railway Company, have been issued, with a capital stock of $10,000. The incorporators and directors are J. C. Parker, Ira S. Comstock, H. W. Johnson, W. W. Woodward, and George R. Butler. J. C. Parker is president, J. C. Hauser, secretary, and F. P. Zollinger, treasurer.

CINCINNATI, OHIO.—H. H. Becktel and A. Faber and others of this city, who are owners of the Louisville, Anchorage & Pewee Valley Electric Railway now building, the pioneer traction of Kentucky, are promoting a project to build a system of roads to extend from Marysville to Louisville following the Ohio River, with a network of spur lines extending to a number of prosperous towns in the Ohio Valley.

COLUMBUS, OHIO.—The Findlay & Southern Railway Company, which is headed by R. Rosenstock & Company, of Cleveland, has applied for a franchise over an independent route into the center of the city. The company has just secured franchises in Union County and through Marysville, under which the road must be in operation by July 1, 1902. Mr. Rosenstock states that work will start within 30 days.

COLUMBUS, OHIO.—The officials of the Columbus, Delaware & Northern Traction Company, who are backed by the Appleyard syndicate, of Boston, are endeavoring to effect a compromise with the Columbus, Delaware & Marion Railway Company, which is building a line over practically the same route planned for by the other company, and which up to the present time appears to have the best of the argument.

COLUMBUS, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has been incorporated by the Secretary of State, the capital stock being $100,000. The object of the company is stated to be the building of an electric line between the cities named. The incorporators are Ellis Bartholomew, William P. Hester, William T. Stephens, Samuel Chester and Claude Wyant. The headquarters of the company are at Toledo.

SANDUSKY, OHIO.—The City Council has passed new 25-year franchise ordinances for the Sandusky & Interurban Railway and the Sandusky, Norwalk & Southern Railway, which operate the city lines and which are owned by the Everett-Moore syndicate of Cleveland. The companies agree to lay new rails, to build certain extensions and to sell 6 tickets for 25 cents. Work is to be completed within 100 days and the company gave a bond of $10,000 to insure the work.

CLEVELAND, OHIO.—The Cleveland Eastern Railway Company has placed in operation two large alternating current units in its power house at Gates Mill. It is stated that the present power houses of the Cleveland & Chagrin Falls Railway, and the Chagrin Falls & Eastern Railway, which have been recently been consolidated with the Cleveland & Eastern, are to be abandoned and the entire system of 127 miles of road to be operated from one large central power house.

CLEVELAND, OHIO.—While in the east recently H. A. Everett, the trolley magnate, inspected several famous summer resorts which are operated by electric railway companies, and it is reported that next season the Everett-Moore syndicate will finance a summer resort project which will eclipse anything of the kind attempted in this section. It is stated the resort will be located on the lake shore, probably near Wickliffe, on the Shore Line of the Cleveland, Painesville & Eastern Railway.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is making some important improvements at its central power station. All of the old return tubular boilers have been torn out and fourteen 260-hp Sterling boilers are being installed. Work has been started on another large addition which completely fill the present building. Contracts have just been closed for a 1600-kw General Electric generator and a 2500-hp Cooper-Corliss cross-compound non-condensing engine. The work on the storage battery auxiliary station is being rushed.

CLEVELAND, OHIO.—The Western Ohio Railway Company, which is owned by the Pomeroy-Mandelbaum syndicate, has increased its capital stock from $1,000,000 to $2,500,000. The new issues have already been subscribed, and will enable the company to build its proposed extension from Lima to Findlay. The company is placing contracts for equipment, which will double the capacity for the present power-house. A contract has been closed for two 1500-hp Cooper-Corliss engines and Sterling boilers. The generators have not yet been contracted for. Contracts for cars and motors will be closed in the near future.

COLUMBUS, OHIO.—The Appleyard syndicate has finally closed the deal for the purchase of the Dayton, Lebanon & Cincinnati Railway, a steam road running from Dayton to Lebanon, and will change it to electricity at once. A right of way is being secured between Lebanon and Cincinnati, and this strip will be built as soon as possible, when the syndicate will have a through line from Columbus to Cincinnati. General Manager Fisher states that when this is built, through sleeping cars will be operated every night from Columbus to Cincinnati. It is also the intention of the syndicate to secure a line from Columbus to Cleveland.

CLEVELAND, OHIO.—A dozen promoters from various sections of the country have submitted propositions to local railway managers with a view to secure trafic arrangements for handling the express business of the various interurban roads in the State. It is stated that representatives of the existing express companies are among the number. It is stated that the Everett-Moore syndicate has under consideration a plan for handling the express business on all its affiliated lines and that something of the kind will be placed in operation as soon as the various roads are connected. The business of the Cleveland district is already in the hands of the Electric Package Company, which operates on all the roads entering the city.

TAMAQUA, PA.—The Tamaqua & Lansford Street Railway Company will shortly commence work on the construction of a line between Mauch Chunk and Lansford, of eight miles.

PHILADELPHIA, PA.—The Union Traction Company has neither bought nor agreed to buy the Mack Rapid Transit franchises for Philadelphia, which it was recently reported had been sold to it for $3,000,000. These statements are made on the authority of a director of the Traction Company.

PHILADELPHIA, PA.—At a meeting the stockholders and directors of the Centre & Clearfield Street Railway Company fixed the capital stock of the company at $500,000, divided into 10,000 shares. An issue of $500,000 of 5 per cent thirty-year bonds was also authorized.

BLOOMSBURG, PA.—The construction work of the Columbia-Montour Electric Railway, between Lime Ridge and Bloomsburg, has been completed, and it is expected that the road will be in running order over that section shortly. The Berwick-Lime Ridge division is nearly built, and will probably be running within a month.

PITTSBURG, PA.—It has been reported here that the Parkersburg Interurban Railway Company, of Parkersburg, W. Va., has absorbed the Parkersburg Gas, Electric Light & Street Railway Company, and the Parkersburg & Marietta Electric Railway Company. The combination has a capital of $500,000. The contract for building the line to Marietta will be let within a few days.

THE AUTOMOBILE.

NEWPORT, R. I.—A "Recognized Race Meeting" is now to be held at Newport under the approval of the Automobile Club of America on August 30, on Ocean Drive, at 2 P. M. There will be seven events, and prizes are offered by Messrs. Astor, Drexel, Belmont, Livermore, Havemeyer, Vanderbilt, etc.

ELECTRIC HOTEL BUSSES.—Two electric automobile 'busses are now in operation by the New Kenmore Hotel, Albany, N. Y., carrying guests to and from railway stations and docks. Each vehicle has a seating capacity of ten persons, and is capable of running 25 miles on one charge of the batteries.

AUTOMOBILE HEARSES.—Three motor carriages draped with black were used recently at the funeral of an employee of a motor company at Coventry, England. One had been made specially to convey the coffin. Great crowds watched this peculiar procession. This is the first time that automobiles have been used in England at a funeral.

NEW YORK TRANSPORTATION.—The New York Electric Vehicle Transportation Company has established sub-stations at 64 Vesey Street, 55 East Eighty-eighth Street, and 9 West 100th Street. Its main station is at Eighth Avenue and Forty-ninth Street. One of the great drawbacks of the company heretofore has been its inability to extend service at points remote from its main station, because of the lack of facilities elsewhere to charge batteries. This new departure is in line with the improvements inaugurated a few months ago.

NEW INDUSTRIAL COMPANIES.

THE STERLING ELECTRIC MOTOR COMPANY, of East Orange, N. J., has been incorporated; capital, $30,000. Incorporators: James R. Mapletoft, Frank C. Ferguson, H. N. Smith.

THE EMPIRE AUTO-REPAIR AND STORAGE COMPANY, of New York, has been incorporated; capital, $11,000. Directors: James Wood, Jr., E. J. Mahedy, of Brooklyn, and Florence Douglass, of Jersey City.

THE TELEPOST COMPANY, of New York City, has been incorporated at Albany, N. Y., with a capital of $100,000 to construct electrical plants. The directors are H. L. Sellers, R. H. Sellers and N. S. McKain, all of New York City.

THE STANDARD SIGNAL COMPANY, of Troy, N. Y., has been incorporated, with a capital of $300,000. The company proposes to manufacture and install mechanical, electrical, pneumatic or other system of interlocking block signals and safety appliances for railroads of every description. The principal

office is located in Troy. The directors are Alfred H. Renshaw and Palmer C. Rickett, of Troy; Henry Burden, Jr., of Cazenovia; John T. Cade, of Ridgefield, N. J., and Harvey N. Loomis, of New York.

LEGAL.

TELEGRAPH DECISIONS.—The latest volume of the English Ruling Cases (24) is noted by the New York *Times* as containing the leading case of Great Britain on the subject of the liability of telegraph companies for mistakes in messages. There the rule is that no action will lie by the receiver of a telegraphic message against the telegraph company for a mistake in the message delivered. In the United States the English rule is not adopted, and, it is held, almost without exception, that a telegraph company is liable to the person to whom a message is sent for negligence in the transmission or delivery of the message. The following are two interesting cases decided in this State: In one suit an operator of the defendant wrote "casks" for "sacks." The message called for 5000 sacks immediately, and, being written casks, the receivers shipped coarse salt instead of fine salt, as they would have done if the word had been sacks. The defendant was held to be liable. In another action to recover damages for the failure of the defendant to transmit a telegraphic message, it appeared that one of the plaintiffs, who was in this city, addressed to his firm in Buffalo a dispatch relative to important business, and demanded an immediate reply. The manager of the defendant sent the dispatch by a messenger to the firm, and told the messenger to wait for an answer. The messenger received an answer, which he put in his pocket and returned to the telegraph office. The answer remained in his pocket until accidentally discovered the next day. The message blank of the company contained a condition to the effect that whenever a message was sent to its office by one of its messengers the messenger was to be deemed the agent of the sender. The Fourth Appellate Division held, by Justice Adams, that the company was liable for the default or omission of the messenger, and that the rule or condition interposed as a defence was not reasonable in its character, nor in accord with good, sound public policy. Even if the condition were given the effect claimed for it, the Court said, the company was still liable, for the reason that, when the manager of the company directed the boy to obtain an answer to the message, the boy became the agent of the company, and the fact that he asked, waited for, and received the plaintiff's message constituted a waiver of the regulation by the company.

PERSONAL.

MR. FRANK J. SPRAGUE has returned to New York after a prolonged stay in London, in connection, it is understood, with traction matters.

MR. C. H. GRANT, of the Northern Pacific telegraph department, St. Paul, claims to have developed satisfactorily a new combination telegraph and telephone system.

DR. W. ESTY, of the University of Illinois, has become assistant professor in the electrical engineering department of Lehigh University. Mr. R. M. Wilson, of the department, has recently resigned.

MR. F. R. WELLES, the manager for the Western Electric Company in Paris, and one of the most ubiquitous electrical men in Europe, is now at home in this country, and is visiting New York, Chicago, etc. His family is with him.

MR. EDSON BRACE, said to have been formerly connected with the United States Patent Office, has favored the St. Louis Exposition people with a plan for a building of steel and glass for electrical and therapeutical exhibits. "The prime idea would be complete insulation from the earth." Mr. Brace also discusses the "saturation of the human body with magnetism." We trust there will be no electricity building there of this marvelous kind or any other kind.

BUFFALO PERSONALS.—Following is a list of names of recent registry at the booth of ELECTRICAL WORLD AND ENGINEER, Electricity Building, Pan-American Exposition, Buffalo; Dr. A. E. Kennelly, Philadelphia; J. C. Freeman, Mt. Pleasant, Mich.; F. P. Wood, Denver, Colo.; Luther Stieringer, Buffalo; L. A. Pollard, Boston; Frank Fowzey, Johnstown, Pa.; J. W. Van Buckirk, New York, N. Y.; Chas. Kuschman, Perth Amboy, N. J.; H. S. Darlington, LaGrange; Paul M. Krahmer, Chicago, Ill.; Samuel M. Strub, Toledo, O.; Geo. Swilzer, Watertown, N. Y.; J. Murray, Chicago, Ill.; Mr. O'Connell, Buffalo, N. Y.; Mr. Nova, Buffalo, N. Y.; Erle W. Miller, Council Bluffs, Iowa; Robert C. House, New York, N. Y.; Louis C. Smith, Philadelphia, Pa.; Geo. F. Clement, Woodbury, N. J.; G. F. Robinson, Pittsburg, Pa.; H Lucia, Chicago, Ill.; Alfred Shields, Greenville, Miss.; Sheriden C. Sell, Buffalo, N. Y.; S. Kochline, New York, N. Y.; F. W. Kroff, Lockport, N. Y.; R. M. Douglass, Jackson, Mich.; Wm. J. Kelly, Portsmouth, N. H.; E. C. Markham, Albany, N. Y.; Chas. Le Blanc, Paris, France; Mr. Bailey Whipple, Cleveland, O.; Wallace M. Probasco, New York, N. Y.; A. Serafini, Buenos Aires, Argentine; R. B. Treat, Newark, N. J.; C. E. Brenton, Indianola, Ia.; J. Haskins Smith, Chicago, Ill.; J. T. Kester, Hillsboro, Ill.; T. C. Tuegger, St. Thomas, Canada; C. A. B. Halvorson, Lynn, Mass.; Wm. D. Young, Cleveland, O.; John M. Marvin, New Haven, Conn.; Wallace Belmont, Buffalo, N. Y.; George Gilbert, Philadelphia, Pa.; G. W. Mackie, Hamilton, Ont.; G. F. Conckling, Plainfield, N. J.; J. E. Dwyer, Plainfield, N. J.; B. T. Conkling, Somerville, N. J.; Van Rensseler Lansingh, Chicago, Ill.; C. C. Spooner, Salida, Colo.; Chas. F. Fell, Buffalo, N. Y.; C. Wiler, Chicago, Ill.; L. E. Hamilton, Chicago, Ill.; B. T. McCormick, Ithaca, N. Y.; H. T. Hall, Schenectady, N. Y.; M. H. Gatchell, Lancaster, N. Y.; W. Jac. Marland, New York, N. Y.; C. R. Sturdevant, Lexington, Ky.; C. Emmelt, Lockport, N. Y.; A. G. Damke, Chicago, Ill.; H. A. Somax, Buffalo, N. Y.; M. R. Berry, Atlanta, Ga.; G. W. Johnston, Buffalo, N. Y.; W. E. Congdon, Salem, Conn.; J. K. Robinson, Iquique, Chili; Wm. D. Ray, Detroit, Mich.; B. W. Steele, Atlanta, Ga.; A. Hengstenberry, New York City; H. C. Wilson, New York, N. Y.; W. W. Sides, Corydon, Ky.; R. L. Torpy, Syracuse, N. Y.; John B. Neely, Spartansburg, Pa.; W. F. Meyers, St. Johns, N. B.

Trade Notes.

THE UNITED STATES STEEL CORPORATION, the largest concern in the world, has in use over 100 Cross oil filters in its mills. They were furnished by the Burt Manufacturing Company, of Akron, Ohio.

SEWING MACHINE MOTOR.—The Paragon Fan & Motor Company, New York, is making a compact and easily attached motor for the operation of sewing machines. These motors are made for both direct and alternating current, and are described and illustrated in Bulletin No. 65, issued by the company.

THE CITY OF QUINCY, MASS., has awarded the contract for building the bridge over the New York, New Haven & Hartford Railroad tracks at Warren Street to the National Bridge Company, 45 Broadway, New York. The structure is 182 feet long, and the contract includes the foundation work.

ENCLOSED ARC LAMPS.—Bulletins 13A and 15A, of the Manhattan General Construction Company, New York, refer, respectively to the "Manhattan" multiple alternating enclosed arc lamp, and the "Manhattan" multiple direct-current arc lamp. Different styles of both types of lamps are illustrated, and their principal points described.

WESTERN ELECTRIC GENERATORS.—The Western Electric Company in its Bulletin No. 2003 describes and illustrates its generators for 125 and 250 volts for power and lighting. The excellent illustrations bring out unusually well every detail of the machines—so much so, in fact, that the accompanying explanatory text is almost unnecessary.

SPRINGS.—The Wallace Barnes Company, Bristol, Conn., makes springs from all kinds of material, steel, brass and phosphor bronze, and any size wire, either flat or round. It has been enlarging its plant with a building 110x36 feet. This will enable it to double its tempering capacity, allowing it to make shipments more promptly than in the past.

THE HAINES & NOYES COMPANY, Chicago, has placed a number of agencies with prominent electrical houses throughout the East. It is pushing its absolutely non-packing transmitter, which contains no felt or other moisture-absorbing material. It will be glad to send a sample transmitter to any one interested. Mr. C. K. Hill, 210 Seventh Street, one of the largest wholesale electrical supply houses of Pittsburg, has just taken an agency for the company's guaranteed telephone apparatus. H. I. Sackett, of Court Street, Buffalo, has taken the agency for Buffalo.

STORAGE BATTERIES FOR ELECTRIC RAILWAYS.—Sipe & Sigler, of Cleveland, manufacturers of the Willard battery, state that the demand for batteries for power-house work is increasing at an astonishing rate. They have just completed a battery of 264 cells, 600-ampere hours capacity, for the Canton-Massillon Railway Company. This will be placed in operation as an auxiliary in a very few days. They recently closed their eighth contract for the government War Department, consisting of 60 cells of 1120-ampere-hour capacity, to be installed at Fort Adams near Newport, R. I.

SIGNALOID, a coloring and frosting liquid for incandescent electric lamps, is rapidly attaining a very wide sale. The manufacturers of this article, the Phenix Chemical Works, 203 Washington Street, Brooklyn, report orders from almost all parts of the world, and amongst their many customers they count some of the largest electrical concerns in America. It is claimed for Signaloid that it will never peel, chip nor crack, and will outlive the life of the lamp. It is said to contain no narcotic substance and the largest lamp manufacturers who do coloring say that Signaloid does not affect the person who does the coloring, and he does not become ill, as is often the case where injurious coloring is used.

FREE SCHOLARSHIPS FOR MECHANICS.—Attention has been called to the notice of the withdrawal of the free scholarship offer recently made by the American School of Correspondence. The American School of Correspondence is situated in Boston. The school is chartered by the Commonwealth of Massachusetts, and, it is understood, enjoys the respect and confidence of thousands of earnest students throughout the United States. Many of these are graduates from the leading technical schools who enroll for the purpose of taking up subjects not included in the courses at college. The instructors are all graduates of leading scientific schools, and have had valuable experience along engineering lines, a number being on the instruction staff of the great technical schools for which Boston is famous. The courses have been carefully laid out by prominent educators and engineering experts, and embrace every subject required by the up-to-date engineer and mechanic in order to have complete mastery over the theoretical details of his daily work. The school was founded to give high grade instruction to those men who have been compelled by adverse circumstances to leave school at an early age in order to earn a living. A postal card addressed to the American School of Correspondence, Boston, Mass., will procure a handsome handbook describing its methods and courses and giving letters from graduates expressing the results of their experience.

THE SCRANTON SCHOOLS.—The display of The International Correspondence Schools at the Pan-American Exposition, has just been completed. It is situated in the northeast corner of the Liberal Arts Building, where an enclosure has been erected for all educational work. The exhibit occupies what is termed 3 units; that is, three cases against the high board partition furnished by the Exhibition to the various exhibitors. The lower part of the cases contains complete sets of bound volumes, above which are arranged three cases containing about 100 cards on which are mounted samples of students' drawing plates, photographs of the different departments of the schools, and practical examples of students' instruction papers and original designs executed after studying the courses. Above the cases of drawing plates is a high screen covered with red burlap, across the top of which, in large brass letters, the title, International Correspondence Schools, Scranton, Pa., is inscribed. In the center of the screen is the framed certificate awarded by the Franklin Institute, of Philadelphia, on each side of which is a tablet describing the schools' methods and what they accomplish. The electrical outfit, drawing outfit, and blowpipe outfit form conspicuous features of the arrangement between the tablets and the top of the cases containing the cards, and small signs, or labels, over each inform the visitor that one of these outfits is furnished to each student in certain courses. The object of the display has been to illustrate the system of education rather than to advertise the schools.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUG. 13, 1901.

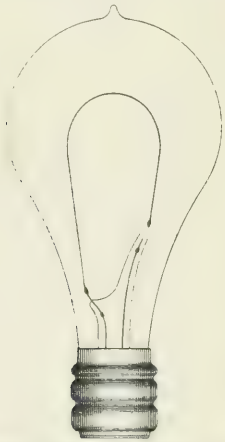
[Condensed by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

680,2[illegible]. ELECTRICAL COULOMB METER; Samuel E. Doane, of Marlboro, Mass. App. filed Dec. 10, 1900. (See Current News and Notes.)

680,236. REGULATION OF DYNAMO ELECTRIC MACHINES; Harold Edwards, of Schenectady, N. Y. App. filed May 17, 1901. (See Current News and Notes.)

680,242. INCANDESCENT ELECTRIC LAMP; H. Gilmore, Boston, Mass. App. filed June 14, 1899. One leg of the filament is considerably shorter than the other, to prevent vibration of the filament.

680,254. ELECTRICAL CONDUIT AND BOX; H. Krantz, Brooklyn, N. Y. App. filed May 3, 1901. The connecting necks of the box are in two parts, one formed with the body of the box, and the other a separate piece.



680,242. Incandescent Electric Lamp.

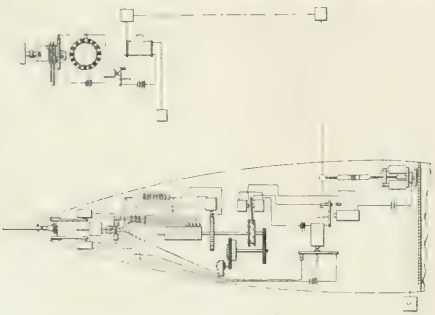
680,265. CURRENT COLLECTOR DEVICE; W. S. Moody, Schenectady, N. Y. App. filed May 22, 1901. A contact ring having an extended surface adapted to be pressed against substantially the entire periphery of the collector ring.

680,277. ELECTRICAL CONDUCTOR; E. D. Priest, Schenectady, N. Y. App. filed May 31, 1901. To prevent excessive formation of eddy currents in armature conductors, the latter is formed of parallel strips crossed at suitable intervals.

680,286. TROLLEY GUARD; C. E. Stanley, Canton, Ohio. App. filed March 20, 1901. A yoke is journaled in the forks of the trolley arm and carries guide wheels immediately above the trolley wheel.

680,376. TIMED ELECTRIC SWITCH FOR MULTIPLE RATE METER SYSTEMS; F. R. M. Cutcheon, St. Paul, Minn. App. filed March 29, 1901. Details.

680,336. ELECTRIC SWITCH; G. E. Linton, Worcester, Mass. App. filed



680,503.—Autotorpedo.

Sept. 14, 1900. The switch blades are tubular and of insulating material for a part of their length, the tube carrying a fuse.

680,408. APPARATUS FOR USE IN ELECTRO-DEPOSITION OF METALS; Sherard Osborn Cowper-Coles. App. filed April 8, 1901. (See Current News and Notes.)

680,421. TRANSFORMER; F. C. Sutter, Pittsburg, Pa. App. filed May 23, 1901. The primary and secondary are divided up into sections and placed upon different parts of the magnetic circuit, the sections being connected in multiple across the mains.

680,437. TROLLEY STAND; E. J. Parker, Worcester, Mass. App. filed Jan. 31, 1901. Details.

680,440. ELECTROLYTIC APPARATUS; Brodde E. F. Rhodin, of Sault Ste. Marie, Canada. App. filed July 19, 1900. (See page 297.)

680,441. ELECTRODE FOR ELECTROLYTIC CELLS; Brodde E. F. Rhodin, of Sault Ste. Marie, Canada. App. filed July 19, 1900. (See page 297.)

680,444. SAFETY STOP FOR VEHICLES; A. L. Stevens, New York, N. Y. App. filed June 4, 1900. The safety stop is operated by the weight of the driver on the seat.

680,490. APPARATUS FOR INDICATING THE LEVEL OF CHARGES IN FURNACES; T. H. Martin, Cleveland, O. App. filed March 2, 1901. Electric terminals are distributed in the furnace, so that the material therein will affect the circuits and operate an indicator to show the level.

680,505. AUTOTORPEDO; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 1, 1901. A wireless telegraph system embodying a torpedo as its receiving station to which directing signals are sent from a keyboard.

680,535. APPARATUS FOR CHARGING STORAGE BATTERIES OF AUTOMOBILE VEHICLES; J. B. Meriam, Cleveland, Ohio. App. filed Oct 11, 1900. A circuit breaker automatically opens the circuit and at the same time cuts off the fuel supplied to the engine which drives the dynamo.

680,543. PROCESS OF PRODUCING PIPERDIN; Wilhelm Pip, of Darmstadt, Germany. App. filed Jan. 12, 1899. (See Current News and Notes.)

680,567. TROLLEY WHEEL; W. C. Cottrell, Asbury Park, N. J. App. filed Nov. 22, 1900. Details.

680,580. SOLDERING TOOL; F. Fouche, Paris, France. App. filed Sept. 15, 1900. A soldering bit is adjusted to an electric heater attached to a handle.

680,590. ELECTRICAL SIGNALING APPARATUS; Felix Benedict Herzog and Schuyler Skaats Wheeler, of New York, N. Y. App. filed Jan. 25, 1886. (See Current News and Notes.) Relates to transmitter of the teleseme.

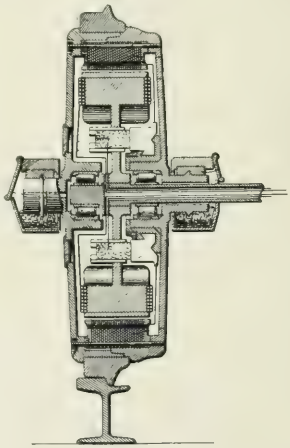
680,597. DYNAMO-ELECTRIC MACHINE AND ELECTRIC MOTOR; Henry Francis Joel, of London, England. App. filed May 21, 1901. An annular field consists of two dove-tailed sections, each section carrying two radially-projecting poles. A single continuous and sinous magnetizing coil partially embraces in succession a considerable periphery of the poles in a manner to magnetize each pair with equal and opposite polarities.

680,614. PHOTOPHONOGRAPH-PHOTOPHONE OR SIMILAR DEVICE; Joseph Poliakoff, of Charlottenburg, Germany. App. filed July 17, 1900. (See Current News and Notes.)

680,618. ELECTRIC AUTOMOBILE MOTOR; C. Richter and R. T. Eschler, Camden, N. J. App. filed Jan. 15, 1901. An electric motor is built into the wheel of the automobile.

680,619. ELECTRIC TRACTION MOTOR; C. Richter and R. T. Eschler, Camden, N. J. App. filed Jan. 15, 1901. Modification in the details of the preceding invention.

680,626. ELECTRICAL SWITCH OPERATING MECHANISM; C. B. Russell, Marlboro, Mass. App. filed May 3, 1901. Two magnets are used to act alternately upon an armature mechanically connected with the switch.



680,619.—Electric Traction Motor.

680,629. ELECTRIC BELT; J. Trussell, Chicago, Ill. App. filed Dec. 8, 1900. Details.

680,636. DEVICE FOR LIGHTING LAMPS BY ELECTRICITY; H. M. Brigham and S. M. Meyer, New York, N. Y. App. filed Feb. 5, 1898. Details.

680,662. TROLLEY STAND; E. J. Kelley, Baltimore, Md. App. filed Dec. 14, 1900. Details.

680,663. TROLLEY STAND; E. J. Kelley, Norfolk, Va. App. filed May 18, 1901. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, AUGUST 31, 1901. No. 9.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 24, 1901.

CONTENTS.

PAGE
Editorial 319
Electrical Development in England 322
Independent Telephone Development 322
Electrical Engineers of the Day—IX. Geo. T. Hanchett 322
Some Details of German Electrical Generating Station Practice. By E. Kilburn Scott 323
The Situation in Independent Telephony 328
A Long Electric Railway in Massachusetts, by Alton D. Adams 329
Telephone Magnetos for Delivering Pulsating Currents for Selective Signaling, by Norman H. Holland 327
Development of the Nernst Lamp in America, by Alexander Jay Wurts 328
Seventh Annual Convention of the Ohio Electric Light Association 331
Telephone Line for Farmers 335
Railway Deals in Ohio 335
Buffalo Convention of the American Institute of Electrical Engineers 339
Supply Device for Electrolytic Cells 344
Operating the New York Central Railroad Tunnel 344
Current News and Notes 345
LETTERS TO THE EDITORS:
Heating of Rotary Converter Armatures, by B. A. Behrend 346
Power Distribution in Steel Works, by C. H. Hines 346
Humming in Church, by G. W. Cook 346
Digest of Current Electrical Literature 347
New Books 351
An Electric Voting Machine 352
Effects in Church Lighting 352
American Incandescent Lamp Company 353
Morse Twist Drills at Buffalo 353
Electrical Engine Stop System 353
American Engine Company's Pan-American Exhibit 353
DEPARTMENTS:
Financial Intelligence 354
Commercial Intelligence 355
General News 356
Trade and Industrial Notes 361
Record of Electrical Patents 362

THE INSTITUTE CONVENTION.

The Buffalo meeting of the American Institute of Electrical Engineers was unquestionably one of the most successful in the history of that body. Indeed, if judged by the timely nature and practical engineering interest of the majority of the papers read, and the liveliness and value of the discussions, it ranks as the most successful, not excepting the Chicago World's Fair convention. The attendance was also very good, and surprisingly well sustained, although the convention opened on Tuesday and did not adjourn until Saturday afternoon. On the other hand, a disagreeable feature was the entire failure in the execution of the carefully prepared plans for the reception of the members and the guests, both upon the arrival at Buffalo and upon the opening of the convention, which failure was the more marked through contrast with the admirable manner in which the programme up to Buffalo had been carried out in its slightest details. Another annoyance was incident to the convention being held in connection with an exposition. Traveling long distances in sultry weather in street cars filled to suffocation, and with the entire commercial element of the city apparently banded to extort, if possible, your last penny—these are conditions not conducive to that serenity of mind which should preside over the discussion of questions of science. Though the Institute met within the Exposition grounds by invitation, the members were accorded no privileges as at Paris. They were required to pay each time they entered the grounds, which in some cases, owing to the Institute programme, involved two admission fees in a day. The Buffalo meeting also showed once again that the most objectionable feature of meetings of the Institute in connection with expositions is the little opportunity afforded the members in attendance for the extension of acquaintance and the personal interchange of ideas.

In view of the general objection to Institute meetings in connection with expositions and the particular ones arising from the Buffalo experience, we hope the Institute may not consider it again desirable to assume the role of an unappreciated side show to an exposition. If some ulterior attraction is thought necessary to secure a large attendance, this might be found in a summer resort, which would have the additional advantage that relaxation could be united with proper attention to the professional objects of the gathering. If such meetings were held the latter part of June before the summer exodus to seaside and mountain fairly sets in, we venture to say that no difficulty would be encountered in obtaining at moderate expense first-class accommodation in the highest class hostelry.

THE NERNST LAMP.

A large amount of our space this week is occupied by the Institute paper of Mr. Wurts on the Nernst lamp, which we print in full. The subject is one of much importance to those engaged in the electric lighting industry, and of interest to all concerned in electro-technics, and the paper embodies a large amount of data now for the first time made public. Proposing to discuss the paper somewhat fully ourselves, as soon as opportunity offers, we can in the meantime commend it to our readers, and express pleasure at the notable advances therein recorded.

TROLLEYS AND ENGLISH RAILROADS.

The decline in the net revenues of English railways is attracting attention. The figures are, indeed, quite striking, and suggest the need of an early remedy. Mr. H. Allaway, a well-known financial expert, in summing up the conditions in the *New York Times*, shows for last year a net falling off of $7,000,000 in the returns of 15 of the leading systems. The London & Northwestern line pays this year a dividend of only 2¼ per cent, or less than at any time since 1863, and the chairman ascribes the decline as due to the competition of the new trolley systems. It is now stated that the company will take up and deal with this problem; in fact, it must do so, just as the New York Central is doing—for it is now rumored that the Central has retained for this work Mr. Bion J. Arnold, who did the pioneer long-distance railroad work out West; in fact, his commission is said to include the planning of a scheme to operate the New York Central by electricity, all the way from New York to Albany.

Returning to the English roads, it is obvious that while they are not feeling the pinch of hard times, as gross traffic is virtually heavier than ever, the cost of steam operation can no longer be endured. We venture to think that England is about to demonstrate on a grand scale the application of electricity to heavy railway work, and there are many conditions there which are more favorable than those to be encountered here. In reality, the trolley competition in England looks to an American as almost negligible, but it is evidently felt. Moreover, there is the still new competition of the automobile. Just what that will amount to no one can tell, but King Edward makes his run from London to Windsor in about an hour, quite often, it is said, and every time he or others like him do that, the railroads are out a handsome fare.

INCANDESCENT LAMPS AT THE BUFFALO EXHIBITION.

The beauty of the electric lighting at the Buffalo Exhibition is due to the fact that it is all incandescent lighting (with the exception of a few flambeaux of natural gas). These lamps are nearly all 8-cp lamps. The total number of these lamps has not yet been officially announced. It is said, however, that 4000 horse-power are transmitted to the Exhibition from Niagara and used for lighting purposes. If this is the case, and if each lamp takes, say, 30 watts, then there will be about 100,000 lamps employed in all. It is curious to remember that each incandescent lamp filament weighs only about a milligramme, and that consequently the entire mass of the lamps collected together would only be a few ounces, making a parcel that could easily be carried in the hand.

A RETROSPECT OF NIAGARA POWER.

One of the most striking papers read at the Buffalo meeting of the A. I. E. E. was the review of eight years of power transmission at Niagara by Mr. L. B. Stillwell, who, as engineer for the Westinghouse Company and afterwards for the Niagara Power Company, has unequaled opportunities for studying the situation. Now that the battle of systems is over and the smoke thereof has blown away, one can look at the situation fairly and discuss the merits of the installation without the imputation of favoritism, and Mr. Stillwell himself does not hesitate to do so. He has a very pardonable pride in the great plant, the success of which he did so much to ensure, and may well be gratified at the few changes which have been necessary in the later equipment. To understand the engineering peculiarities of the Niagara plant aright one must realize the conditions under which the work was initiated. It was organized as a comercial enterprise when there was no art of electrical power transmission. Even when the contracts were let, polyphase transmission was barely yet in the commercial stage of development on the continent, while in this country there was nothing running outside of the manufacturers' workshops, although several plants were under construction. Started at such a time, the original scheme boldly contemplated the building of a great manufacturing metropolis above the Falls, where would be gathered, drawn by the irresistible attraction of cheap power, the larger industries of half a continent. Hence to obtain available space for such a colossal enterprise the land above the Falls was secured and the huge tunnelled tail race was constructed at an expense enormously greater than would have been necessary if the hydraulic plans had contemplated merely the gigantic power transmission plant which actually has grown up. Entailed upon the system by this fundamental departure were striking hydraulic details, technically magnificent, but utterly without the scope of the engineering plans which would normally be made for the utilization of such a power.

To a lesser extent the same original conception of a power city dominated the electrical development. As Mr. Stillwell very frankly indicates, with an extended power transmission service in view, the three-phase rather than the two-phase system would have been the logical choice, although now through the introduction of phasing transformers, the use of three-phase or two-phase generators is a matter of individual taste, almost of indifference. The choice of two-phase at the time was probably due mainly to various non-technical considerations, although one of the consulting engineers later displayed something akin to the odium theologicum by damning the three-phase system for this case on account of the reputed effect of unbalancing upon the lights, while in the same breath he sanctioned the use of a frequency which made lighting from the Niagara circuits impracticable. That the frequency chosen was below that suitable for incandescent lighting was unfortunate in view of later developments, and Mr. Stillwell expresses a strong personal preference for 30 cycles which would, in part at least, remove this difficulty. When the function of the Niagara plant expanded from local power supply to the broader and more brilliant field of electrical distribution over a radius of many miles, lighting became a consideration of no small importance, and it is certainly a pity that the major part of the lighting of Buffalo should have to be accomplished via motor-generators to bring the frequency to a feasible figure. The only material reason for a frequency even so low as 30 cycles is some added facility in the use of rotary converters, and in point of fact substantially all transmission plants designed for the general commercial distribution of electrical energy have deemed it wise to operate at 50 to 60 cycles, even when supplying a considerable load for electric traction and operating, like the great system recently inaugurated in California over 150 to 200 miles of line. On the whole, electrical energy at 60 cycles is a more saleable article than at 25 cycles, and it seems to us at least a debatable question whether in adhering to the old frequency for the immense new plant there is not too great a sacrifice for the sake of uniformity.

The advantage to the art from the colossal scale of the Niagara work has been inestimable. Problems of every kind have presented themselves for solution and have in general been successfully solved. The mere matter of switchboard construction on the gigantic scale there needful almost called for the development of a new art. The solution adapted from railway switch tower practice is certainly beautiful. The switchboard for eleven 5000-hp generators must of necessity be too large for effective manual control, but a board in miniature controlling and interlocked with the main board is both wonderfully effective and delightfully facile of operation. One of the many important matters brought out by Mr. Stillwell, and which we are particularly glad to see presented in its true light, is the question of the

general use of conduits for high-pressure transmission circuits. It is a good thing to have their prohibitive cost put squarely upon record. It is so great that even if they had an infinitely long life, which is hardly to be anticipated, they would still be an impossible burden to carry. There is every reason to believe that for transmission circuits at the voltages now generally employed, an overhead line can be made on the whole fully as reliable as a conduit and at a small fraction of the expense. On the new Niagara line there is shown an appreciation of the weak points of overhead construction that is very gratifying. It is indeed a strange thing that until very recently power transmission companies stuck rigorously by the pins that had originally been planned for telegraph wires. Work on a large scale must imply some variation from small models, and lines of 500,000 cir. mils. cables certainly require strong suspending parts. Of troubles on the lines due to the ordinary course of accidents, the Niagara plant has had its share, and from what Mr. Stillwell indicates, we should judge that certain phenomena connected with resonance had been not altogether unknown, but with all this the plant has done its work well. We note with strong approbation that its engineers have stood out firmly for first-class inherent regulation, and have obtained it. We believe that it is necessary for first-class service in a long-distance transmission plant. The generators are not as cheap to build as those that regulate poorly, but they stand up to their work under variations of load and of power factor in a way that greatly facilitates good service. In the long run, good service is the criterion of success.

Surgings in Circuits.

Mr. C. P. Steinmetz, in his valuable paper read before the A. I. E. E. Convention last week, has added another contribution to the Transactions which will become classical. The paper deals with the waves which occur on long-transmission lines having distributed inductance and capacity. For the sake of simplicity, he substitutes localized capacity for distributed capacity, and assumes that the transmission line has all its capacity connected to the circuit at the center of its length. This reduces the case to a pair of wires half the length of the actual line, possessing resistance and inductance, and terminating in a condenser of the total line capacity. In any such circuit it is known that if we suddenly apply a simple alternating e. m. f. at the generating end of the line, a simple alternating current will be found to flow in the circuit after a considerable number of cycles have been executed, or periods have elapsed. But in the initial stage of the operation there is a disturbance, which dies away logarithmically. This disturbance, which appears in the differential equations as an evanescent constant, is the surging effect of applying an e. m. f. to the circuit, as though a direct-current e. m. f. of equal magnitude had been applied to the imaginary half-line and terminal condenser. The disturbance is oscillatory, and has the frequency of the half-line circuit, and not the frequency of the alternating-current generator. The magnitude of the surging e. m. f. cannot exceed the magnitude of the impressed e. m. f. at the top of its wave, so that the total instantaneous e. m. f. brought to bear upon the line cannot be more than the maximum cyclic impressed e. m. f., plus the temporary surging e. m. f. of equal magnitude; i. e., a total of double the maximum impressed e. m. f. If the impressed e. m. f. is applied to the circuit at a time when the instantaneous e. m. f. is zero, or nearly zero, then the surge will be very small.

On breaking the circuit there will be similar surges. The simplest way to deal with them is to consider that when a current is flowing in the imaginary half-line circuit with terminal condenser, that current will have an electromagnetic *vis-viva* equal to LI^2, where L is the total inductance of the half-line circuit, and I the strength of the current. This represents energy stored up in the surrounding ether and associated with magnetic flux. If the circuit is instantly broken, this electromagnetic energy will be liberated in a manner that will give rise to surgings, and if the system had no resistance, either conductive or hysteretic, there would be no energy dissipated, the energy would be alternately electric and magnetic, and the surgings would go on indefinitely in the disconnected circuit. The electromagnetic energy of the type LI^2 will disappear as soon as the surging current is stopped by the condenser, and will take the form of electrostatic flux energy in the condenser, of the type CE^2, where E is the surging e. m. f. and C the capacity of the condenser. At the moment, the current has vanished, the condenser energy is equal to the previously magnetic energy, and consequently the surging e. m. f. in the condenser is $I\sqrt{L/C}$ volts, or $I\sqrt{KX}$, where K is the reactance of the condenser, and X the inductance reactance of the half-line circuit. That is to say, the e. m. f. at the first surging wave will have the strength of the current broken in the circuit, times the geometric mean of the two reactances of the half-line circuit. This surging e. m. f. may be considerably greater than the e. m. f. supplied by the generator when the current interrupted is full-load current, on the assumption that the interruption occurs at the top of the full-load current wave. If the interruption occurs at or near the bottom of the wave, the surge will be small. Moreover, in circuits of large inductance and small capacity, such as overhead wire circuits, the condenser representing the total capacity of the line will be comparatively small, and the surging e. m. f. which will store up in that capacity an energy equal to the electromagnetic energy of the current at interruption, will be much greater than where the capacity is large, as in underground wires, where, moreover, the inductance is somewhat less. Consequently, in underground wires the surge is fortunately not so great as in overhead wires, other things being equal.

The most dangerous surgings are those which may happen when a short-circuit occurs at the receiving end of the line, and when this short-circuit current is suddenly interrupted. Here, owing to the strength of current momentarily flowing, the stored magnetic *vis viva* LI^2 may be far greater than that accompanying the full-load current wave crests. If such a short-circuit current is interrupted suddenly at the top of the wave, the surge e. m. f. of an overhead circuit may be 100 times greater than the e. m. f. of the generator, as Mr. Steinmetz pointed out. The surging frequency depends upon the length of line and upon the reactances of the line, but is usually considerably higher than the frequency of the working alternator. It is evident, therefore, that there is danger to insulation in breaking an alternating-current circuit at the current-wave crests, and the danger increases with the strength of the current. It would also seem that if a condenser capable of standing the working pressure, and of suitable capacity, were brought into connection with the circuit at the moment when the circuit was broken, the surge of e. m. f. might be kept from rising by storing the energy in this condenser. From this point of view, capacity in a transmission circuit is useful, except in so far as its charging current or hysteretic loss may be objectionable during operation.

The important point brought out by the paper is that while resonance during the operation of a long-distance alternating-current circuit may be quite small, this resonance being due to forced oscillations from the generator, due to the fundamental frequency, or odd multiple harmonics thereof, there may be considerable danger from line resonance at making, breaking or suddenly changing the load on the circuit, due to free oscillations in the circuit, and that the disturbance due to suddenly interrupting a short-circuit is the most of all to be feared.

Electrical Developments in England.

Mr. George Westinghouse returned last week from England, where he has been since May 1 on business in connection with the development of the British Westinghouse Company. In view of the rumors of a clash of interests between himself and Mr. Yerkes about the electrical equipment of the District Underground Railway in London, of which road Mr. Yerkes has the control, Mr. Westinghouse authorized a denial of the story, and said: "There are absolutely no differences between Mr. Yerkes and myself. As a matter of fact, he has awarded to the British Westinghouse Company the contract for engines of 30,000 horse-power and generators for his Metropolitan District Railway. He will require much more apparatus, the manufacture of which in England will be advantageous to his interests. It may, therefore, be said that his interests and mine are in harmony, with the probability that these operations, respectively, will be mutually helpful."

As to the hostility said to have developed against the American control of the Metropolitan District road and against the improvements by American companies, Mr. Westinghouse said:

"The public want the improvements that are now under way, and while they might prefer to have them as the result of British enterprise, they are glad to have them regardless of the source. Nine-tenths of what has been cabled to America on that subject is exaggerated. I believe such mischievous statements, made by disappointed or scheming people to the London representatives of American newspapers, do great harm to the development of American interests."

Operating the New York Central Railroad Tunnel.

In accordance with rumors that have been current, it is now stated that engineers of the New York Central Railroad have prepared a plan designed to do away with the troublesome smoke and gas nuisance in the Park Avenue tunnel, through which more than 500 trains pass daily. This plan has been laid before President Newman, and will be submitted by him to the executive committee. Two tracks extend through the central section, which is ventilated by frequent large openings into Park Avenue. On each side of this section is a dark tunnel accommodating a single track. These side tunnels are ventilated only by side openings into the central section. It is the purpose of the plan to devote these side tunnels entirely to suburban traffic, which is to be operated entirely by electric motive power. From a convenient point above the Grand Central Station the grade of the side tunnels will be lowered radically so as to form an underground loop pasing into and across the station below the main tracks. The main tunnel is to be more effectively ventilated, possibly by electric blowers.

The estimated cost of the proposed changes, which are here outlined only in a general way, is between $6,000,000 and $7,000,000.

Electrical Engineers of the Day—IX.

George T. Hanchett.

George Tilden Hanchett was born at Hyde Park, Mass., Sept. 4, 1871. While attending high school he became interested in electricity, and by working evenings and during vacations in a local machine shop, succeeded in completing a machinist's apprenticeship. During this time he established a little laboratory, which included some light machine tools, and built small dynamos and motors, induction coils and similar electrical apparatus. Later he began to do work as opportunity offered for local electrical concerns. Entering the Massachusetts Institute of Technology in 1889, he was graduated four years later from the course of electrical engineering with the degree of S. B. While at the Institute and during summer vacations he persisted in his policy of gaining practical experience in workshops, and during this period spent some time in the factory of the Brush Electric Company at Cleveland, where he acquired a practical familiarity with the design, construction and testing of electrical machinery.

Shortly after graduation Mr. Hanchett accepted a position with E. P. Roberts & Co., of Cleveland, and became engaged in laying out wiring plans and designing switchboards, and in other consulting engineering work. Quite a number of local installations in Cleveland were installed from plans and specifications which Mr. Hanchett prepared, among others the Garfield Building, Kennard House, Hollenden Hotel, Soldiers' Monument and Pilgrim Church. In 1894, as electrical assistant of Mr. Charles O. Lenz, he continued the same line of work in Providence, R. I., where he prepared wiring plans for a number of large installations, including the State Armory in Providence, police station and the Auditorium and Broad Street Power Building in Pawtucket, besides doing much detail work pertaining to electrical engineering. In 1895 he accepted a position with the Collyer Machine Company, of Pawtucket, R. I., for which he designed and built a line of electrical machinery, and had general charge of the electrical work of that company.

In the fall of 1895 Mr. Hanchett came to New York to accept a position on the editorial staff of the *Electric Railway Gazette*, and upon the discontinuance of that journal was transferred to the editorial staff of the *Electrical World*. In the fall of the following year Mr. Hanchett opened an engineering office in New York. For the first year the larger part of his time was retained by the Walker Company, of Cleveland, Ohio, but subsequently his consulting business became more general.

Mr. Hanchett has conducted a number of experimental investiga-

tions as opportunity and facilities afforded, and did some work on Röntgen rays, induction coils and electrolytic interrupters at the time when these were of prominent public interest. The results of these researches have been principally published in these columns. We may note as of particular interest the establishment of several new principles in the construction and operation of induction coils, and an investigation of certain anomalous voltage and current phenomena in electrolytic interrupter circuits. In this work Mr. Hanchett gives evidence of marked originality as an investigator. Indeed, originality in thought and methods has been characteristic of every phase of his professional career.

In 1898 Mr. Hanchett invented and placed on the market in connection with Mr. F. B. Sage a direct-reading ohmmeter, which has met with considerable commercial success. Of late years much of Mr. Hanchett's work has been in machine design, and among more recent examples may be mentioned several automobile controller and motor designs, automatic switches for the Murphy Safety Third Rail Electric Company, and a reversible motor compressor for the same company. Latterly he has had entire charge of the experimental work on the Murphy system, and the Baltimore tunnel plant of this system, described in these columns, was designed and installed under his supervision. A large part of Mr. Hanchett's work has been of a varied character, such as tests, expert opinions, investigations and the design of special machinery work requiring much skill and judgment, but not of a kind that brings general professional recognition.

He is a member of the American Institute of Electrical Engineers, and the author of a work on "Modern Electric Railway Motors," which has had a large circulation.

Some Details of German Electrical Generating Station Practice.

By E. Kilburn Scott.

THE boiler houses in German central stations visited recently by the English Institution of Electrical Engineers, are all exceedingly well arranged, and they have, in fact, the appearance of having been designed throughout by the boiler contractor, instead of the boilers being placed in a building and in connection with apparatus designed by some one else.

The double (or elephant) boiler is quite commonly used, and the fire grates are in most cases inclined so as to be self-feeding. This appears to be necessary for the proper burning of the brown lignite coal which is used, it being a coal which gives plenty of ash, but practically no clinker. The boilers are usually arranged in pairs with a gangway all round, so that it is possible to walk quite freely and comfortably right round each set of boilers. Elaborate coal conveying apparatus is always used, but strange to say in the large central stations of the Berliner Elektricitats Werke hand firing is in vogue.

At the Luisenstrasse station in Berlin, and also in the station of the elevated railway, the boilers are placed immediately over the engines, so that piping is reduced to a minimum, the real reason, however, for this arrangement is the great expense of land. It is interesting to note that the German equivalent to the English Board of Trade has made it a rule that no boiler may be placed under any structure other than its own roof.

The engine rooms of the modern German central stations, particularly those in Berlin, at Moabit and Oberspree, and also at Wiesbaden, have been built on a magnificent scale, and are lavishly decorated with glazed brickwork, handsome tiled floors, etc. As a rule, the engine room is high enough for the crane to swing the heaviest castings quite clear of the big machinery, and this, of course, adds to the imposing appearance. High-speed engines are entirely absent, and each low-speed unit has so much space round it, that just about double the amount of plant could be put into the station. From this readers may judge that the standing charges for rates, taxes and interest on foundations and buildings are very high. The contrast with the crowded English stations, filled as they generally are, with high-speed engine plant, is very marked.

The Sulzer, Goerlitz, Collman, and other horizontal engines, which were seen, excited much admiration, not only on account of the splendid proportions and finish, but also because the engines worked so quietly. There is no doubt that in the matter of valve and governor gear for slow-running engines the continental makers have nothing to learn.

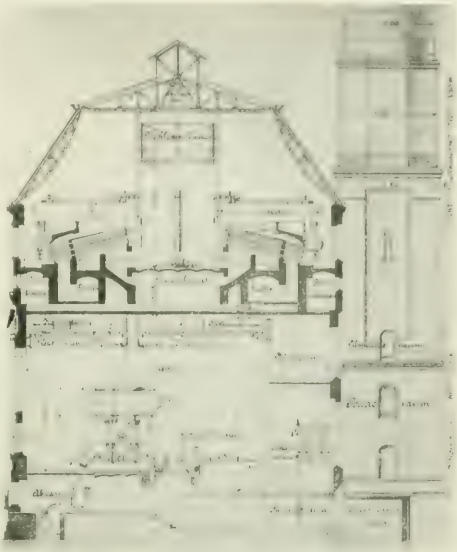


Fig. 2.—Cross Section Power Station, Berlin Elevated and Under Ground Railway.

Very large storage batteries are installed in some of the stations, as, for example, in Hanover. In successful accumulator manufacture, Germany may fairly be said to take the lead, and this is a

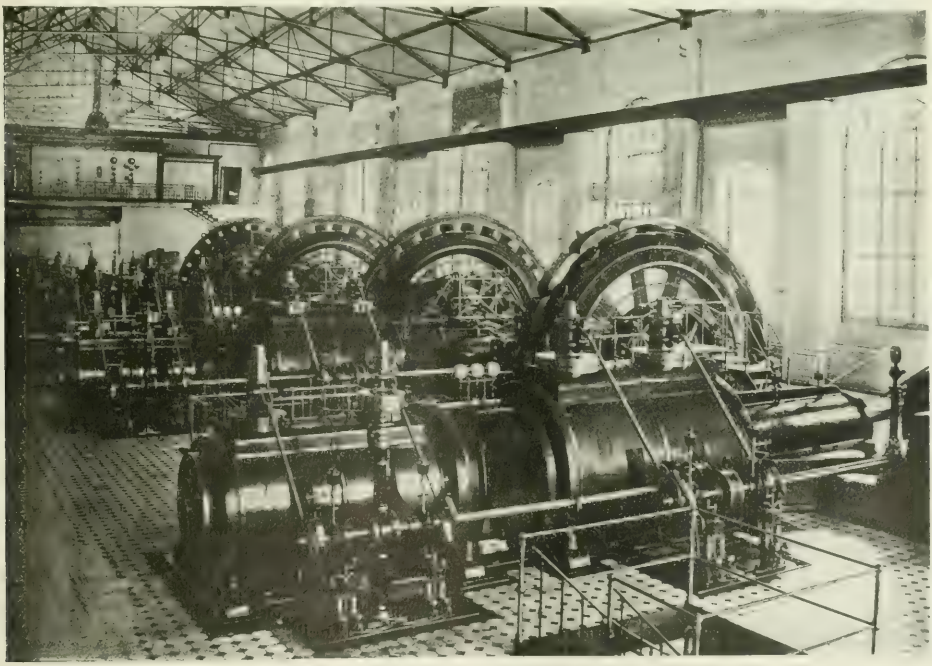


Fig. 1.—General View Dresden Central Station.

good deal due to the success of the Tudor and Hagen cells, and also to the fact that the Germans appear to have recognized the fact that to keep an accumulator battery in proper order it is well to have at least one member of the station staff who is an expert in their manufacture. They do not believe in leaving the battery entirely to the tender mercies of ordinary engine driver or switchboard attendant.

In all the modern engine rooms piping is entirely out of sight, the steam ring or header being, as a rule, arranged vertically on the boiler house side of the wall, and the branch pipes to each engine carried under the engine house floor. This arrangement (the very opposite to English practice) is highly satisfactory, as it reduces the risk of accident, and enables the designer to lay out and ornament the engine rooms on the grand scale which is so characteristic of German central station work.

Coming now to the dynamo machinery, it was interesting to note how many of the old type Siemens & Halske machines are still in use, and also how well they worked. The stationary inner pole machine with a Gramme armature having its outside conductors developed into a commutator has undoubtedly done good work. Even so modern a station as that recently equipped for the Berlin Elevated Electric Railway has this class of machine, the only difference being that it has a separate commutator. (This commutator, by the way, had been erected without having been turned up.)

Regarding the standard multipolar dynamos, there is not much to be said, as all machines nowadays are very similar in design. The pole pieces of most machines were specially shaped, some as in the Schuckert machine being skewed. Some of the machines had brushes only to those poles about the horizontal diameter, which were easy to get at. Combination carbon and gauze brushes are commonly employed, and nearly every machine had a means of lifting all the brushes together when required. Generally speaking, the commutation of the various makes of dynamos was quite beyond criticism, for although most brush rockers were provided with means for ready adjustment, it did not appear to be ever required.

In several instances special efforts were made to keep the commutator cool, etc.; the dynamos, for example, in the Luisenstrasse station in Berlin are fitted with a small electrically-driven air blast to remove the coper and mica dust from the armature, and some of the Lahmeyer dynamos have slots cut right through the segments to allow air to circulate through the commutator from the inside. At the Homburg central station two dynamos are coupled to the same engine, one being of large diameter, to act as a flywheel.

With regard to the alternators, it would appear that the inductor type of machine has dropped out of use. The machine usually employed has a stationary armature and revolving field, each pole having its own coil. The largest and probably the finest alternators, are those of 2500 kilowatts supplied by the A. E. G. to the Moabit and Oberspree central stations inspected by the visitors from England.

As a rule, the armature frame casting is made very heavy and massive, there being a good deal of choice in the actual section employed. There are cases, however, as in the Schuckert machines in Nuremberg central station where the armature frame is made of light section, the necessary stiffness being obtained by radial tie rods, as in the machine which the company showed at the recent Paris Exhibition.

At first sight this light construction appears to be open to much criticism, but when one considers that the problem is very similar to that of a bridge there is much to be said in its favor. At any rate, it is interesting to find the A. E. G. adopting a somewhat similar method for its largest type alternators. The company are now building up their armatures with two side castings and stiffen them with tie rods having right and left-hand screws. Besides cheapening of manufacture and transport the reasons put forward are that it is possible to adjust the air-gap to a much greater nicety, and the armature stampings being exposed on their outer periphery have a better chance of cooling.

The Ferranti edgewise winding for the poles is practically universal, and in some cases the edge of the copper was turned up for appearance sake. In almost all the machines which had solid cast steel poles, the flange of the magnet coils nearest the pole piece is made of very heavy section gun metal. When the poles were laminated, as in the case of A. E. G. machines, damping coils are employed, which consist simply of solid copper rods passed through pole pieces and short-circuited at the ends.

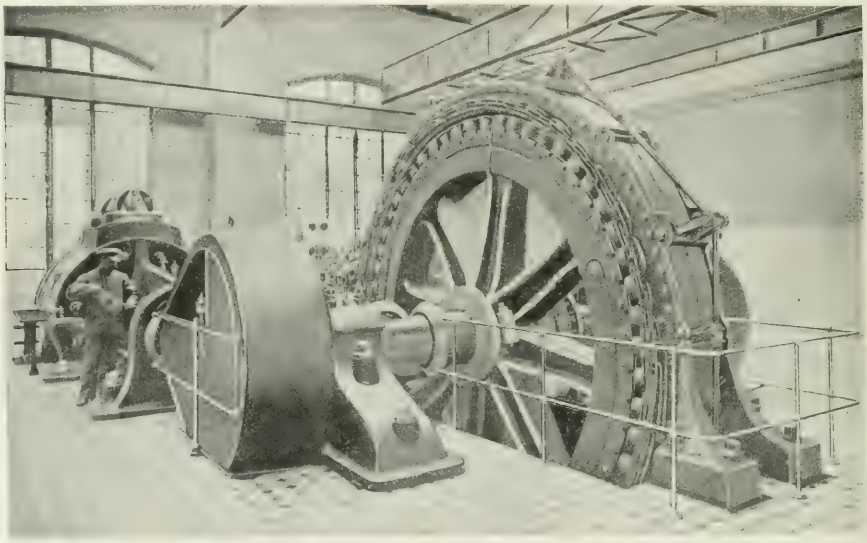


FIG. 3.—THREE-PHASE ALTERNATOR.

Frankfort is an interesting station, because, although a single-phase station, it has a motor load of over 5000 horse-power, including the motor generators for driving the city tramways. The eight alternators in this station are by Brown, Boveri & Co., and they have armature rings which can be revolved when necessary for inspection or repair. The barring engine can be used for turning, either the flywheel or the armature ring. In order to get the engines into synchronism, the flywheel is fitted with a contact piece, which at each revolution makes contact with a projection on the armature ring and so may be made to ring a bell.

The sub-station for the Schiller Platz has four 250-kw synchronous motors driving 500-volt traction dynamos, and there is also a buffer battery and an arc lighting switchboard. It is the largest underground sub-station in the world, and credit is due to the original engineer of the Frankfort station, G. J. Mehns, formerly with the Thomson-Houston Company, for carrying out so fine a job. Single-phase motors are used for all manner of work, including the driving of lift elevators direct.

In several of the Berlin central stations special rotary converters were to be seen which were provided with an alternating-current

booster on the three-phase side. The arrangement is such that by adjusting the field current in the poles of the booster the voltage on the direct-current side can be accurately adjusted within very wide limits, for example, the pressure may be raised high enough to charge batteries.

In the matter of high-tension switches and fuses the German practice is perhaps not as far advanced as one would have expected. Oil break switches and fuses which have been so successful in America and also in England do not appear to be employed in Germany at all.

Some of the switchboards equipped by the A. E. G. have a special carriage type switch, in which the switch contacts are mounted on insulators on a four-wheeled trolley and the break is made by running the truck back.

Fuses are nearly always of the cartridge type, the wires being contained in glass tubes and buried in a refractory material, such as marble dust, powdered mica or talc. When the voltage is extra high, wooden tongs are provided so that the fuse can be removed with less risk of accident.

One of the switches shown to the visitors is worth mentioning on account of its simplicity. It consists merely of a Siemens & Halske horn lightning arrester, fitted with a metal plug at the bottom, where the horns approach each other. In switching off, the plug is withdrawn and the arc then runs up the curved horns until it has a length of several meters, and so is unable to maintain itself. It has been said that when an arc is allowed to persist in this way there is a heaping up of voltage which is dangerous, but, on the other hand, there is a distinct risk to the insulation in making too sudden a break.

The inaccessibility of the switchboard platforms was a matter of some surprise, for the platforms were either fitted with a spiral staircase from the engine room or they were approached from a staircase at the rear. One station engineer explained this by saying that they did not want the switchboard attendant to leave his post nor to make it easy for the engine attendant to go on to the switchboard platform.

As a rule, the back of the switchboard was not shown on account of its being considered too dangerous.

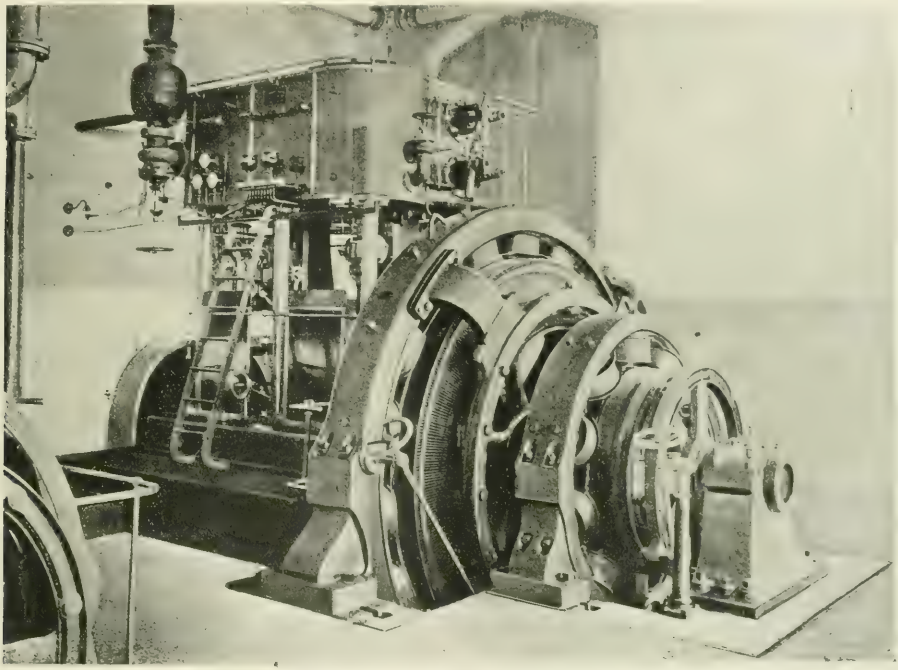


Fig. 4.—Direct-Connected Unit, Homburg Electricity Works.

The Situation in Independent Telephony.

Following is a copy of an announcement sent to the stockholders of the Federal Telephone Company, of Cleveland, Ohio: "The independent telephone situation was never in as good condition in every way as it is to-day. The completion of the work that is now in course of construction, namely, the exchanges at Alliance, Canton, Dayton, Findlay, Mansfield, Springfield, Zanesville, and several smaller exchanges in Ohio, together with Detroit, Jackson, and other important points in Michigan, and the main line of the United States Telephone Company connecting Michigan, West Virginia, Kentucky and Pennsylvania with the present system in Ohio, will make one of the most complete telephone systems in the country, which is a combination of strength not equaled by any other property in existence. (1) On account of the various business interests represented. (2) The property is practically all new and modern. (3) The number of subscribers reached is much greater than that of our competitor. (4) The rates are reasonable and always have been, therefore the public is and will continue with us.

"In addition to the work above described, other companies are pushing the development rapidly in nearly every section of the United States from Boston, Mass., to Seattle, Wash. In order to complete certain new properties we have decided to offer to our present stockholders in addition to their present holdings, the following securities to be designated as Federal Telephone Company, Pool A; payments to be 50 per cent, Aug. 20; 25 per cent., Sept. 1, and 25 per cent Sept. 15, with interest at 6 per cent from the date of payment, to Jan. 1, 1902, all balance to bonds to draw interest in favor of pool holders, from Jan. 1, 1902.

	Bonds.	Stocks.
Findlay Home Tel. Co.	$80,000	$24,000
Citizens' Tel. Co., Fostoria.....	45,000	13,500
Columbiana County Tel. Co...	220,000	66,000
Zanesville Tele. & Tel. Co.....	160,000	48,000
Lancaster Tel. Co.	45,000	13,500
	$550,000	$165,000

"For each $900 paid into Pool A the subscribers will receive a receipt of the Federal Telephone Company entitling them to $1000 bonds and $300 stock bonus in the above named companies.

A Long Electric Railway in Massachusetts.

By Alton D. Adams.

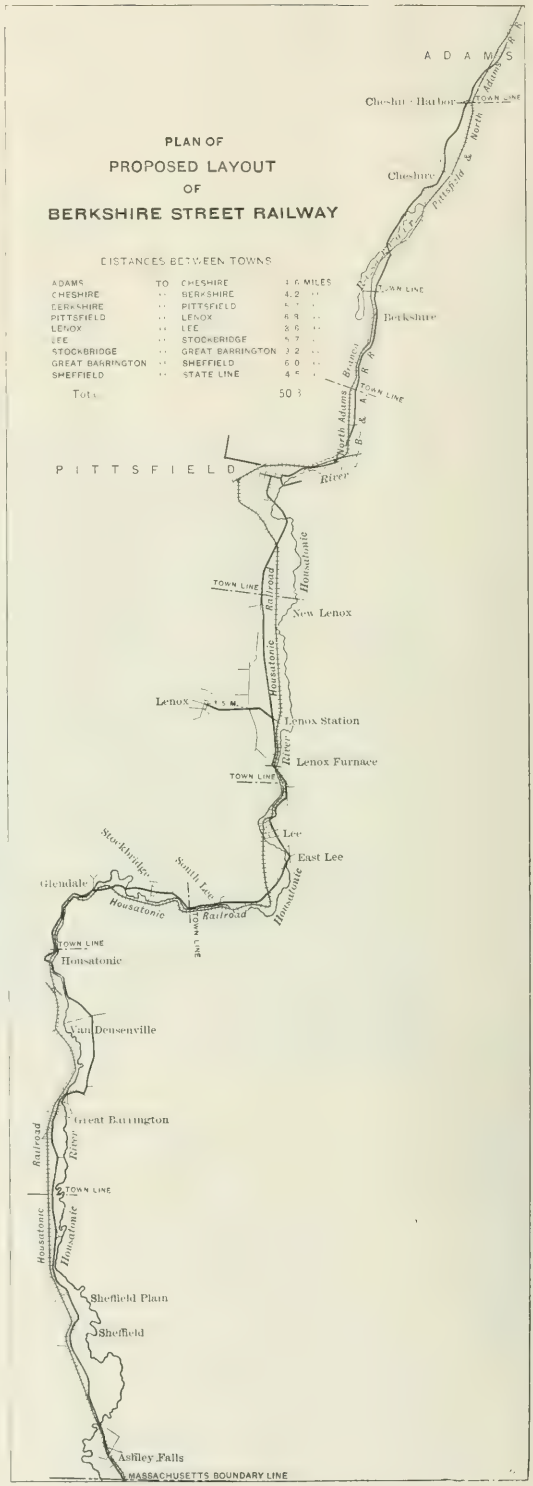
SOME interesting railway work has just been inaugurated in Massachusetts, under a contract for the construction of such a line between Great Barrington and Cheshire, by the way of Pittsfield, Lenox, Lee, Stockbridge and Housatonic, in the heart of Berkshire County.

This contract, which has just been let to Fred T. Ley & Co., of Springfield, Mass., for the sum of $675,000, covers only the construction of the track and electric lines of the road, and calls for their completion in not more than four months from July 22, 1901, under a forfeit of $100 per day for any excess of this period, and a bonus in a like sum for each day by which completion precedes the required date.

The contract for the equipment of electrical machinery necessary for this railway is still pending, but will be closed very shortly. From Cheshire to Pittsfield the general course of this railway will not be far from that of the North Adams branch of the Boston & Albany steam road, and from Pittsfield to Great Barrington the valley of the Housatonic River and the tracks of the Berkshire division of the New York, New Haven & Hartford Railway, represent the approximate route. The entire length of the Great Barrington & Cheshire Railway is 42 miles, consisting of a single main track with turnouts. At Cheshire, connection will be made with the Hoosac Valley Electric Railway, which runs to North Adams and Williamstown, thus completing a continuous line from the northwest corner of Massachusetts to within about 15 miles of the southern boundry of the State, a total distance of about 58 miles. The Great Barrington & Cheshire road is to be located for approximately one-half of its length in the public highway, and for the remaining half on a right of way owned by the company. The road will be ballasted with 2 ft. of gravel along its entire course, and standard steam railway ties of chestnut will be laid on centers of 2 ft. Seventy-lb. steel rails will be used throughout for the track, and these will be double bonded to serve as the only return conductor, no supplementary wire or ground feeders being provided. Twenty steel bridges are included in the contract for the construction of the road. Two trolley wires, each of No. 4-0 hard copper, will be strung over the single track, and will serve as feeders along a large part of its length. One advantage of the two trolley wires is that the use of turnout switches at sidings is thereby avoided. The overhead construction is to be mounted on side brackets, except in the centers of the towns, and will be suspended from chestnut poles. Two circuits of three wires each will extend from Pittsfield through Lee, and on to Housatonic. At Pittsfield the steam-driven electric generating station for the road will be located. This station is to be provided with two alternating generators, each three-phase, with a capacity of 750 kilowatts at 12,000 volts. Besides this generating station, there will be two sub-stations, one at Lee, and the other at Housatonic. The generating station and each sub-station will be provided with transformers and two rotary converters, each rotary having a capacity of 300 kilowatts. Each transformer will receive current at 12,000 volts and deliver it to the rotary converter that will supply the trolley line with direct current at 550 volts.

The two circuits of three wires each from the generators at Pittsfield to the sub-stations at Lee and Housatonic, will both connect to the transformers in each sub-station, so that either circuit may supply energy to either rotary. Approximate distances between the places named are Pittsfield to Cheshire, 13 miles; Pittsfield to Lee, 15 miles; Lee to Berkshire, 10 miles, and Berkshire to Great Barrington, 4 miles. Dividing the spaces equally between the adjacent groups of rotary converters, the rotaries at Pittsfield must supply the line 13 miles to Cheshire on the north, and 7.5 miles, or one-half way, to Lee on the south. The rotaries at Lee must supply 7.5 miles to the north and 5 miles, or one-half way, to Housatonic on the south. At Housatonic the rotaries feed back on the line 5 miles, and on to Great Barrington, a distance of 4 miles. The Great Barrington and Cheshire line will be started about Dec. 1 with seven cars. Each car is to be 45 ft. in length, and equipped with motors of 200 horse-power. Between Cheshire and Great Barrington the regular running time is to be 1.75 hours, so that the average speed for the 42 miles is 24 miles per hour. Each car is designed, however, to make 40 miles per hour when desired.

This electric railway is not only the first rural and interurban line



MAP OF ROUTE OF BERKSHIRE RAILWAY.

in Massachusetts to adopt the polyphase system, but it is also believed to be the longest line that has ever been built as a single interurban system in the State. Steam railways, paralleled by this electric road, depend on local travel for their earnings to a very large extent, and the competition of the street cars will probably prove to be a very serious matter for them. As Massachusetts law provides that not more than 5 cents may be charged by street cars for transportation of a passenger through or in any one town, the possible fare on the new electric line seems limited to 30 or 35 cents from Cheshire to Great Barrington, a rate of less than 1 cent per mile. This, of course, will cut much below the average steam railway fare, but the projectors of this interesting line are quite confident that even at such a low rate they can make the investment a good one.

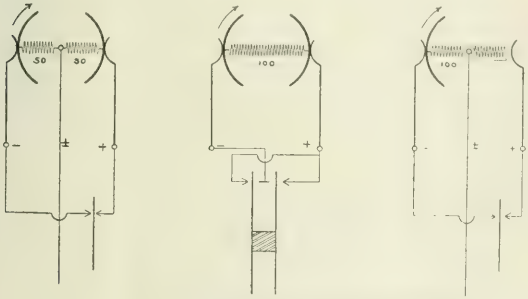
Telephone Magnetoes for Delivering Pulsating Current for Selective Signaling.

By Norman H. Holland

While the records at the Patent Office disclose the fact that over 400 patents have been taken out on selective signaling devices and kindred apparatus, yet with the exception of those which operate by means of difference of polarity, there are comparatively few "individual call" systems in operation. It would appear that whereas in the early days, considerable experimental work was done in this direction on a practical scale, since the introduction of the bridging method of connection, selective signaling has been allowed to rest. When it was found that by means of connecting the ringing coils in multiple, we could obtain a party line circuit which contains qualities that would allow efficient ringing and good talking—the prime requisites—the advantages of selective calling were considered secondary and given up when they would seem to entail as a necessary attendant complicated apparatus at the substation. The ease with which four signals can be operated between the two sides of a metallic circuit and the ground by means of using only currents in different direction, has made that form of individual calling on party lines quite popular; and there are increasing numbers of such systems daily being put into use.

Simpler forms of these polarity systems require very little additional attachment, either at the sub-stations or exchange, to that employed on the usual bridging line. The ringer, however, is usually provided with a spring which retains it when at rest always on one side, and the magneto generator, which is of ordinary construction, is provided with a commutator so as to deliver a pulsating current in one direction.

There are three different ways in which the winding of a magneto generator can be connected to the commutator in order to deliver a direct current, and I show the three methods in the following diagrams: The crescent shaped, heavy black lines in the diagrams, are meant to represent the periods in the revolution of the armature in which a current is generated. As is well known, an ordinary Siemens' "H" armature has two portions of its revolutions in which no current is generated. These correspond to the interval in which the armature shoes are completely covered by the pole pieces. These intervals of no current are represented in the diagram by breaks in the heavy black circle.



FIGS. 1, 2 AND 3.—MAGNETO FOR SELECTIVE SIGNALING.

Referring to Fig. 1, the winding represented is that in which the winding is connected to the frame at its central point and an equal amount of wire wound on each half of the armature, the outer ends of each coil terminating respectively at each commutator segment.

Fig. 2 represents also a double segment commutator. In this, however, the winding is not grounded at all, and current is taken from between the inner and outer brushes.

Fig. 3 represents a commutator with just a single segment. The writer believes the third method of connecting is the most preferable and that it will be found the best suited for operating selective signals. The fault with the method of connecting in Fig. 1 is that whereas the current is taken from the frame and either of the outside wires, just half the number of turns are active at any one time. Therefore, an armature having a sufficient number of turns to develop 100 volts, if connected the same as that in Fig. 2 at the same speed and even conditions, only 50 volts would be developed by the generator as connected in Fig. 1.

Fig. 2, while using the total number of turns at each impulse requires a double-throw pole-changing switch to change from positive to negative. Fig. 3 delivers at maximum voltage, as every turn of the wire is utilized, while a single-pole switch will change from positive to negative.

There is another consideration, however, which is important, besides that of utilizing all the wire and convenience in changing the polarity of the circuit. It will be understood by comparing the three diagrams that with the two segments shown in the winding of Fig. 1 and Fig. 2, twice the number of impulses will be given at the same speed as there would be in Fig. 3. In this, the third method again shows its superiority over either of the others. In a generator having a permanent magnet field, the voltage or pressure varies almost directly as the speed. It would seem, therefore, that gearing up the generator as high as possible would be a distinct advantage. In practice, however, it is soon found that when the speed in the armature has reached a certain point it delivers so rapid an alternating current that the bell hammer will not follow, requiring a definite time for the armature to change its direction and move from one pole to the other. In Fig. 3 we approach more nearly those conditions which prevail when using the generator to deliver alternating current in actuating a centrally pivoting polarized armature. If an alternating current is supplied to the line, the bell is first pulled on to one side by the current of a certain direction, the reversing of the current pulling the bell back to the other side.

In Fig. 3 the current from the single segment pulls the bell over to one side, allowing the spring to restore it during that period in which no current is generated in the armature, thus allowing the same amount of time for the armature to be pulled over by the spring as is given for the current to pull it over. It will be seen that the spring would have to act to restore the armature between the impulses of both commutators if the generator is wired according to Fig. 1 or Fig. 2. In practice, this means that unless the generator is turned quite slowly, the armature of the bell will not respond properly. Thus, to get the same time for the bell hammer movement it would be necessary to rotate generators No. 1 and No. 2 just about one-half as fast as you could turn No. 3, the result being a corresponding drop in voltage, so that if you could get 100 volts from an armature connected as in Fig. 3, under equal condition of field and winding it would only be practical for you to get a little over 50 volts from a magneto wound and connected as shown in Fig. 2, or about 25 volts from a generator wound as in Fig. 1.

The voltage of the generator delivering pulsating current of this kind if connected, as shown either in Fig. 2 or Fig. 3, reaches just as high a maximum as if the same winding were delivering the usual alternating current. This has been questioned often because of the fact that you can ring more alternating bells through a given resistance than you can those which are arranged to operate by pulsating direct current. This is not, however, due to the inferiority of the strength of the generator, but to the retarding influence of the spring used on selective bells, which, of course, the pulsating current has got to overcome. It is sometimes the case that generators with commutators for delivering direct current are placed on bridging lines, not with any intention to make the system for selective signals, but merely so it will be impossible for the different parties on the line to ring one another, and can only drop the target at central. Sometimes the ringers on such lines are not equipped with springs. It is, however, very much better to use springs to retain the armatures on every bell in the circuit all on the same pole (north or south, as the case may be) as otherwise some of the stations may be annoyed by a single tap at the bell every time a subscriber rings central.

The Development of the Nernst Lamp in America.[1]

By Alexander Jay Wurts.

It was in 1897 that Mr. Henry Noel Potter, while in the employ of Mr. Westinghouse, at Goettingen, became acquainted with the Nernst lamp. Early in 1898, Dr. Nernst, Mr. Potter and an assistant came to East Pittsburg at Mr. Westinghouse's request and exhibited the new discovery. Mr. Westinghouse quickly recognized its great possibilities and directed the writer to prepare for its commercial introduction. A happy choice brought Mr. Marshall W. Hanks to my assistance. Mr. Potter returned to Goettingen to study some of the details of the work. In June, 1899, Mr. Edward Bennett joined us, as did also Mr. Frederick M. Goddard a month or two later, who had been assisting Mr. Potter in Germany, but unfortunately in December of that year Mr. Goddard contracted a violent cold from which he never recovered. In February, 1900, Mr. Murray Charles Beebe joined us, and in August of the same year, Dr. Max von Recklinghausen.

I have thus briefly introduced the characters who have worked upon the Nernst lamp in America, and without whose names its history would be incomplete; my only regret being that these gentlemen are not all present on this occasion to share in the pleasure of announcing to the American Institute of Electrical Engineers the results of our work upon the Nernst lamp.[2]

THE GLOWER.

It is not my purpose to describe the details of our experiments, but rather to give the results of our work. Let us begin with the glower, so named to distinguish it from the filament of the incandescent lamp.

Our standard 220-volt glower is about 25 millimeters long and .63 of a millimeter in diameter. It is made by expressing from a die a dough made of the rare earths mixed with a suitable binding material, cutting the porcelain-like string thus made into convenient lengths, drying, roasting and finally attaching lead wires. This sounds very simple, but the making of glowers is an art not easily acquired; it is the result of long and painstaking investigation, particularly with reference to the terminal connection between the glower and lead wire. This connection, as Dr. Nernst made it, consisted of a few turns of platinum wire wound around each end of the glower, the convolutions being finally pasted with cement. This forms a successful and effective terminal, but the shrinkage of the glower ends, away from the convolutions of platinum wire sometimes causes the contact to deteriorate, resulting in the weakening and early destruction of the glower near the terminal. In the Hanks terminal, these conditions are reversed. A platinum bead is embedded in the end of the glower in such a manner that any tendency to shrink on the part of the glower material can result only in tightening the contact and thereby maintaining intimate union between the platinum bead and the glower. It is, then, a simple matter to fuse lead wires to the embedded platinum beads.

The glower, as you all know, is a non-conductor when cold, becoming, however, a conductor when heated. It is also an electrolyte; but it may be fairly stated that this phenomenon is not clearly, if at all, understood. Oxygen, however, seems to be necessary, or at least desirable, for its successful operation. As might be expected, no electrolytic action is apparent when operating with alternate current. With direct current the electrolytic action is quite marked, resulting in a black deposit on the negative end of the glower, which spreads gradually from the negative toward the positive terminal. As this deposit increases, the voltage of the glower changes somewhat, and the candle-power and efficiency fall off, owing to the poor light-emitting properties of the blackened portion. The life of the glower on alternating current is about 800 hours; with the same glower on direct current, it is considerably less than this. There are, however, radical improvements being made in direct-current glowers.

A glower burns at a higher efficiency in its own heat, that is, in a globe, than it does in the open air. We shall refer again to this feature in connection with the multiple glower lamp. The glower is about as strong as a piece of porcelain of the same size, and it is difficult to break a short section. The terminals of a glower give off platinum black, which deposits on the globe; and although this cannot be wiped off with a cloth, it is easily removed in a variety of ways, so that the globe may be considered a permanent fixture in the lamp, and, for that reason, may assume fancy designs. When properly made, the voltage of a glower changes but slightly during its life, the tendency being to rise from two to four per cent in 800 hours. For a short time before rupture, the voltage rises rapidly until the glower is broken.

The characteristic of a glower with reference to voltage and current is remarkable, and has given rise to the necessity of a steadying resistance. As the current in the glower is increased, the voltage across its terminals rises, at first rapidly, and then more and more slowly to a maximum, beyond which it again drops off with increasing rapidity as the current and resulting temperature through the glower continue to increase. Beyond the point of maximum voltage, the decrease in resistance of the glower is so rapid as to make the current difficult of control; in fact, without a steadying resistance, such a conductor would rapidly develop a short-circuit and flash out. The characteristic of a Nernst glower is shown in curve 1 (Fig. 1), the small circle situated near the crest of the curve representing the point of 1.76 watts per candle in the open air.

In studying the characteristics of the glower and seeking for methods of operation under the best possible conditions, we naturally exploited the field in various gases, including a vacuum, and although the experiments in this direction have not been exhaustive from a scientific standpoint, the results have been negative as far as practical results are concerned, and have demonstrated that for the present, at least, there is nothing to be gained in this direction. The vacuum curve and corresponding air curve are shown in Fig. 1.

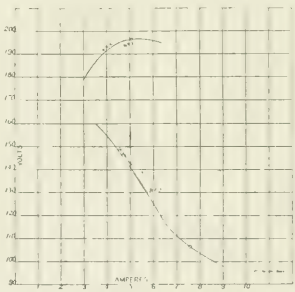


FIG. 1.—VACUUM AND AIR CURVES.

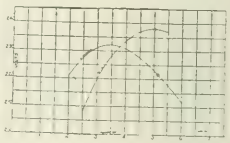


FIG. 2.—NITROGEN AND AIR CURVES.

Aside from the fact that the vacuum has shifted the point of 1.76 watts efficiency to a much lower voltage and higher current density, it will be observed that all the points of the curve now lie on one side, giving a decreasing difference of potential for an increasing current. Such a condition as this involves the use of a relatively large steadying resistance, and renders the operation of the glower inefficient. Fig. 2 shows the nitrogen curve with corresponding air curve, and it will be observed, as in the case of the vacuum, that this gas has also rendered necessary a large steadying resistance and has thereby lowered the available efficiency of the glower. In Fig. 3 we have both the oxygen and hydrogen curves to compare with the air curve. It is interesting to note how closely the oxygen and air curves compare with each other, while the hydrogen curve shows characteristics similar to that of the vacuum curve requiring a large steadying resistance.

There is an interesting phenomenon connected with glowers operating in a space free from oxygen, and which seems to be especially pronounced when operating in a vacuum. Where oxygen is excluded the glower seems to be sluggish and to respond but slowly to changes in line voltage. The curves in Fig. 4 show this sluggish action in a vacuum. The line voltage is indicated by a dotted line in the upper part of the diagram, beginning with 270 volts. The upper solid curve shows the change of current value during a lapse of time indicated in minutes; while the lower curve shows the change in voltage on the glower during the same interval. Previous to this test, the glower had been run at .25 of an ampere for half an hour, after which the

[1] A paper read before the American Institute Electrical Engineers, Buffalo, [illegible]

[2] Explanatory Notes.—The Hefner nuit of candle-power has been adopted in this paper, so that ready comparisons may be made with results obtained on the Nernst lamp in European countries.

Names of Parts in the Nernst Lamp: The "glower" is the filament or light-giving body. The "ballast" is a steadying resistance connected in series with each glower. The "holder" is the removable piece containing glowers and heaters. The "heater-porcelain" is the porcelain disk in the holder immediately back of the heater. The "heater-case" is a small glass globe used in the six-glower and thirty-glower lamps.

line voltage was raised 20 volts and the current values and differences of potential on the glower were taken at intervals for 10 minutes, resulting in the curves shown. Shortly after the completion of this test, the line voltage was lowered 20 volts, when the glower again adjusted itself slowly to the new conditions, and returned to

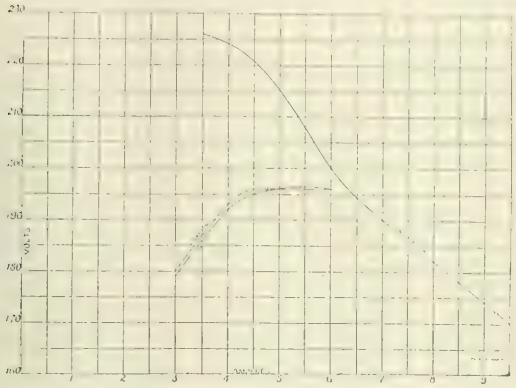


FIG. 3.—OXYGEN, HYDROGEN AND AIR CURVES.

its original current and difference of potential. In air, the glower would have responded almost immediately to similar changes in line voltage. It is likely that the slight changes in both cases after the first minute are largely, if not entirely, due to the temperature correction of the resistance that was connected in series with the glower.

STEADYING RESISTANCE OR BALLAST.

The advantage to be gained by the use of a steadying resistance which would enable the glower to be operated efficiently at a point on or beyond the crest in the characteristic curve, was well recognized. To accomplish this under all conditions of commercial use, and with as little loss as possible under normal conditions, the steadying resistance should have as large a positive temperature correction as possible and this temperature correction should always be immediately available. For example, if the glower were operated on or beyond the crest of the characteristic, the current could obviously be controlled by a sufficiently large steadying resistance having no temperature correction, but such resistance would very ma-

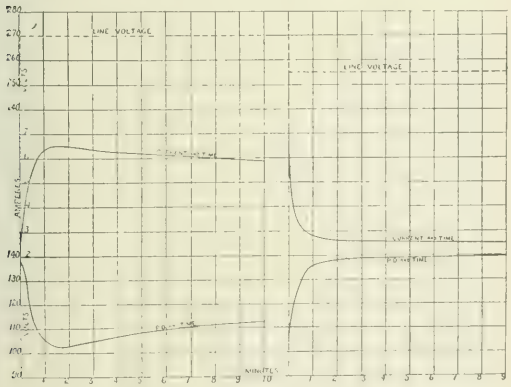


FIG. 4.—ACTION IN VACUUM.

terially decrease the net efficiency of the glower. On the other hand, if the resistance is assumed to have a high temperature correction, the necessary steadying resistance under normal conditions may be very much less than when no temperature correction is present, and then should there be an increase in e. m. f. above normal, the corrective power of the steadying resistance would be brought into play to check any abnormal flow of current through the glower; in other words, to take up the additional voltage; but, as already stated, the temperature correction should be *immediately* available, for if it were not, the glower would "shoot over" when lighting above the normal pressure, that is, take more current at the start than it would a little later after the temperature correction of the steadying resistance had asserted itself. The same would also be the case with any sudden increase in the e. m. f. applied to the glower unless the corrective power of the steadying resistance were immediately available to check the current flow.

Mr. Potter has designed a steadying resistance or "ballast," as he has named it, which is certainly unique in construction and which meets in a very effective manner, the peculiar requirements of the glower. Iron wire is used on account of its high temperature correction, and by properly mounting this in a small glass tube filled with some inert gas, he has secured a ballast having at once a high corrective power with minimum resistance at normal, and oxygen being entirely excluded, the wire can readily be worked throughout the entire high corrective region without danger of destruction. This remarkable characteristic of the ballast is well shown in Fig. 5, from which it will be noticed that for a 10 per cent rise in current

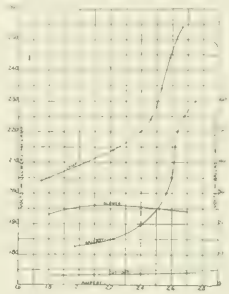


FIG. 5.—CHARACTERISTIC OF THE BALLAST.

the resistance of the ballast increases 150 per cent, so that a glower thus protected becomes at once operative throughout a wide range.

THE HEATER.

As already stated, the glower is a non-conductor when cold, becoming, however, a conductor when heated. For practical service in a lamp, therefore, it is necessary that some means be provided for heating the glower and bringing it to a conducting temperature. This topic could well form a subject by itself, but time will permit me to review but briefly the developments made in this direction. Some of the lamps which Dr. Nernst brought with him from Europe were fitted with electric heaters, while others were intended to be heated by an alcohol lamp or even a match. The further refinements of the lamp imposed new and severe requirements upon the heater. It is therefore especially gratifying that we can announce the construction of a simple, satisfactory and effective heater, suited to the requirements of the latest forms of the lamp. The glower is lighted at a temperature of about 950 degs. C., and it will be readily apparent that to acquire such a temperature quickly and without rapid destruction of the heater and adjacent parts renders the section of the materials a very serious problem. Platinum for the heater seems like an undesirable expense in a commercial lamp, and although many attempts have been made to devise a cheap mineral heater, platinum still holds its own as the least expensive, the most durable, and altogether the most desirable material for this purpose; and, after all, the expense is not so serious, because when the platinum heater is burned out, the value of the scrap is nearly 90 per cent of the original cost, and as the labor is almost negligible, the running cost of the heater is small.

As now constructed, the heater consists of a thin porcelain tube overwound with a fine platinum wire pasted with cement, the latter serving as a protection to the platinum wire from the intense heat of the glowers. These tubes are wound for 110 volts, and are connected in pairs of two in series, according to service, the one, two and three-glower lamps taking one pair, and the six-glower two pairs. These heater tubes are mounted on a porcelain support in such a manner as to afford easy access for repairs without removing the glowers. The life of the heater when running continuously is about 200 hours, or 133 hours when the current is turned on and off 4000 times at regular intervals. Inasmuch as the heater is not called into service for more than about 30 seconds to light the glowers, this would indicate a practically infinite life. In actual service, however, the heater remains in close proximity to the glowers and the high temperature to which it is thereby subjcted causes a material decrease in its life. Nevertheless, the life of the heater is surprisingly

long, probably several thousand lamp-hours. The exact time, however, cannot be definitely determined until a large number of lamps have been operated over a very considerable period in general commercial lighting.

CUT-OUTS.

An automatic lamp requires a cut-out to disconnect the heater from the circuit as soon as the glower shall have lighted. This is another one of those details that Dr. Nernst developed and exhibited in some of his early lamps, but which we have sought to still further perfect and to adapt to the special types of lamp which we have constructed. The cut-out involves a coil, a moving member and a contact, all of which must function at a temperature of about 110 degs. C. without possibility of failure. The coil must therefore be heat proof, the contact must not weld, and the moving member should not hum on alternating current. These requirements are severe, but they have all been met in a most effective and satisfactory manner by embedding the coil in cement, by making the contact of silver, and by suspending the moving member from a single point of support.

The latter feature of the cut-out is illustrated in Fig. 6; 1 is the

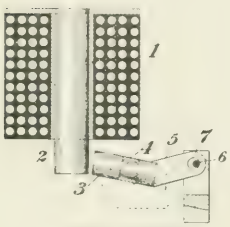


FIG. 6.—CUT-OUT.

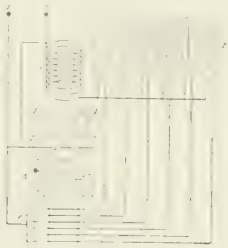


FIG. 7.—CONTACT PRONGS.

coil, 2 the core, 3 the armature or moving member, which is round in section; 4 is a silver band, which makes contact by gravity with two silver wires not shown, forming a V; 5 is a strip of sheet steel .007 of an inch thick, which is inserted into the armature and securely held by a pin; 6 is a small steel rod or support for the armature, and 7 is a hole in the steel strip 5, somewhat larger in diameter than the pin 6, so that when the armature is attracted by the magnet, there is practically only a single point of contact between the strip 5 and the supporting pin 6. This construction has resulted in a cut-out which entirely avoids the humming sound so persistent in the ordinary types of alternating-current apparatus.

LAMPS.

The lamps thus far developed are indicated in the following table:

Candle-Power.	Voltage.	No. of Glowers.	Style.
50	110	1	Indoor
50	110	1	Outdoor
50	220	1	Indoor
50	220	1	Outdoor
100	220	2	Indoor
170	220	3	Indoor
400	220	6	Indoor
400	220	6	Outdoor
2000	220	30	Indoor

The main features are the same in all. The indoor lamps are provided with ornamental spun brass housings; the outdoor lamps with neat japanned cast-iron housings. Single glower lamps have single pole cut-outs, whereas all the multiple glower lamps are provided with double pole cut-outs, the reason for this difference being that the extremely high temperature in the immediate neighborhood of a number of glowers tends to establish leakage currents between the glowers and heaters, unless the latter be entirely disconnected from the circuit.

We will examine in detail the six-glower lamp as typical of all the others. This lamp is suspended from an eye-bolt which, being removed, allows of immediate access to the inner parts. On removing the housing, we find that the ballasts are placed in a semi-circle around the cut-out, the arrangements of the parts being such as to make all easy of access. The connections are made with small aluminum plugs on the ends of the interconnecting wires which avoid the many familiar inconveniences associated with set screws. All the parts are mounted on porcelain; in fact, there is no combustible material whatever in the lamp. The heaters and glowers are attached to a removable piece or "holder," the design being such that the heaters backed by a porcelain disk are immediately above the glowers, resulting in the following advantage: Stagnation of heat from the heater, thereby lighting the glowers in minimum time; no shadows, nearly all the light being thrown downward where it is ordinarily most desired; stagnation of heat from the glowers whereby the latter are run in their own heat and therefore at a higher efficiency than they would otherwise. The glowers and heaters are attached to the binding posts of the holder by means of small aluminum plugs, so that the perishable members are always easily and conveniently interchangeable. The holder is provided with nine contact prongs, which, when the holder is pushed up into the lamp, automatically make the desired connections. These are shown in Fig. 7; 1 and 2 represent the line terminals; 3 the actuating coil; 4 and 4 the double pole cut-out; 5 the heater; 6 the glowers, and 7 the ballasts, there being, of course, one ballast for each glower. A small glass globe, called the "heater-case," is held by spring clamps around the glowers, the function of which is to retain the heat and thereby decrease the time of lighting as well as increase the efficincy of the glowers. In service, the "heater porcelain," which is the porcelain disk immediately above the heater, becomes coated with a thin layer of platinum black, unless measures are taken to prevent it, and this not only decreases the illuminating power of the lamp, but if not removed, will in course of time become conducting and cause leakage of current. No simple means have been discovered for removing the platinum black from the porcelain surface. This difficulty, nevertheless, has been avoided by coating the surface of the porcelain with a thin layer of white paste, which may be easily removed with a stiff brush or scraper. The platinum black now deposits on this coating, both of which may be removed together, leaving the fresh, white surface of the original porcelain to be recoated for further service; but even should the platinum black be allowed to accumulate, all danger of leakage currents is avoided by surrounding the holes through which the lead wires pass, by small annular rings or grooves, it having been discovered that the platinum black will not deposit in these small spaces; the continuity of the platinum black surface between the lead wires is thereby interrupted. For higher candle-powers, the six-glower holder is used as a unit, and this may be multiplied to any desired limit.

The quality of the light is remarkable for its beauty and close ap-

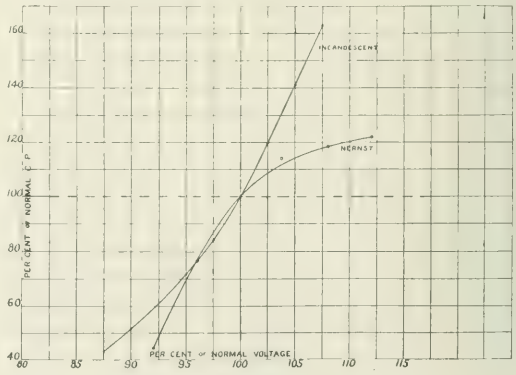


FIG. 8.—CURVES OF INCANDESCENT AND NERNST LAMPS.

proximation to daylight. All colors are seen in their proper shade, making the light especially desirable in stores, art galleries, drawing-rooms and the like. The absence of shadow, the steadiness of the light, the simplicity and low cost of maintenance, the high efficiency of the lamp, and the fact that it is operative on 3000 alternations, are features that will commend themselves strongly to the lighting world.

EFFICIENCY.

It is not an easy matter to state the efficiency of a light, and the difficulties are especially pronounced in the case of the Nernst lamp. It would seem desirable, therefore, to give the results of various methods of measurement and comparison rather than to make any definite statement based on any particular method or set of read-

ings. Referring, therefore, to the six-glower, 220-volt, alternating-current lamp, from which most of the data has been obtained, we may note the following:

A 220-volt glower operating at its normal current of .4 of an ampere, requires 20 volts more in the open air than when burning with five other glowers in a three-inch globe. The lower voltage and consequent better efficiency, when using multiple glowers in a globe, is due to the fact that the glowers are operating in a highly heated atmosphere. The efficiency of the six-glower lamp with clear heater case, but without the dome shade, is 1.2 watts measured in the direction of greatest intensity.

A more satisfactory statement will be found in the accompanying table giving the spherical and lower hemispherical efficiencies of the six-glower Nernst lamp, together with the corresponding figures of alternating-current and direct-current enclosed arc lamps:

					Mean Intensity in H. U.						Watts per Mean H. U.					
					Spherical.			Lower Hemisphere.			Spherical.			Lower Hemisphere.		
	Voltage.	Current.	Watts.	Power Factor.	Opal Outer.	Clear Outer.	Single.	Opal Outer.	Clear Outer.	Single.	Opal Outer.	Clear Outer.	Single.	Opal Outer.	Clear Outer.	Single.
6-Glower.	220	2.35	517	1.0	141	—	147	230	—	279	3.47	—	3.5	2.15*	—	1.85
A. C. Arc.	110	6.29	417	.6	130	159	152	—	100	251	3.21	2.62	2.4	—	2.23	1.48
D. C. Arc.	110	4.9	539	1.0	177	207	—	—	—	272	3.03	2.60	—	—	1.98	—

An opal inner globe or heater-case was used in all cases except the four readings marked *.
*A clear heater-case and sandblasted spherical globe were used.

The arc lamp figures were taken from the report of the Committee for Investigating the Photometric Values of Arc Lamps, read before the National Electric Light Association in May, 1900. Examining this table, it will be noticed that the spherical efficiency of both arc lamps is better than that of the Nernst. In the lower hemisphere, the Nernst is somewhat better than the alternating-current arc, and not as efficient as the direct-current arc. When reflecting shades are used, the alternating-current arc again has a slight advantage for the whole of the lower hemisphere; but if we disregard the mean of the lower hemisphere and consider the floor or desk illuminating power of the lamp, we find that the Nernst lamp has a very decided advantage over the enclosed alternating-current arc; for example, if we consider the mean of the lowest 30 per cent zone, the efficiency of the enclosed alternating-current arc is 1.56 watts against one watt for the Nernst and the mean of the lowest 60 per cent zone is for the enclosed alternating-current arc, 1.45 watts against 1.23 watts for the Nernst.

Comparisons between the illuminating powers of the Nernst and incandescent lamps indicate a watt consumption in the Nernst lamp a little less than half of that in the incandescent for equal illumination. The superior quality of the Nernst lamp is also very marked both for reading purposes and for the correct determination of color.

A similar comparison between the illuminating power of the Nernst and enclosed alternating-current arc lamps shows for an equal consumption of watts in the two lamps, a much superior floor illumination for the Nernst lamp, slightly better general illumination for the arc lamp; but the quality and steadiness of the Nernst light, together with the entire absence of shadow, give an impression of decided superiority in favor of the Nernst.

The two sets of curves, Figs. 8 and 9, show interesting comparisons between the Nernst and incandescent lamps under conditions of varying voltage. Fig. 8 shows the relative change in candle-power and Fig. 9 the relative change in efficiency, all the variations in each case being given in per cent of normal conditions. These curves are self-explanatory, except as to the remarkable steadiness of candle-power in the Nernst lamp when forced above normal voltage. The feature is due to the great corrective power of the iron ballast.

At present our data regarding the effect of running Nernst lamps at different efficiencies is rather limited. Figures of this character require many readings under all kinds of conditions, and it may be some time before these can be satisfactorily and definitely recorded, but, roughly, it may be stated that the efficiency of he glowers falls but slightly during their natural life, whereas the decrease in lamp efficiency will be affected to a considerable extent by the care and attention which the lamp receives.

PERFORMANCE OF THE LAMP.

At the present writing, July 15, we are operating at East Pittsburg, 73 six-glower lamps, one three-glower and three single-glower; in our laboratory and shop at Allegheny, 40 six-glower, 10 three-glower, and 21 single-glower lamps; in the courtyard we have four outdoor six-glower lamps, and in the tumbling room of the foundry, one outdoor six-glower lamp, all running on alternating current at 220 volts. In addition to these, there are 14 single-glower direct-current 110-volt lamps in Mr. Westinghouse's residence, making a total of something like 50,000 candle-power in and about Pittsburg. At the Pan-American Exposition, we have lighted the interior of the dome of the Electricity Building by festooning 92 six-glower lamps from a pendant chandelier consisting of a central lamp of 30 glowers and 2000 candle-power encircled with six lamps of the six-glower type; on the floor, variously distributed, there are 12 six-glower, 24 three-glower and eight one-glower lamps. These figures are intended to give some idea of the scale on which the Nernst lamp has been developed and the resources which have been placed at our disposal.

Seventeen six-glower lamps have been running at East Pittsburg for more than a year, and are now showing an average life of 800 hours per glower. A similar record has been made with 14 six-glower lamps operating in Allegheny for about a year and a half. The four outdoor six-glower lamps have been running every night during the last 12 months through all kinds of weather, and up to the present time have not given a moment's trouble. The six-glower lamp in the tumbling room of the foundry failed in the cut-out at the end of 1000 hours, owing to the accumulation of a bunch of iron dust on the pole of the cutout magnet, but a few strokes of a brush removed the difficulty and the lamp was continued in service.

The line service to these lamps has been fairly good for a shop circuit. As a matter of record, however, it was decided to test four six-glower lamps on the city lighting circuit, noted for its poor regulation and to keep a record of the service and the lamp performance. The record follows:

Four six-glower, 220-volt lamps were run 1000 hours on the regular circuit of the Allegheny County Light Company. The run was continuous with the exception of three periods per day of one-half

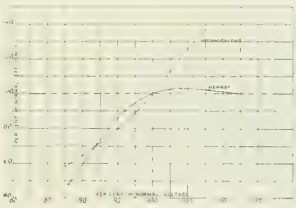


FIG. 9.—CURVES OF INCANDESCENT AND NERNST LAMPS.

hour each when the lamps were turned off. A record of the voltage was kept with a Bristol voltmeter. An inspection of the voltmeter cards show that these may be classified under three types. Of the first, there were 15 cards, indicating that the voltage did not rise higher than 229 volts and only remained there for a short period. Of the second type, there were 26 cards, in which case the voltage reached a maximum of 232 volts, maintaining this for about four hours. Of the third type, there were four cards showing a rise of voltage to 237 and remaining at 235 for five hours. These cards show that the lamps have been tested on a circuit, pressure of which varies from 4 per cent below to 7½ per cent above normal. There were no ballasts or heaters burned out during this run, nor did the lamps receive any attention or give any trouble.

Of the 24 glowers in these lamps

15 ran 1000 hours;
6 ran 792 hours;
1 ran 580 hours;
2 ran 380 hours;

making an average of 890 hours.

The three, two and one-glower 220-volt, alternating-current lamps have given equally satisfactory service, but the glowers in the 110-

volt alternating-current lamp are not quite so uniform in their performance and the same glowers on direct current are comparatively short lived, averaging in the neighborhood of 150 hours; 220-volt glowers, however, on a direct-current circuit would last nearly double that time. At East Pittsburg, where a section of the factory about 350 ft. long is lighted with 50 six-glower lamps suspended immediately above the traveling cranes, the features which strike one more forcibly than anything else are the beauty of the illumination and the total absence of shadow and flicker so intimately associated with the electric arc illumination in places of this character.

In connection with this topic, it will be interesting to note just what is going on in the lamp during the time of lighting, also during

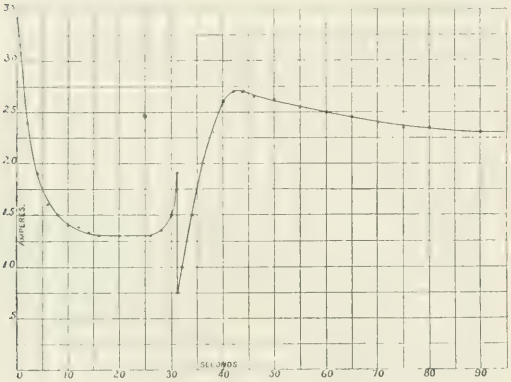


FIG. 10.—CURRENT CURVE OF SIX-GLOWER LAMP.

service under varying conditions of line voltage. Referring to Fig. 10, we have a curve showing the current taken by a six-glower 220-volt lamp during the lighting period. It will be noticed that as the current is turned on, there is a sudden rush of nearly 3.5 amperes through the heater, which, owing to the temperature correction of the platinum wire, is quickly reduced to about 1.3 amperes. At the end of 26 seconds, the first glower begins to light; at the end of 30 seconds the second glower is lighted and the heater is cut out, the current dropping at once to .75 of an ampere; the remaining glowers then light rapidly until at the end of 40 seconds all the glowers are lighted. From this point on, there is a slight drop in the current until the lamp reaches its normal running temperature.

Referring once more to Fig. 5, we find the current and voltage characteristics of the different elements in the lamp, and above these the characteristics of the lamp itself, the latter being the sum of the cut-out coil, the ballast and the glower. The lamp curve was taken from actual measurements and approximates very closely to the sum of the elements, the slight difference probably being due to some differences of temperature. The voltage scale for the cut-out and ballast curves will be found on the right-hand side of the diagram; that of the glower and lamp on the left-hand side. Your attention

FIG. 11.—HEATER TUBES AND GLOWERS.

is now directed to the excellent characteristic of this lamp, and when we consider the severe conditions imposed by the glower characteristic, I think we are to be congratulated on the results which have been attained. With a normal in the lamp of 2.4 amperes and 220 volts, it will be noticed that an increase of 14 per cent in voltage causes but a 10 per cent increase in current, resulting in a comparatively steady light and safe running conditions for the lamp in commercial service. A rise of 25 per cent in the line voltage would burn out the ballasts in a very short time, but a rise of 10 per cent for short periods does not seriously affect the life of either glower or

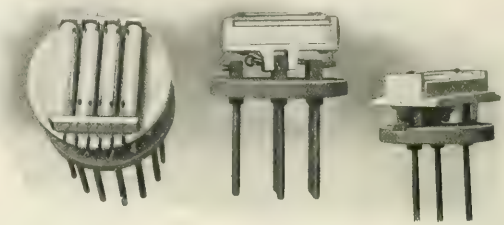


FIG. 12.—HOLDERS FOR THE SIX, TWO AND THREE, AND ONE-GLOWER LAMPS.

ballast; a rise of 5 per cent may be considered allowable for indefinite periods.

REPAIR AND MAINTENANCE.

When the lamps are first started, they require no attention. After 1000 hours, however, the renewals become fairly regular, and our

FIG. 13.—PARTS OF SINGLE-GLOWER LAMP.

experience shows an average life of 800 hours for the glowers, 2000 to 3000 hours for the heaters and an indefinitely long life for the ballasts. It will, however, be some time before the average life of the heaters and ballasts can be definitely determined. The attention which these lamps receive, consists in having the inspector examine the lamps once a week through a colored glass to determine whether or not all six glowers are burning. If two glowers are out, the lamp is turned off, the holder removed and two new glowers inserted;

FIG. 14.—TWO AND THREE-GLOWER LAMP, INDOOR TYPE.

FIG. 15.—SIX-GLOWER LAMP, INDOOR TYPE.

the holder is then returned to its place and the lamp continued in service. Aside from such renewals, these lamps have not given the least trouble.

On the occasion of starting up 50 six-glower lamps at East Pittsburg, one of the engineers who had had considerable experience with

FIG. 16.—METHOD OF GRIPPING HOLDER.

FIG. 17.—THIRTY-GLOWER LAMP, INDOOR TYPE.

arc lamps, remarked that my troubles would now begin; but, frankly, I think he was mistaken. Aside from the renewal of the perishable parts, I see nothing in the lamp which could possibly cause trouble except under the most extraordinary circumstances; in fact, should a lamp receiving proper attention fail to light, I would look for the trouble elsewhere than in the lamp.

In commercial service it is intended that the central station shall make the renewals in the holders. The customer will be provided with a case containing a suitable number of complete holders, ready for service, so that when a renewal is to be made, the customer will simply remove the old holder and insert a new one, such operation consuming but a moment's time; then, at convenient periods, the old holders will be exchanged for new. Where lamps are used in quantity, the renewals will probably be made by the local attendant. The replacing of a ballast requires the removal of the lamp from the circuit, but after that the renewal is easily and quickly made. A slight withdrawal of one screw releases the ballast tube from its socket, whereupon the small aluminum terminal plugs may be withdrawn and the new ballast inserted. This operation does not require any tools other than a pair of small tweezers, and the renewal can be made without returning the lamp to the work-bench.

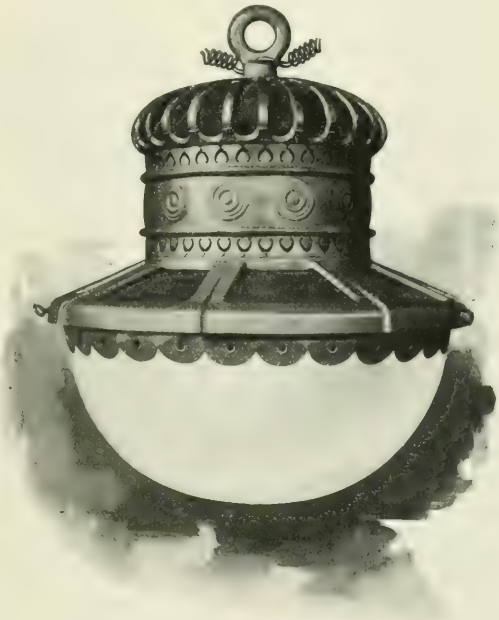


FIG. 18.—SIX-GLOWER LAMP, OUTDOOR TYPE.

After about 100 lamp-hours, the heater case becomes somewhat discolored, and, for first-class maintenance, this should be cleaned at the end of that time. The following instructions for the care and inspection of the Nernst lamps are observed at East Pittsburg:

Inspection of the Lamps.—The lamps should be inspected every 100 lamp-hours. After being turned off, the lamp is turned on, and it is noted whether all the heater tubes become bright. If any of the heater tubes are burned out, the holder is replaced by a new one.

If the heaters are intact, the number of glowers burning is determined. If five or six are burning, the lamp needs no attention.

If less than five glowers are burning, the lamp is to be turned off, the holder taken out and the number of broken glowers determined by inspection. If the number of broken glowers is less than the number of glowers that were out, one or more ballasts are out of order and the lamp is to be taken down at once and the defective ballast replaced. When two or more glowers are burned out, the holder is to be replaced by a reserve holder.

Ballasts.—These are supplied in boxes marked "Ballasts for six-glower lamps," "Ballasts for one-glower lamps," etc. Burned-out

ballasts are to be renewed as soon as discovered and may be replaced without taking the lamp to the work-bench.

Heater-Case.—This receives a coating of platinum black on the inside and should be replaced every 100 lamp-hours by a clean heater case. The coating may be removed from the old heater case with a bristle brush running at a high rate of speed. The heater case may then be used over again.

Glowers.—These are supplied in glass tubes marked with the voltage of the lamp for which the glower is intended, thus, "Glowers for 220-volt, six-glower lamps." Glowers marked for six-glower, are not to be used in a three or one-glower lamp, and vice versa.

Heaters.—These are wound for 110 volts and are so marked. They are connected two in series for 220 volts. In the six-glower lamp there are four tubes connected in multiple series.

Heater Porcelain.—(This is the porcelain disk immediately behind the heater.) The heater porcelain is given a white coating, which becomes fairly hard, but can be easily scraped or brushed off when it becomes covered with platinum black. When a holder with a black heater porcelain is removed, the glowers should be taken out, the old coat brushed off, except directly under the heater tubes, and a new coat of "heater porcelain paste" applied. The paste is a white powder which is to be mixed with water and applied with a camel's-hair brush. After replacing the heater porcelain and allowing it to dry in the air, run the heater for two minutes on 220 volts, placing the holder in a heater case. This hardens the coating, after which the glowers may be replaced.

FIG. 19.—SINGLE-GLOWER LAMP, INDOOR TYPE.

Cost.—It is too early to say anything definite about the cost of these lamps. Fourteen or fifteen dollars would seem to be a fair price for a six-glower lamp, other lamps in about the proportion of the number of glowers. It is estimated that the cost of renewals will be considerably less than for enclosed arc lamps. Provision will be made for the return of the perishable parts containing platinum.

CONCLUSION.

In closing, let me say that the Nernst lamp can in no sense be considered an experimental device. The development of details connected therewith has continued until all question of doubt as to its commercial success has been removed by the operation of a large number of lamps of various sizes and finished pattern for extended periods under commercial conditions, and it is confidently felt that the splendid exhibit of these lamps, which may be seen at the Pan-American Exposition, will prove a fitting demonstration of the complete and thorough manner in which the brilliant discovery of Dr. Nernst has been taken up and pushed forward in America.

Seventh Annual Convention of the Ohio Electric Light Association.

THE seventh annual convention of the Ohio Electric Light Association was held at Hotel Victory on Put-in-Bay Island, Ohio, on Aug. 20, 21 and 22, 1901, under the presidency of Mr. E. J. Bechtel, of Toledo, Ohio. An attractive programme was presented, the papers being of great excellence, and a lively interest was taken in the discussions. The business sessions opened Tuesday afternoon with an excellent address by the president, E. J. Bechtel, of the Toledo Traction Company, reviewing the work of the Association in the past, and indorsing the proposed system of uniform accounting, and recommending the admission of representatives of the manufacturers and supply houses as associate members. This recommendation was referred to the executive committee, and later favorably reported by them, and adopted by the association as an amendment to the constitution.

Mr. W. D'A. Ryan, of the General Electric Company, read a paper on the "Relative Merits of Open and Enclosed Arc Lights for Street Illumination," printed copies of which appropriately illustrated, were distributed to those present. This paper attracted general attention, and was very favorably commented upon. The discussion of it was participated in by Messrs. White, Dow, Scovil, Thulen, Bechtel, Rust, Perkins and Turner. Mr. Ryan has for the first time attempted to illustrate the value and inherent variations of electric light and the causes thereof. The luminometer, an instrument invented by him, makes it possible to investigate the relative merits of various globe combinations, and also the relative lighting distance of various sized units with a degree of accuracy far exceeding, it is said, anything heretofore deemed possible or attempted.

At the night session Tuesday Mr. Lehman B. Hoit, of the Bullock Electric Manufacturing Company, showed lantern slides illustrating recent improvements in the construction of alternating and direct-current apparatus, and also the application of direct-current machines for operation of various classes of machines, and explained the economy in the use of the multiple voltage system of control. The system, as described, dispenses with the use of rheostats for controlling the speeds of machines to which the motors are directly connected. The saving over the rheostatic control, the speaker stated, where there is desired a variation of speed, is about 90 per cent.

Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, presented a paper on "Selection and Maintenance of Meters for Measurement of Electric Current." Mr. Turner has always been a valued contributor to the literature of the Ohio Association, and was listened to with attention. The paper was followed by discussion.

At the Wednesday morning session letters of regret were read from Messrs. G. N. Clapp, of the Washington E. H. Gas & Electric Company, and George Matt, executive committeeman, of the Lancaster Electric Light Company.

Mr. Clarence Renshaw, of the Westinghouse Electric Manufacturing Company, read a paper on "Suburban Electric Railways, Particularly with Relation to Central Stations." The paper was discussed.

On Wednesday afternoon a paper was presented by Mr. J. Henry Hallberg, of the General Incandescent Arc Light Company, New York City, in which he gave in detail and quite impartially a résume of the principal methods for controlling alternating-current arc lamps in series on constant-potential circuits, demonstrating that the reactive coil system in connection with the shunt lamp possessed the most points of advantage to central stations. In connection with the paper was furnished a complete set of plates which illustrated in a diagramatic way the various methods of connection and control for circuits of the kind mentioned.

Mr. H. C. Wirt, of the General Electric Company, presented an interesting paper on transformer designs, bringing out quite strongly the essential qualities, such as insulation, core loss and regulation, showing the effect of the latter on the life and candle-power of incandescent lamps. The paper covered an experience of the last 13 years in transformer manufacture. Interesting data was given as to the life and durability of modern transformers as compared with transformers made several years ago. Important recommendations were made as to the desirability of manufacturers and stations establishing voltage and frequency standards, so that data tables could be compared without necessity for correcting them for uniform voltage. At present some tables are based on 2000-volt primary, and others at 2080 volts. It was urged that 2080 volts be the standard voltage, in view of the fact that the majority of central stations are operating at primary voltage at transformer terminals of 2080 volts, or higher, requiring the use of 104-volt lamps. A few stations on the other hand, employ the use of 100-volt lamps. It is important that manufacturers give attention to the requirements of insulation and temperature rise of transformers. It was suggested that in comparing the economical operation of transformers the yearly cost, which should include interest and depreciation, power consumption should be made the basis of comparison. Electrical efficiencies alone, independent of the cost, should not be taken as a guide as to the merit of the different designs.

New members admitted were the following: The Port Clinton Electric Light & Power Company, Charles E. De Witt, president; the Northern Ohio Traction Company, L. E. Beilstein, general manager, Akron, Ohio; the Shawnee & Straitsville Electric Light Company, S. N. Poston, secretary-treasurer, Nelsonville, Ohio; the New Lexington Electric Light Plant, T. J. Smith, proprietor, New Lexington, Ohio; the People's Gas & Electric Company, W. P. Engel, Defiance, Ohio, president.

Mr. D. L. Gaskill, of Greenville, read a very important paper on "The Relation of Electric Light Companies to Municipalities from a Legal Standpoint," which was considered a valuable contribution, and elicited considerable discussion.

Mr. Gaskill stands for the furnishing of the best and most efficient service, and the taking of the public into the confidence of station managers, believing that a liberal policy is the best from every consideration.

Mr. Gaskill has given considerable thought to this subject, and his opinions coming from a legal authority, are always given weight.

The first business of the Thursday morning's session was election of officers and selection of place of meeting. The following reported by the nominating committee were unanimously elected, viz.:

President, W. F. White, Cincinnati; vice-president, E. H. McKnight, Middletown; secretary-treasurer, J. H. Perkins, Youngstown. Executive Committee: H. C. Fogle, Canton; S. M. Rust, Piqua. Finance Committee: W. F. Raber, Mansfield; L. H. Thulen, Leetonia; F. E. Valentine, Urbana. Advisory Committee: D. L. Gaskill, Greenville; A. W. Field, Columbus; Samuel Scovil, Cleveland. The association is to be congratulated upon its choice for president of one of the progressive electric light men of the country, who is establishing a national reputation. Columbus, Ohio, was selected as the convention city in 1902, on the invitation of Mr. A. W. Field.

Mr. E. S. Pillsbury, of the Wagner Electric Manufacturing Company, St. Louis, gave a paper on "Single-Phase Alternating-Current Motors," illustrated by diagrams.

Several topics were then taken out of the "Question Box," and freely discussed.

After adopting suitable resolutions of thanks to the various essayists and others who had contributed to the instruction and pleasure of the convention, the convention adjourned sine die, the date of the next meeting to be hereafter fixed by the executive committee.

The ladies' entertainment was looked after by Mr. Emil G. Schmidt, of the Sandusky Electric Light Company, who personally conducted an excursion around the Islands on Wednesday morning, also a visit to the Caves. Mesdames Bechtel, Perkins, McKnight and daughters, Scovil, Valentine, Hoit, Renshaw, Douds, Field and Gaskill were of the party.

The following were in attendance upon the convention: E. J. Bechtel, Toledo Railways & Light Company; A. W. Field, Columbus Edison Company; D. L. Gaskill, Greenville Electric Light & Power Company; W. F. Hubbell, Wauseon Electric Light & Power Company; E. H. McKnight, Middletown Electric Light & Power Company; J. H. Perkins, Youngstown Gas & Electric Company; John M. Plaisted, Columbus Electric Company; W. F. Raber, Citizens' Electric Railway, Light & Power Company, Mansfield; S. M. Rust, Piqua Electric Company; Emil G. Schmidt, Sandusky Electric Light Company; Samuel Scovil, Cleveland Electric Illuminating Company; T. J. Smith, New Lexington Electric Light & Power Plant; L. H. Thulen, Leetonia Electric Light & Power Company; F. E. Valentine, Urbana Electric Light & Power Company; Alex. Dow, Edison Illuminating Company, Detroit; F. J. Alderson, Stanley Instrument Company, New York; Perry R. Boole, Electric Appliance Company, Chicago; H. B. Coles, G. I. L. Company, Cleveland; F. C. Colwell, G. I. A. L. Company, Cincinnati; Chaw M. Crofoot, Pass & Seymour and Crouse-Hinds Electric Company, Cincinnati; H. J. Douds, G. E. Company, Cincinnati; Robert E. Gorton, N. Y. & Ohio Company, Warren, Ohio; J. H. Hallberg, General Incandescent Arc Light Company, New York City; W. J. Hanley, G. E. Company, Cincinnati; Lehman B. Hoit, Bullock Electric Manufacturing Company, Cleveland; Wagner Electric Manufacturing Company, St. Louis; H. E. Hull, Erner-Hopkins Company, Columbus; F. M. Knierim, the F. Bissell Company, Toledo; Charles S. Kuntz, Post-Glover Electric Company, Cincinnati; Ray D. Lillibridge, New York; W. G. Nagel, the W. G. Nagel Electric Company, Toledo; Ernest J. Paradis, the W. G. Nagel Electric Company, Toledo, and F. G. Vaughen, H. C. Wirt, W. D'A. Ryan, all of the General Electric Company.

Telephone Lines for Farmers.

In a letter to Mr. H. B. Gates, secretary of the Indiana Mutual Telephone Association, at the recent annual meeting, discussing the demand of farmers everywhere for telephone service, Mr. George W. Beers, of Fort Wayne, said:

In view of the demand for telephones by farmers, your toll or county lines should be built after the best engineering methods, employing only the best of materials. Poles 30 and 35 ft. in length should be used, equipped with 10-pin cross-arms, braced to the poles, the poles should be spaced about 132 ft., using 40 to the mile on straight lines, and more as needed on corners and turns. They should be sunk at least one-sixth of their length, those poles on corners and turns should be double-armed and thoroughly stayed and guyed, according to the service required. Nothing but copper wire should be used, and not more than five stations on any one circuit.

Your farmer subscriber will have greater need for the long-distance lines than your city residents, and therefore his line should be equal in all respects to those used in your exchange. Your farmer is indebted to the independent exchange owner for his telephone. He should not forget this fact when he is solicited to use the opposition service. You should keep it before him in every way that only four short years ago he could not only not have a telephone in his home, but that he could not find a toll station in his post office or trading town unless it happened to be one of the 49 larger towns in the State. Then the poles connecting the large cities where messages were plentiful and the rates high encumbered his roads, blockaded his drains, mangled his trees, he could get no nearer to the sound of a telephone than the hum of the wires. Now, your poles encumber his roads, block his ditches and mutilate his trees, but he is compensated by the connection you have given him with his doctor, his market and the world. You have relieved his isolation and made his farmhouse merely a suburban residence. Does he appreciate your service? I think so. Will he patronize his benefactor? Unquestionably. Build him good lines, give him good service and he will not forget.

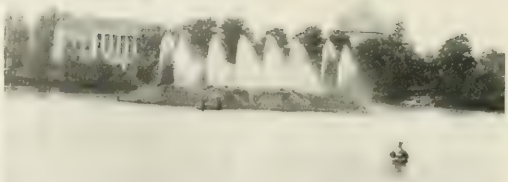
Railway Deals in Ohio.

Last week the Everett-Moore syndicate at Cleveland closed several deals which have been hanging fire for some months. Chief among these was the incorporation and the forming of a preliminary organization of the Lake Shore Electric Railway Company. The temporary capital stock was $10,000, but this will be increased soon to $4,500,000. The incorporators were: Barney Mahler, F. W. Coen, D. G. Jaeger, A. M. Snyder, E. M. Gronamyer and L. M. Hildreth. The permanent officers will be: Barney Mahler, president; F. W. Coen, secretary, and R. E. Danforth, general manager. The new company will operate the lines between Cleveland and Toledo, and includes the Lorain & Cleveland Railway, the Sandusky & Interurban Railway, the Sandusky, Norwalk & Southern Railway, and the Toledo, Fremont & Norwalk Railway. This consolidation was figured on some time ago, but was delayed until the final transfer to the syndicate of the Toledo, Fremont & Norwalk Railway. This road was turned over on Thursday, Aug. 8. The system is in operation except for a short section, and this gap will be completed within the next 60 days. It has been reported that the Toledo & Detroit Shore Line will be operated as a part of the Lake Shore Railway, but this point has not been decided upon. The final transfer to the syndicate of the Toledo city lines also took place last week. The three roads extending east from Cleveland heretofore operated separately as the Cleveland & Eastern Railway, the Cleveland & Chagrin Falls Railway, and the Chagrin Falls & Eastern Railway, have been consolidated under one management, and the system will probably be known as the Cleveland & Eastern Railway. R. L. Andrews, of the Cleveland & Eastern has been appointed general manager of the combined road. The other officers will remain as before the consolidation was effected. The offices and freight station of the three lines have been consolidated at the old quarters of the Chagrin Falls road and the freight business will be conducted separately from that of the Electric Package Company, which controls the freight business of the other Cleveland roads.

Another important move of the Everett-Moore syndicate last week was the organization of the Securities Company, of Cleveland, which will have charge of the financing of the bonds of the various Everett-Moore enterprises. The company is capitalized at $1,000,000, and the incorporators were E. W. Moore, H. A. Everett, Frank S. Borton, Charles W. Wason and H. B. McGraw. Frank S. Borton, secretary of the Cleveland Electric Railway and of the syndicate, has been chosen as the president of the security company.

It is understood that the syndicate has a number of important plans in view for the future. It is stated also that plans are under consideration for a controlling company to handle a freight business of all the various lines, although for the present this branch of the business will be conducted as now. Report has it that the syndicate will build its own car shops and rail mill for the production of its own steel. Mr. Everett states that while the former is a possibility, the latter is out of the question.

Buffalo Convention of American Institute of Electrical Engineers



NEW YORK STATE BUILDING.

ABOUT 125 members and guests of the American Institute of Electrical Engineers boarded the specially chartered steamer "Montauk" at New York on Sunday, Aug. 18, and at 10 a. m. the steamer started on her trip up the Hudson to Albany. The committee in charge of arrangements had carefully provided for the comfort of the passengers, and notwithstanding an overcast sky and threatening rain, the trip will long be remembered by those who participated as one of unqualified enjoyment. An excellent luncheon was provided by Mazetti, and later in the afternoon refreshments were served. A band discoursed music on the forward deck.

The boat arrived at Albany at 6.30 p. m., and about 10 minutes after disembarking special trolley cars took up the party and landed it at the Ten Eyck, where dinner was had and the night passed. On Monday morning, at 8.30, a special train was boarded and a half-hour later it was switched into the works of the General Electric Company at Schenectady. There the passengers were met by Professor Elihu Thomson, Mr. E. W. Rice, Jr., and almost all the members of the works' technical staff. Carriages were waiting to conduct the ladies of the party on an excursion in and about Schenectady. With members of the G. E. staff as guides, the technical visitors were shown through all the important departments of the works in a short time, the party breaking up into groups of from 4 to 10, each with its conductor.

About 2½ hours were spent in inspecting the works, and at noon the entire party, including the ladies, was reunited in an extension now being built to one of the large buildings, which for the occasion had been transformed into a luncheon room, with Mazetti presiding over the culinary department. The tables were handsomely decorated with flowers, and an admirable collation was served.

When the coffee was reached, Mr. E. W. Rice, Jr., in some well-chosen remarks, referred in complimentary terms to the visit to the works of the Institute members and their foreign guests. Professor Elihu Thomson also expressed his pleasure at the visit, and Mr. C. O. Mailloux responded for the visiting party.

When the special train left the works at 1.30 it had on board 134 passengers. Some members did not extend their trip beyond Schenectady, but the party was, on the whole, somewhat increased by a contingent of Institute members joining at Schenectady. Of this total number, 83 were members of the Institute, 18 were foreign guests and 33 ladies. The guests were as follows: Professor Janet and MM. Debeauve, Roux, Marcel Aubert, Maurice Aubert, De la Tour, Courtier, David, all of the Societe Internationale des Electriciens. Messrs. Cooper, Denham, Cottam, Gamleu, Sawers, Pott and McNott, all of the British Institution of Electrical Engineers. J. F. Ch. Janisch, of the Deutscher Elektro-Technische Verein, Professor Gustav Gillon, of Louvain University, Belgium.

Up to the arrival at Buffalo there had not been a hitch in the admirable arrangements that had been made for the professional and social entertainment of the guests. In New York, Albany and Schenectady, members of the local committees were in constant attendance, and the programme fixed in advance was smoothly carried out in all of its details. Much of the credit for this unqualified success is due to Mr. E. H. Mullin, who had direct charge of arrangements for transportation and accommodation. Upon the arrival at Buffalo a new condition was encountered, and until the end of the meeting there was much cause of complaint, due to the lack of arrangements for the reception and entertainment of the party. When the party alighted from the train at Buffalo, no member of the local committee was present at the station, and nothing could be learned as to the arrangements for the transportation of the visitors to the hotel. After lingering about the station for a half hour or more and descending and ascending stairways, much to the discomfort of the ladies, it was learned that a Belt Line train passed near the hotel, and finally the tired party arrived there about 9.30 p. m. To dispose finally of this unpleasant feature of the trip, we may say that the Mayor of Buffalo was not present at the opening of the convention, according to programme, and no explanation of this omission, which was unfortunate in view of the foreign attendance, was offered. On the last day of the session, the custodian of the building in which the meetings were held demanded that the audience room be vacated, and threatened forcible measures if the demand were not complied with. It then appeared that the room had only been secured for three days, instead of the five days called for by the programme, and had it not been for the courtesy of the organization which was to have occupied it on Saturday, the last day's session would have been suddenly cut short. At Paris, members of associations meeting in the Exposition grounds, were charged no admission, but at Buffalo the regular gate charge was exacted in the morning, and upon return to the grounds after a programme visit, admission was again charged.

SESSION OF TUESDAY, AUG. 20.

The convention was called to order about 11 p. m. by President Steinmetz in the lecture hall of the New York State building within the Exposition grounds. Mr. Steinmetz referred to the large number of papers to be presented, almost all of which treated of questions of great timely interest to the electrical engineering profession. To the foreign guests he expressed the high appreciation of the Institute for the cordiality with which its members had been welcomed abroad last year by sister bodies, and hoped that their presence at the present convention would still further strengthen the professional feeling which, like science, should know no country. Professor Janet responded in graceful terms, after which Professor George F. Sever, on behalf of the electrical engineers connected with the Exposition, welcomed the members and offered them every facility within the power of himself and colleagues with respect to the inspection of the various features of the Pan-American electrical plants. After some announcements by the secretary, including an offer of free telephonic service to members from the Buffalo Bell Company, the session was adjourned to 10 a. m. Wednesday morning.

In the afternoon, special trolley cars conveyed all who desired to go to Niagara for a visit to the Falls and objects of scenic interest in the vicinity, this visit being preparatory to a professional one later in the week.

SESSION OF WEDNESDAY, AUG. 21.

Four papers were read at this session—those of Messrs. Lincoln, Haskins, Davis and Browne—the discussion of which, however, was soon diverted to a discussion of the relative merits of direct current and polyphase motors. This latter discussion and the discussions on other days of synchronous versus induction motors, and polyphase versus direct-current traction, formed the three leading features of the convention.

The paper by Professor Browne gives an excellent resumé of the principles involved in power factor indicators and includes a description in detail of numerous types of these instruments. This paper will be printed in abstract in a following issue.

The paper by Mr. Caryl D. Haskins entitled "Some Fundamentals of Electric Meters," dealt specifically with the watt-hour meter in respect to the relation between torque, friction, ageing of various kinds, and local surroundings. In endeavoring to produce a direct-current meter always correct at all readings, friction is the main

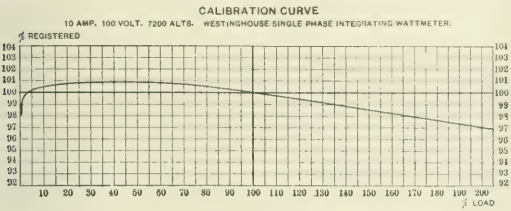
difficulty presented, and particularly changes which occur in friction with time. The remedy favored in the paper is not the minimizing of friction, but compensation for the same, and the radical increase of damping load in relation to possible friction load. With respect to the latter, it is obvious that the description of a relatively very large amount of energy in the Foucault energy disk renders wide variations of friction substantially negligible.

In considering the requirements for this condition, it is stated that the whole essence of success in a motormeter necessarily lies in literally permanent magnets. The question of copper vs. aluminum Foucault disks is discussed, and decided in favor of the latter.

As to compensation for friction, it is not sufficient that friction should be compensated for at an average point of calibration, but also important that the compensation can be instantly adjusted to meet the actual conditions surrounding the meter at its point of use. Instead of restoring the meter to its initial condition periodically by cleaning and the like, it becomes possible, where an adjustable compensation is available, to recompensate at the appropriate time for the permanent friction load and thus restore the meter to a stable condition of equilibrium.

The conclusion of the paper is that the two essentials meriting the most careful study in meter design are, first, the expenditure of the maximum permissible amount of work in the Foucault disk; and, second, the provision of the best means for instantly compensating for friction variation at the point of use without affecting total calibration.

Under the head of "Metering of Electrical Energy," Mr. Harry P. Davis outlined some of the more important features which should be embodied in the ideal motor meter, the several principal points being



CALIBRATION CURVE.

considered under the heads of simplicity, proper design of the rotating element and proper design of the enclosing case.

With reference to the second point, the requirements are that the shaft be short and stiff, and the entire revolving element simple and light in weight, this last consideration being most essential, affecting as it does in a vital manner the portability, life and ability of the meter to remain in calibration. Artificial, complicated and delicate devices for obviating injury to jewels or to act as substitutes for them, should be unnecessary if careful attention is given to these considerations in the design and proportions of the revolving element. The best bearing is a step bearing employing a hard sapphire jewel with a polished cupped surface of large radius supporting a highly polished steel end in the revolving shaft, the revolving element not weighing more than a few grammes and having a low speed. In the case of alternating-current meters the design should be such as not to allow vibrating effects. Stress is laid upon the desirability of an enclosing case of substantial cast material designed to be dust, insect and moisture proof.

To meet the conditions of central station lighting service, a meter should have a wide range, and record accurately to at least within 2 per cent, whether one lamp or the entire number installed are in circuit. A meter of small capacity capable of standing a considerable overload for short periods is most desirable for this case, as it gives very accurate returns for the light loads which are usual.

To illustrate the points of a modern meter the data of a specific one are given. This is a Westinghouse induction meter, in which the magnetic field produced by the windings induce secondary currents in an aluminum disk, causing it to rotate in the same manner as the armature of an induction motor. The design of this meter has been worked out, to give the best all-around result in actual use. The coils are wound on iron cores, with very nearly closed magnetic circuits, thus greatly reducing the magnetizing forces necessary. This is particularly noticeable in the series coil, which in an 80-ampere meter consists of but one turn of wire having a length of about three inches. Meters of other capacities have a proportionate number of turns. As so small a magnetizing force is required, it is evident that the induction drop will be small, and as there are so few turns of wire, it can be made with a very low resistance, conditions which are very necessary to enable the meter to stand a heavy overload. The aluminum disk with its shaft is very light, weighing but 15 grammes.

The accompanying figure is a calibration curve of this meter. This shows that from 1/50 of full load, to 1½ times full load this meter is correct within 1½ per cent, and at twice full load it is still within 3 per cent. The small loss in the series coil of this meter can best be appreciated when it is stated that during this test it carried without injury to itself for a considerable period a load of six times the rated full-load capacity of the meter, representing a heating effect in the series circuit of 36 times that occurring at its normal rating.

In conclusion, the subject of metering polyphase circuits is considered. The use of the two-wattmeter method is criticized, and the employment of a single polyphase meter advocated. Such a meter can be connected either to a two or three-phase circuit, the connections being straightforward, and what is most important, its reading will be on a single dial, and will show the total energy, irrespective of unbalancing of the loads or changes in power factor. The whole question of using single-phase meters on polyphase circuits depends entirely on the balancing of the loads on the several phases, and the power factor of the circuit. In view of the uncertainty of polyphase circuits in this respect, the exclusive use of polyphase meters is to be recommended, ensuring, as they do, accurate registration without regard to these irregularities.

The paper by Mr. Paul M. Lincoln dealt with a synchronism and a frequency indicator, the principles of which are the subject of two patents which were considered in our issue of Aug. 10. A synchronism meter of this type was on exhibition in Electricity Building, where its operation was explained by an attendant. In form it had the appearance of a small motor, on the shaft of which and in front of a white desk was a pointer. In synchronizing the pointer revolved either to the right or to the left, according as the frequency of the e. m. f. of the machine to be synchronized was greater or less than that of the circuit with which it was to be connected. As synchronism was approached, the speed of the pointer was reduced, and when it came to rest exact synchronism was indicated. In detail, both the synchronism and the frequency indicator consisted of two coils at right angles and movable in a magnetic field. Calling the coils at right angles A and B, and the field coil F, in the case of the synchronizer, coil F is connected to a set of bus-bars and coils A and B to a generator to be seen in parallel to the bus-bars. Then the motion of the movable coils gives a constant index of the phase conditions of the generator with respect to the bus-bars. Following is the explanation given of the action of the instrument:

Suppose a stationary coil F has suspended within it a coil A, free to move about an axis in the planes of both coils and including a diameter of each. If an alternating current be passed through both coils, A will take up a position with its plane parallel to F. If now the currents in A and F be reversed with respect to each other, coil A will take up a position of 180 degs. from its former position. Reversal of the relative directions of currents in A and F is equivalent to changing their phase relations by 180 degs., and therefore this change of 180 degs. in phase relations is followed by a corresponding change of 180 degs. in their mechanical relations. Suppose now that instead of reversing the relative direction of currents in A and F, the change in phase relations between them be made gradually and without disturbing the current strength in either coil. It is evident that when the phase difference between A and F reaches 90 degs. the force between A and F will become reduced to zero and a movable system, of which A may be made a part, is in condition to take up any position demanded by any other force.

Let a second member of this movable system consist of coil B, which may be fastened rigidly to coil A, with its plane 90 degs. from that of coil A, and the axis of A passing through a diameter of B. Further suppose a current to circulate through B, whose difference in phase relative to that in A, is always 90 degs. It is evident under these conditions that when the difference in phase between A and F is 90 degs., the movable system will take up a position such that B is parallel to F, because the force between A and F is zero, and the force between B and F is a maximum; similarly, when the difference in phase between B and F is 90 degs., A will be parallel to F. That is, beginning with a phase difference between A and F of 0, a phase change of 90 degs. will be followed by a mechanical change in the

movable system of 90 degs., and each successive change of 90 degs. in phase will be followed by a corresponding mechanical change of 90 degs.

To investigate the mechanical relations corresponding to intermediate phase relations, suppose the phase difference between *A* and *F* to be 0. The force between *A* and *F* will then be a maximum, and that between *B* and *F*, 0. Now, suppose a small change in phase between *A* and *F* to take place. The force between *A* and *F* becomes slightly less than the maximum, and that between *B* and *F* becomes other than 0. The movable system will take up the position of equilibrium between forces on *A* and *B*, which will be somewhere intermediate between *A* parallel to *F*, and *B* parallel to *F*. It is further evident that the direction of motion of the movable system depends upon the sign of the differential change, so that such a device is not only responsive to a change of phase between *A* and *F*, but is also responsive to the direction of that change.

It may be interesting to note that quadrature between *A* and *B* is not absolutely necessary either in the mechanical angle between *A* and *B*, or in the phase angle between their currents. So long as there is a displacement between *A* and *B*, both mechanical and electrical, the device is responsive to phase changes between *A* and *F*.

In the construction of the device, a laminated iron magnetic circuit is used and the phase difference between *A* and *B* is secured by using a non-inductive resistance in series with one coil, and an inductance in series with the other. It is, of course, impossible to secure 90 degs. phase difference in this manner, but sufficient difference can be obtained to answer all practical purposes. Current is introduced into the armature through three slip rings, one of the rings being made to do duty for one end of both armature windings.

The same system may be used as a frequency indicator by placing in series with the field coil a capacity of such a value that at normal frequency the capacity reactance will neutralize the inductive reactance. At normal frequency the current in the coil will therefore be in phase with the impressed e. m. f., but will lead or lag at any change of frequency. The phase relations between the impressed e. m. f. and the currents in the armature will, however, remain practically unchanged with varying frequency, and consequently the angulary movement of the coils *A* and *B* will therefore be a measure of the frequency.

The paper gives an analytical discussion of the principles of both methods, and shows under what conditions a maximum of range and sensitiveness is possible.

In the following discussion Mr. Barstow expressed the opinion that the idle current used in starting induction motors should be metered and an income derived from the same, in which Mr. Haskins concurred. Mr. Steinmetz said that central stations should exercise supervision over the installation of induction motors and see that those giving a large idle current were not installed. He said that means could be devised for indicating and charging separately for the idle current of motors, but doubted the advisability of such a charge. Induction motors can, however, be made to start with very small wattless current. Mr. Mershon said that owing to the short duration of the starting current, the income derived from charging for it at any reasonable price would be very small. Mr. Mailloux suggested that a penalty be charged for wattless current, such a method being in line with the present one of penalty charges for current where the consumer's demand is not a favorable one from the central station standpoint. In reply to a question, Mr. Haskins said that in the usual type of two-rate meter one or the other of two dials is thrown into mesh at certain hours by a clock; the double-dial meter, he added, has been replaced by the single-dial alternate meshing arrangement. Referring to the suggestion that central stations should exert supervision over the installation of induction motors on their circuits, Professor Browne said that the application of a power factor indicator would betray the efficiency of a motor. Mr. Harold W. Buck spoke in complimentary terms of the Lincoln synchronizer, which is employed upon the Niagara plant. Formerly when belted generators were used almost any synchronizing arrangement could be employed, such as incandescent lamps and voltmeters. Where, however, direct-connected machines of great power are used, they must be thrown into circuit as near exact synchronism as possible in order to avoid serious trouble.

Reference to the idle current of induction motors led to a lively discussion of the relative merits of direct-current and induction motors, which occupied almost all the time after the reading of the papers until adjournment. The discussions were participated in by Messrs. Mershon, Dunn, Scott, Steinmetz, Holmes, Mailloux, Fisher, Scott, Hering, Janisch, De la Tour and others. The attitude of those taking the leading part in the discussion was frankly partisan for their respective positions. For the induction motor the principal claims were for greater simplicity, minimum cost of maintenance and greater durability, while for the direct-current motor the claims were urged of less cost, greater flexibility of speed control, less disturbance on regulation, and a higher efficiency at full load and at overload. Those taking the extreme positions conceded on the one hand the better adaptability of the direct-current motor for elevator and street railway service, and on the other hand the better adaptability of the induction motor for use in connection with high-voltage transmission service.

One of the principal charges brought against the alternating-current motor was in connection with the large starting current required. Mr. Dunn stated that in the tests of two motors under the same conditions, a direct-current motor gave 6.4 times the normal torque with 7 times the normal current, while the induction motor took 4.4 times normal current at only 2.2 normal torque, which, moreover, was the maximum torque the latter would stand. In another case it was stated that 8 and 9 times normal torque was required in starting an induction motor. In reply to the latter criticism Mr. Scott said that the motor load probably had abnormal torque, and that a four-fold starting was way above the average, 1½ to 2½ being the usual figures for squirrel-cage rotors. Mr. Mershon said that with starting resistance in the rotor circuit an induction motor can be built to require no more starting torque than a direct-current motor, and that regulation with rotor resistance was just about as good as in the case of direct-current motors when starting, and better than the latter when running. In design there is no limit to the starting torque which may be given an induction motor. While the squirrel-cage rotor undoubtedly does take a large starting current, a motor with resistance in the rotor circuit would not require more than 10 per cent excess current in starting. Mr. Scott said it should be borne in mind that the abnormal current at starting only had a duration of a few seconds, and that while a motor of the rotor resistance type had a lower starting current, such a motor was more complicated than the squirrel-cage type. He dwelt upon the simplicity of the squirrel-cage motor and pointed out that as an offset to the magnetizing or idle current which it required, it dispensed with the commutator and brushes and the consequent attendance upon the same.

Mr. Dunn said that while he admitted the simplicity of the induction motor and its superiority in connection with high voltages, he considered it open to a number of objections in connection with general power distribution. The starting current was only one objection to the induction motor. In shop work it was not equal to the direct-current in speed, in regulation, in torque or in efficiency, the latter in the case of the direct-current motor being higher at both normal load and overload. In the case of factory work speed control is the dominant factor. Moreover, a direct-current motor costs less and its installation does not reduce the capacity of the generating plant and it requires less copper for distribution. He considered that too much stress had been laid upon the commutator and brushes, which required but slight attention; in fact, faults really did not commonly occur at the commutator, but at the rocker arm. Both induction and direct-currents have to be inspected at intervals, and it is little additional trouble to attend to the brushes of direct-current motors at such inspection. An instance was cited where direct-current motors were employed in a graphite plant where graphite settled an inch or more thick on the motors without interfering with their operation. It was suggested that in this case the small air-gap of an induction motor would have been filled up and its operation rendered impracticable. Mr. Dunn said that comparisons between direct-current and induction motors were invariably made on the old records of the former while the introduction of the induction motor was so recent that records relating to it were yet lacking. In view of the great progress constantly being made in connection with direct-current motors, it was unfair to judge the motor of to-day on the records of the past. In the discussion the fact was brought out that direct-current elevator motors are now frequently so designed as to take less current at starting than at normal load.

Mr. Mershon said that the greater cost of induction motors was counterbalanced by their advantages. Referring to the performance of motors in graphite dust, Mr. Mershon said that such dust was good for induction motors, and he spoke of a case where induction motors were running satisfactorily in a quartz mill and covered with quartz dust. Mr. Scott said that the objection to the induction mo-

tor on the score of the greater generating capacity due to idle current required, could be met with the statement that the extra copper and other material in the direct-current motor could be transferred to the generator, thereby decreasing its capacity sufficiently to take care of idle current. Mr. Holmes created a laugh by resuming some of the statements made as to the great simplicity of construction and few parts of the induction motor as compared with the direct-current motor, and then asking why this model of simplicity should cost so much more than its alleged greatly complicated direct-current rival.

Mr. Mailloux referred to a case where induction motors had been installed and then had to be removed owing to the difficulties in starting, a 50-hp motor blowing the fuse on a 150-hp generator. Referring to this and other criticisms of a similar kind, Mr. Scott said that they are invalid in the absence of data as to the starting torque of the motor load, which in some instances, as in the case of flour mills, is abnormal and would similarly affect direct-current motors.

Messrs. Steinmetz, Janisch, De la Tour and others held that both types of motors have their field. The former created a laugh by saying that an induction motor is undoubtedly best for use in a powder mill, while the superior claims of the direct-current motor for elevator service could not be contested. Between these two limits there was much debatable ground, and it lay with the engineer to decide in each specific case which type of motor was the better for that case.

On Wednesday evening special trolley cars were provided for a trip to Niagara, where the party witnessed an illumination of the gorge rapids by powerful arc lights.

SESSION OF THURSDAY, AUG. 22.

Five papers were read at this session, those of Professor Aldrich and Messrs. Perrine, Scott, Steinmetz and Rice. As in the case of the previous meeting and the following meetings of the convention, discussion was deferred until after the reading of all the papers.

The first paper read was that of Professor W. S. Aldrich and George W. Redfield, entitled "Performance of an Artificial Forty-Mile Transmission Line." It gives a description of a transmission line set up in the electrical engineering laboratory of the University of Illinois, and a number of tests made on the line and apparatus connected therewith. An abstract of this paper will be given in a following issue.

A paper was then read by Professor F. A. C. Perrine, on the "Elements of Design Particularly Pertaining to Long-Distance Transmission." The question of capacity was particularly dwelt upon, which was shown to be the predominant factor in long high-voltage transmission lines. It is pointed out that in the case of a line of 100 miles in length operating at a voltage of 50,000 or 60,000, and with a periodicity of 50, the line-charging current is 2000 kilovolts, the introduction of units smaller than 2000 kilowatts is thus inadvisable, and the transmission of power less than 3000 kilowatts commercially impractical in such a case unless the capacity effect be neutralized by the use of reactive coils. The influence of the wave form in long-distance transmission was discussed with reference to the capacity of the line. Curves taken by means of an oscillograph show that the effect of capacity in circuit is to reduce the accentuation of the teeth of the current curve. It is stated that by far the most important effect of capacity in circuit is that which relates to the regulation of transformers and generators attached to the line, since leading current taken from such apparatus has the effect of decreasing the voltage, while lagging current increases it proportionately. An abstract of this paper will be printed in a following issue.

The next paper was by Mr. Charles F. Scott, on "The Induction Motor and the Rotary Converter, and Their Relation to the Transmission System." The greater part of the paper is taken up with a consideration of the relative merits of the induction and synchronous motors, between which a comparison is made in parallel columns under 10 main heads and 37 sub-heads, the former being as follows: Auxiliary apparatus; starting, normal; starting, abnormal; starting and maximum running torque; speed; current; power factor; reaction upon generator and circuit; and causes which may accidentally stop a motor. With a few exceptions, the comparisons are very strongly in favor of the induction motor. The summary is as follows:

The induction motor is a passive element in the system, each motor attending to its own work and not trying to run the system. The synchronous motor is an active element in the system. It acts as a generator, impressing its own wave form, its e. m. f., and its fluctuations upon the circuit, which fluctuations may be caused by an intermittent load. The induction motor is not sensitive to differences in the design of other apparatus operating on the same system. The synchronous motor is a sensitive element in the system. Its successful operation is dependent upon the proper design of the motor itself, and the other machines connected with the system, and also upon the proper adjustment and freedom from speed fluctuation in generators and other motors. It is liable to momentary variations from normal conditions, such as a sudden overload and sudden decrease of generator speed, or momentary fall in e. m. f. With the induction motor no experience and electrical skill are required of the attendant, and there is little or nothing to get out of order, either through carelessness or design. The synchronous motor requires skill and care on the part of the attendant for starting and for adjusting, and for keeping the brushes and auxiliary apparatus in proper condition. The induction motor has a definite power factor, depending upon the load. The out-of-phase current does not vary greatly at different loads, and a changing load, therefore, has comparatively little effect upon the drop in voltage, and in regular service there is little liability that the motor will disturb the e. m. f. of the circuit. The power factor in the case of the synchronous motor is under the control of the operator, and the current may be made leading or lagging. Instruments are necessary, however, in order that proper adjustment may be made by the attendants. The induction motor and its operation are simple and reliable, while the synchronous motor and its operation are complex and involve many possibilities of accident. In conclusion, it is stated that the synchronous motor is now rarely considered seriously as a competitor of the induction motor, except in large sizes.

The second part of the paper deals with the rotary converter in comparison with the motor-generator. The rotary converter is stated to have the advantage over the motor-generator in point of cost, there being but one machine instead of two. In point of efficiency, there being a loss in only one machine instead of two, and in its effect upon the voltage of the transmission system, as it may be compounded to overcome the drop which would otherwise occur in generators and transmission circuits. On the other hand, the direct-current e. m. f. of a motor-driven generator is not dependent on the e. m. f. of the supply circuit, and may be adjusted or compounded, as desired. It is added, however, that the voltage delivered by a rotary converter may be satisfactorily adjusted and controlled by regulating devices or by compounding, so that usually the close relation between the e. m. f.'s at the two ends of the converter is not disadvantageous, provided the e. m. f. of the supply circuit is reasonably constant. It is admitted that there are special cases, as where the voltage has to be adjusted over a very wide range, where the motor-generator is to be preferred. The opinion is expressed that a motor-generator employing a synchronous motor does not seem to possess any exceptional advantages over the converter, except in some cases where the independent control of the direct-current voltage is desired. A motor-generator employing an induction motor secures many of the advantages set forth in the preceding comparison between synchronous and induction motors, such as in being particularly applicable to circuits supplied with generators in which the speed has a rapid and periodical fluctuation, or with which, for any reason, the use of a synchronous machine is impractical or undesirable. The induction motor driving a generator is also to be preferred where units are quite small and the attendance is unskillful.

A short concluding section of the paper deals with the alternator. It is stated that an alternator which may be quite satisfactory for lighting purposes may be wholly inadequate for successfully supplying current for either induction motors or rotary converters. For the latter service an alternator should have good inherent regulation, as suddenly changing loads or the throwing on or off of motors cause fluctuations in voltage to which external devices for adjusting for field current cannot act quickly enough to prevent disturbance. For the operation of rotary converters the generator speed should be uniform, and the generators should also have good inherent regulation, not only in order that the e. m. f. may be maintained at heavy loads, but for the purpose of holding the converter rigidly in synchronism. The field should be stiff and the iron not saturated, in order to prevent shifting of the magnetic field back and forth with changing armature currents. In conclusion, a generator which is to supply induction motors or rotary converters should be selected with reference to the service which it is to supply. In some cases unsatisfactory results have been obtained in the use of motors or

converters, and the trouble has been located in fluctuating speed or in the characteristics of the alternators supplying the circuit.

Undoubtedly the most important paper read before the convention was that by President Steinmetz, entitled "Theoretical Investigations of Some Oscillations of Extremely High Potential in Alternating High-Potential Transmissions." The paper forms, in fact, one of the most important in the long series of valuable papers which Mr. Steinmetz has contributed to the Transactions of the Institute. With capacity circuits any change in circuit conditions involves an electric oscillation, and Mr. Steinmetz gives for the first time a systematic treatment relating to the rise of potential on lines containing capacity due to conditions which cause electric oscillations. Leaving aside harmonics, such conditions may arise from pulling a switch, extinguishing a short circuit, or starting up a generator, all of which will produce oscillations or frequencies which may be very rapid.

In his paper Mr. Steinmetz said that the first time he noticed such a phenomenon was when making a series of observations on the effect of opening a high-potential circuit with different types of circuit breakers, on an artificial line consisting of inductive coils and about half a mile of high-potential cable, with a spark-gap between needle points connected across the system, to measure an instantaneous rise of voltage. If the needle points were brought so close together that a discharge occurred between them, an extremely high voltage was invariably induced locally in the system, of a total striking distance reaching as high as 40 inches, or between one-quarter and one-half million volts, the normal voltage of the system being about 10,000. The explanation of this phenomenon is probably as follows:

By striking between the needle points shunting the circuit, the system was short circuited and thus instantly drained of its electrostatic charge, so that the potential locally fell to practically nothing, while an excessive current passed between the needle points as arc. By the heating effect of this current the arc was instantly blown out explosively and thus the short-circuit current of the system ruptured. After the explosion the discharge between the needle points again short circuited, interrupted itself, etc. The phenomenon is thus of similar character, but infinitely greater power to the action of the Wehnelt interrupter (the latter depending upon the combined effect of self-induction and electrolytic polarization), while the phenomenon observed occurred with self-induction and capacity.

Since that time in a number of instances of high-potential circuits electrical discharges were noticed, with striking distances many times greater than that of the normal potential of the system, under circumstances where a short-circuiting arc interrupted itself in the open air. A short circuit in a constrained space, as in a buried cable, does not appear to give this effect.

From this and other reasons, Mr. Steinmetz was led to believe that a short-circuiting high-potential arc in free space, in a system containing self-induction and capacity, is a self-interrupting phenomenon, and thus may cause very serious high-potential effects. On any high-potential limited power transformer this phenomenon can be observed in the entire change of the character of the arc between the high-potential terminals when inserting capacity in shunt. From the flame of the steady and noiseless arc, which curves upward by its heat, the discharge changes to the glaring white, noisy, lightning-like, destructive high-potential oscillation. This change can be shown photographically, the photographs giving in the absence of capacity, the striations of the successive half waves of the impressed frequency, while in the latter case they show a system of successive electrostatic sparks not followed by the striated alternating arc flame. As shown by Mr. W. S. Andrews, a number of oscillating discharges may occur during the same half wave of alternating primary e. m. f.

The paper then proceeds with an exhaustive mathematical investigation of the electric character of electric oscillations which may be produced in high-transmission lines, and in conclusion several numerical examples are worked out.

In one the case is considered of a transmission line carrying 100 amperes at full load, under an impressed e. m. f. of 20,000 volts, the resistance drop being 8 per cent, the inductance voltage 15 per cent of the impressed voltage, and the charging current 8 per cent of full-load current. The resistance drop in the step-up transformers is assumed at 1 per cent, and the reactance voltage 2½ per cent.

The resistance drop between constant potential generator terminals and middle of transmission line is then 5 per cent, or $r = 10$ ohms. The inductance voltage is 10 per cent, or $x = 20$ ohms. The charging current of the line is 8 amperes, and consequently the capacity reactance is $K = 2500$ ohms. Assuming a sine wave, the impressed e. m. f. is 28,280 volts. In this case the rise in voltage due to rupturing the line under short circuit would be tenfold, or 282,800 volts.

In the case referred to in the beginning of the paper, the distinctive voltage was induced by a short circuit on an experimental 10,000-volt, 40-cycle line. During the occurrence of the phenomenon the generator voltage probably fell to about 5000, due to limited capacity. The resistance of the system was very low, about $r = 1$ ohm, while the inductive reactance may be estimated as $x = 10$ ohms, and the capacity reactance as $k = 20{,}000$ ohms. From these data the equations deduced show that the oscillation had a frequency of 1800 cycles; and a maximum e. m. f. of nearly one-third million volts.

The paper ends with the following conclusions:

1. The most important sources of destructive high-voltage phenomena in high-potential circuits containing inductance and capacity are not resonance phenomena from the wave of impressed e. m. f. or its higher harmonics in case of the deviation of the wave from sine shape, but are electric oscillations produced by a change of circuit conditions, as starting, opening circuit, etc.

2. These phenomena are essentially independent of frequency and wave shape and of impressed e. m. f., but depend upon the conditions under which the circuit is changed, as in the manner of change and the point of the impressed e. m. f. and current wave at which the change occurs.

3. The electric oscillations occurring in connecting a transmission line to the generator are not of dangerous potential, but the oscillations produced by opening the transmission circuit under load may give rise to destructive voltages, and the oscillations caused by interrupting a short-circuit are liable to reach voltages far beyond the strength of any insulation. Thus special precautions should be taken in opening a high-potential circuit under load. But the most dangerous phenomenon is a low resistance short circuit in open space.

4. The voltages produced by the oscillations in open circuiting a transmission line under load or under short circuit are moderate if the opening of the circuit occurs at a certain point of the e. m. f. wave. This point approximately coincides with the moment of zero current.

The last paper read at the Thursday session was one by Mr. E. W. Rice, Jr., on "The Control of High-Potential Systems of Large Power." This paper, which will be printed in full abstract in a following issue, deals with the development and present status of switches for the control of circuits of high-voltage supplied with a great amount of power. A considerable portion of the paper is devoted to a description of the type of large cellular oil switches employed on the New York Metropolitan Railway. In conclusion, the paper outlines the principles which should govern the layout of large generating stations of from 5000 kilowatts and over.

The discussion of the foregoing papers was participated in by Professor Janet, Professors Shepardson and Aldrich, Messrs. Fisher, Kennelly, Steinmetz, Mershon, Perrine, Stillwell, Scott and others. Professor Shephardson said that assuming the discharge from high-voltage conductors to be a function of the diameter, aluminum conductors are indicated as preferable to copper on account of the increased diameter for a given resistance. He suggested that the stranding of such conductors might, however, counterbalance this advantage, but Dr. Perrine said that as the effect is dependent upon the surface of the conductors, a stranded conductor would act the same as a solid one. He also said that the employment of aluminum was limited to stranded conductors. Mr. Fisher referred to some sparking experiments in which it was shown that the introduction of capacity increased the sparking, and he suggested that the capacity caused the e. m. f. wave to become more peaked. Mr. Emmet took issue with a statement in Mr. Scott's paper that the wave form of the generator should be observed in the selection of apparatus for use on circuits supplied by it. He said that it was not at all necessary to design motors, converters and generators for each other. As to synchronous motors, the worst results in their use arises from overloading, and the trouble from running synchronous apparatus in parallel is negligible. Referring to high-voltage insulation, Mr. Emmet said that dry air is a good insulator, but it is easily punctured. On the other hand, solid insulators require considerable energy to puncture them, and overtones usually did not continue long enough to supply such energy. At Niagara Falls abnormal e. m. f.'s will cause long jumps through air, but no trouble has been found in transformer insulation, and the same is true with respect to the effects of lightning discharges. Mr. Kennelly said

that he considered that Mr. Scott's paper showed too much harshness toward synchronous motors, and that in many cases a mixed system would be best, being made more flexible by the employment of synchronous motors. Mr. Kennelly made a plea to drop the word "rotary" and simply use "converter" in referring to rotary converters. He referred in high terms to Mr. Steinmetz's paper, which show the importance of the evanescent constant in the algebraic equation. This is evident from the fact that it might give rise to a voltage 100 times the fundamental, as shown by Mr. Steinmetz, and without the presence of harmonics, since the cases considered by Mr. Steinmetz were independent of the wave form. He spoke of the interesting analogy of Mr. Steinmetz between the effect set up by the Wehnelt interrupter and that by the breaking of a short-circuit, or the analogy between electrolytic capacity and static capacity.

Mr. Steinmetz, referring to Mr. Scott's paper, said that the synchronous motor is entirely suitable where a large motor is needed, and the induction motor is similarly suitable where the reverse is the case. He said that he had designed 100,000-kw induction motors, and the same capacity of synchronous motors, and he had seen no reason to change his belief that synchronous motors are preferable to induction motors where the former can be used. It is true, however, that the starting torque of a large induction motor is larger than that of the synchronous motor. The latter has a larger air-gap and a power factor of from 95 to 100 per cent. Both motors drop out of step at excessive load, while the synchronous motor can be adjusted to have no deleterious reaction on the generator, and be made to have a beneficial action on the circuit. For many services the induction motor requires resistance in its rotor circuit. He challenged the statement that the squirrel-cage induction motor can be started on 1½ normal current, and said that the wave shape could not properly be used to explain trouble from the operation of alternating-current motors. At Niagara, for example, in passing from two-phase to three-phase the peak of one of the phases is made different from the peak of the other two phases, and yet no trouble had ever been experienced in the operation of apparatus from this fact.

Referring to a statement that intervening resistance beyond a small amount is prohibitive to the running in parallel of synchronous apparatus, he stated that a 60-cycle synchronous converter has been operated heavily loaded in parallel at the end of the 22-mile line for eight months, and no trouble experienced. Another advantage of synchronous motors in a station is that they can be used as generators in case of necessity, and such motors had a higher efficiency—95 per cent and over—than alternating-current generators. A synchronous motor can be operated at 10,000 volts or more, while an induction motor requires transformers with high voltages, and it is more expensive than the synchronous type.

Dr. Perrine said the advantages that Mr. Scott had enumerated for the induction motor were possible ones, but were not always realized in practice. He referred to one case where a 700-kw generator would not start a 300-kw motor, and to another case where four friction clutches were necessary on shafting driven by an induction motor. Mr. Scott said in reply that he believed the large torque in these cases was due to the fact that the motors were driving a flour mill where an enormous torque is required in starting up. Dr. Perrine said that the operation of synchronous motors requires some skill, but that in California almost all the plants use such motors, many of them in mines where the conditions are particularly trying, and yet with good results. At a recent meeting of the Pacific Coast Electrical Transmission Association, the consensus of opinion was that for large powers it is not advisable to use induction motors, except where there are ignorant employes. He referred to the desirability of synchronous motors as part of a steam reserve, and said that several years ago every synchronous motor in California was running as a generator.

Mr. Stillwell said that he preferred induction motors wherever their use was possible, and that the only point in favor of the synchronous motor is its high power factor, and this was apparent rather than real, owing to the lack of skilled attendance. In terminal stations the attendance is sufficiently skillful for synchronous motors, but sub-station expenses would be increased should they be installed there. At Niagara better results had been achieved from the use of induction than synchronous motors. When the potential of the synchronous motor drops it lets go. It is true that the clearance of the induction motors is less than that of the synchronous motor, but the latter may introduce harmonics. As to wave shape, no trouble from defective wave shape has been experienced in the Niagara plant.

Mr. Oberlin Smith considered that induction motors are preferable to synchronous motors for running machine shops. Mr. Mershon referred to his Telluride high-voltage experiments, and said that the discharge from line is dependent upon the diameter of the conductor and the distance apart of the conductors. The loss from stranded cables is greater at first, but decreases as the surface of the latter become somewhat corroded. He found that there was less loss from the line at the receiving than at the generating station, and that the loss was largely dependent upon the wave form, being greater with a peaked wave. The form of the wave was found to vary with the capacity in circuit. As to the relative merits of the induction and synchronous motor, he favored the former, but each had its sphere. As to the power factor, that of the synchronous motor could not be maintained if adjustments were not made with changes of load. As to efficiency, he said that recently in the case of some bids, manufacturers had guaranteed about the same efficiency in each case.

Professor Janet spoke of the great value of Mr. Steinmetz's paper, which showed clearly what bad effects might come over short circuiting the line containing capacity. He mentioned a case that came under his observation during the Paris Exposition when a workman drove a nail in a cable, which was simultaneously punctured a mile or more distant. He spoke of the desirability of reverse circuit breakers, and was informed by Mr. Steinmetz that these were largely used in this country. Professor Aldrich called attention to the experiment detailed in his paper, showing that by proper adjustment the synchronous motor would neutralize the power factor of a line. Professor Perrine said that the general effect of capacity is to depress the peak of the wave, but sometimes the reverse occurs and harmonics are accentuated. Mr. Scott, referring to the statements of Mr. Steinmetz and Mr. Emmet that synchronous motors are superior to the induction motor when the conditions are proper, said that more conditions favored the induction motor. A synchronous motor must have a starting motor and therefore starting current as in the case of the induction motor. When started without load the two are on a parity. Mr. Scott said that it was true that lowering the voltage lowers the efficiency of the induction motor more than that of the synchronous motor. In case of an overload the synchronous motor stops immediately, while the stop of the induction motor is gradual. As to the instance cited by Professor Perrine concerning experience in starting a flour mill, Mr. Steinmetz asked what the effect would have been had the synchronous motors been used, and added that the manufacturing company referred to in making a recent addition to its plant had purchased, not a synchronous, but an induction motor.

After the adjournment of the session a visit was made to the Buffalo terminal station of the Niagara line.

Thursday was "Electrical Day," and in honor of the occasion there was a special display of fireworks in the evening, which included a set piece limning the features of Mr. Henry Rustin, chief of the Electrical and Mechanical Bureau. It was ludicrously unfortunate that on this night above all others there should be an interruption of electrical service, and yet this is what occurred. A short circuit developed on one of the cables in the Exposition grounds, and for two hours the Exposition was in darkness.

SESSION OF FRIDAY, AUG. 23.

Two papers were read at this session, one by Mr. L. B. Stillwell entitled "A Description of the Niagara Falls Transmission Plant," and another by Mr. A. J. Wurts entitled "The Development of the Nernst Lamp in America." The latter paper is printed in full elsewhere in this issue. A full abstract of Mr. Stillwell's paper will appear in a following number, and some comment relating to the same will be found in our editorial pages. The paper is by far the most voluminous presented at the meeting, filling 91 pages of the Transactions, which corresponds to about 20 pages of this journal.

A considerable portion of the paper is historical, and Mr. Stillwell quotes frequently from his correspondence with the Niagara Company, in which he proposed a number of features, the adoption of which have greatly conduced to the success of the installation. Mr. Stillwell said that the wisdom of the decision to reject the three-phase system is now at least open to question, but added that if a new Niagara problem were presented to-day with conditions such as are met with the existing plant, he would be still inclined to use two-phase alternators. He considers that the wisdom of the selection of the frequency of 25 cycles per second has been demonstrated, though he personally considers 30 cycles preferable. The town of

Echota is satisfactorily lighted by incandescent lights using 25-cycle current, but this condition he believed to be somewhat helped by the fact that the potential wave of the Niagara alternators is flatter than a sine wave.

The paper gives an account in detail of the first three alternators as planned and constructed, and their operation under test in service. It is stated that the general mechanical features of these alternators—that is, the external revolving field with inwardly projecting field poles surrounding a centrally located and stationary armature—were proposed by Professor Forbes. The two following sections of the paper deal with the design, test and operation of alternators Nos. 4 to 10. The change in the construction of these latter alternators is stated to be not material as affecting their money-earning power. Their advantages may be summed up in the statement that the efficiency is about .3 per cent higher, the regulation is somewhat closer and the limiting temperature under continuous full load about 15 degs. C. lower.

The remaining sections of the paper deal with the exciters, the switching apparatus and measuring instruments, transmission and distribution, and equipment of power house No. 2. Load curves are given in the paper for local and long-distance service as compiled from half-hourly wattmeter readings for the 24 hours ending at midnight, July 21, 1891. The local load varies between 13,200 kilowatts and 15,700 kilowatts. This marked uniformity of output is explained by the fact that nearly all of the power used locally is delivered to manufacturing companies whose processes are continuous, and whose use of power is practically constant. The long-distance load varies from a minimum of 3300 to a maximum of 15,600 kilowatts. Of this maximum probably 90 per cent is used for railway and lighting purposes. The average total load is about 24,000 kilowatts. The loss in the lines averages about 6.5 per cent. By calculation, with this line loss the net efficiency of the step-up transformers, line and step-down transformers, should be 89.5 per cent. As measured, the efficiency has been found to be 88.4 per cent. The more important features in which the equipment of the new power house will differ from that of the old power house are as follows:

In the new power house the alternator equipment will comprise eleven 3730-kilowatt, two-phase alternators, wound for 2200 volts. All switch gear and measuring instruments will be located in one structure instead of in two, as in the old power house. All switches will be of the General Electric cellular oil type, and they will be manipulated from a dummy switchboard. The regulation of the alternators will be materially closer than the older machines, and the external appearance will be considerably changed. The exciters will not be located above ground, as in the case of the old power house, but in chambers excavated in the sides of the wheel pit at the level of the turbine floor. The new alternators will be used for long-distance service and the old ones for local service.

Comparing the Niagara plant with a steam plant of the same type, it is stated that on the basis of 3 lbs. of coal per unit at the switchboard, more than 800 tons of coal per day would be burned.

Part was taken in the discussion by Messrs. Steinmetz, Buck, Lincoln, Sperry, Perrine, Stott and others. In reply to a question by Mr. Steinmetz, Mr. Stillwell said that the e. m. f. curves had been taken off for different loads, and that the load e. m. f. wave was distorted. Mr. Buck said that the history of the Niagara plant resumes the greater part of the history of electrical engineering since 1891. It jumped the size of the generators from a few hundred kilowatts to 5000 horse-power, raised the generated voltage from 1100 to 2200, and the system of 1891 remains the standard of to-day.

Mr. Lincoln referred to the deterioration of the rubber of cables, which he considered to be due to a static effect. An instance was cited of rubber cable with 9/32 insulation, and held in porcelain insulators clamped on the wall. The cable had originally withstood 100,000 volts, but after a week it broke down on 13,000 volts strain between the line and ground. He said that the deterioration may be due to ozone generated by static discharge to ground, which statement was supported by Mr. Sperry, who said that a rubber hose with a ⅝-inch wall is rendered useless in a day and a half in an atmosphere containing 1½ per cent of ozone.

Professor Perrine spoke of the unreliability of resistance temperature measurements, and said that a proper specification would provide for the highest thermometer temperature and the average resistance temprature.

In reply to a question as to how the trouble from anchor ice was obviated, Mr. Stillwell said that the racks were lifted and the ice allowed to go through the wheel.

Referring to interruptions of Niagara service, he said that 30 per cent were to be charged to the cables, 30 per cent to exposed contacts such as at circuit breakers, 10 per cent to carelessness in throwing switches by unskillful men, 10 per cent from outside interferences with the line and 20 per cent to lightning. Interruptions due to the first two mentioned causes could be reduced, but he doubted if there could be any improvement with respect to the three last mentioned causes, which are responsible for 40 per cent of trouble. In answer to a question as to trouble from lightning in California, Dr. Perrine said that in the case of the Blue Lake line the trouble was principally due to lightning induction along 200 miles of line. He doubted the utility of choke coils, but favored their use for the reason that they introduced more lightning arresters into the circuit. Long lines in California are protected by barbed wire grounded at every fourth pole on an iron spike at the bottom of the pole. One of the functions of barbed wire is to keep the line discharged. It was found that a dead line is charged by a dry wind blowing across it. He considered barbed wire better than smooth wire, and expressed the opinion that it furnished the best lightning protection. Lightning effects he classed under three heads, as follows: Neighborhood discharges, giving rise to inductive effects; secondary discharges and direct discharges. The first two may be guarded against by lightning protecting devices, but as to the third he said that we must "trust in Providence."

The discussion of the Nernst paper by Mr. Wurts was joined in by Messrs. Howell, Steinmetz, Hammer and others. In answer to a question, Mr. Wurts said that in the six-glower lamp the heater was cut out of circuit after two glowers had become conducting, the heat of the latter bringing the other glowers up to the conducting temperature. In reply to a question by Mr. Howell, Mr. Wurts said that experiments had been made with lamps in vacuum, but that such an arrangement is impracticable commercially. No relation was discovered between the conducting and the fusing temperature. Mr. Howell said that the lamp appeared to be limited by the necessity for ballast, and since different materials conduct at widely different temperatures, this limited the employment of ballast to certain materials and limits of temperature. In reply to a question, Mr. Wurts said that in the six-glower lamp the platinum of each glower is worth 2 cents, and platinum in the heater 8 cents. The price of a six-glower lamp would probably be about $8, and that of a single-glower lamp $3. Mr. Howell dwelt upon the fact that the Nernst lamp requires a considerable excess of current in starting, which in the case of a single-glower lamp is about double that of the normal current. Mr. Wurts pointed out that this disparity was very much smaller in the case of a six-glower lamp, and, moreover, that the starting current decreased fom maximum to normal within four seconds. He stated that the life of the glower is about 800 hours, and there is only a few per cent of deterioration during the life.

Mr. Steinmetz said that it is not fair to compare the Nernst lamp in its present state with the incandescent lamp, which has been in commercial use for 20 years. He considered that the candle-power of the Nernst lamp is not comparable with that of incandescent lamps owing to the quality of the light given out.

In reply to a question, Mr. Wurts said that the temperature of the glower is about 2500 degs. C., as determined by calorimetric test. He said that while there was some blackening it is not as serious as in the case of the incandescent lamp, and could, moreover, be easily removed. Mr. Hammer spoke of the superiority of the American type of Nernst lamp over the European type, particularly in discarding the method of connecting the glower and the use of a spiral heater. In reply to a question, Mr. Wurts said that the life of the direct-current glower is about 300 hours, and that while it might be made 500 hours, this type of lamp is not so good as the alternating-current type. He said that the Nernst lamp was particularly indicated for use in dry goods stores, factories, railroad stations and yards, etc. It would probably not be a sharp competitor of the incandescent lamps, except where the latter are used grouped. One of its advantages is that it can be used on 25-cycle circuits, tests having shown no difference in the quality of the light from 25 and 60-cycle circuits. Mr. Howell said that the curves of the paper showed that in a six-glower lamp the normal current is 2.3 amperes, and the starting current 3.5 amperes. This statement was confirmed by Mr. Wurts. In conclusion, Mr. Wurts announced that the commercial manufacture of the Nernst lamp would be commenced in a large factory in Pittsburg within two weeks.

In the afternoon a trip was made by special trolley to Niagara, where the power houses of the Niagara Falls Power Company and

the Niagara Falls Hydraulic Power & Manufacturing Company were visited. Some members of the party also visited the works of the Carborundum Company. Among the events of the evening was a dinner given by Professor Janet, at which a number of prominent members of the Institute were guests.

SESSION OF SATURDAY, AUG. 24.

Two papers were read at this session of the convention, one by Mr. A. H. Armstrong, entitled "Notes on Modern Electric Railway Practice," and the other by E. J. Berg, on "Electric Railway Apparatus." Both of these papers will be printed in full abstract in a following issue. The main feature of both papers was a discussion of the relative merits of direct and alternating-current motors for electric traction service, and in both cases the conclusions were that in almost every respect the direct-current motor is superior to the alternating-current motor for electric railway service. A possible exception, however, was made in both papers in the case of long lines over level ground with infrequent stops.

Upon the conclusion of the reading of the papers, Mr. Gifford described a method of starting converters as simple shunt motors, thus obviating the difficulties otherwise resulting from variations in the voltage of the starting current. Professor Gillon gave some details of the polyphase traction experiments at Berlin at high speeds and employing a potential of 10,000 volts. He expressed the opinion that under certain conditions with respect to starting, this system was applicable where the direct-current system would fail. With respect to the use of polyphase motors for urban traction, he said that the arguments made against this system were based upon high acceleration, but as high speeds are never used in urban service, any arguments against the polyphase motor based upon such speeds were unfair. Polyphase motors, he said, can be designed to give as large a starting torque as may be desired by momentarily increasing the voltage at the terminals. Professor Gillon expressed the opinion that the air resistance offered to a train consisted largely of frictional resistance against the lateral sides of the train. Mr. Janisch also referred to the Berlin-Zossen experiments, which were carried out by the company of which works he is chief engineer. He said the tests were satisfactory as to the application of the polyphase system to high-speed traction. It was found, however, that the overhead trolley is not practicable for high speeds, and at Zossen side contacts were substituted. He intimated that the reason the work had not been followed up was due to the disfavor with which the German Government viewed prospective electric roads with respect to competition with State lines and cost of transforming the latter from steam to electricity.

Mr. Arnold expressed regret that American engineers were antagonistic to the three-phase railway, and that we had to go abroad to find the defenders of this system. Personally, he was a friend of the direct-current rotary-converter system, and therefore in a position to consider impartially the merits of the polyphase system. He believed that, if left to themselves, our American engineers will solve the problem. One solution of this problem he considered to be the use of energy usually dissipated in starting a train. Electric elevator motors are started at less than normal current, and he believes that the same can be done with polyphase motors. He considered that Mr. Berg's example, which worked out against the polyphase system was not fair, since it applied to a shorter road well adapted for direct-current traction. With a longer road his conclusions would be modified. He believed that the direct-current motor is best, in connection with sub-stations, for urban roads and also best for interurban roads with light cars. For heavy railroading he was strongly in favor of the alternating-current system.

Mr. Mailloux said that short runs precluded the use of the alternating-current motor. The greater the speed the greater the difficulty for the alternating-current motor, due to acceleration. The problem is a function of the speed and the length of run. Integral acceleration curves he considered give the best indication as to the relative merits of direct and alternating-current motors for railway traction, and he referred to Mr. Berg's diagrams as showing that the direct-current motor is better than the alternating-current motor for accelerating. The starting torque of an alternating-current motor is only 2½ to 3 times that of the running torque, while that of the direct-current motor is 4 or 5 times greater. In conclusion, he said that the question of alternating-current motors in electric traction was one for the future and not for the present.

Professor E. P. Roberts expressed disappointment at the statements made concerning alternating-current traction, particularly in view of present conditions in Ohio which seem to call for the use of the alternating-current system. Owing to recent consolidations of railroads in Ohio the connected lines are very long, and he had hoped that this would produce conditions that will permit the substitution of alternating-current traction.

Mr. Stillwell said that in the electric railway field we had been apt to go along old lines and have not given sufficient attention to alternating currents. He believed that the question should not be considered generally, but with respect to specific cases. An objection to the present sub-station system is that it is dependent upon three or four points of supply, each point demanding the exercise of skill. On the other hand, with the alternating-current system, all the skill could be concentrated at one point. With a direct-current system and a number of sub-stations the reserve and corresponding investment is out of all proportion with the generating plant. For example, in the Manhattan system there is one reserve generator and seven reserve rotaries. On a large direct-current sub-station system the acceleration is limited by fluctuations in the sub-stations, for though the fluctuations may be moderate at the power house they may be extreme in the sub-stations. Before adopting the alternating-current system, however, it must be worked out for specific cases. As to the claims of greater transmission efficiency of the alternating-current system, he said that on New York elevated roads this saving would only apply to 18 per cent on the total cost, so that by raising the efficiency from 80 or 90 per cent by the use of alternating currents, the increase would be but 2 per cent, not considering the labor element or a large saving in investment. In conclusion he said that to-day the sub-station system is the best for large cities.

Mr. Arnold coincided with Mr. Stillwell in this latter conclusion, saying that the sub-station system was the best to-day for urban and slow-speed interurban roads. For heavy railroading, however, the alternating current is alone applicable, and he quoted a railroad president who has operated both steam and electric roads for five years to the effect that he can carry freight cheaper with electricity than with steam. As to the factor of acceleration in the railway problem, he had thoroughly considered it, and what he said in favor of the alternating-current system was said with a full knowledge of the importance of this factor. In conclusion, he said that he did not like to see American engineers take the attitude that the direct-current system is perfection and appear to be antagonistic to the alternating-current system.

Professor Roberts said that he found that sub-station charges were a great factor in transportation charges. Mr. Steinmetz said that at one time he believed that the polyphase system had a higher transmission efficiency and less operating expense, but after thoroughly considering the question recently he has found that the transmission efficiency is less, owing to the inefficiency of the induction motor. With the induction motor the fluctuations are very great and transformer sub-stations would be required, and this latter is the electrical apparatus which will stand less overloading, with the consequence that the expense for transformer plant would be very great. Rotary converters require extremely little attention and not much expense.

Mr. Potts, of London, said that in the face of such very diverse opinions as to the relative merits of the direct and alternating-current railway systems, he thought it best to say nothing in view of the smaller experience of Great Britain in electric traction. He referred to the very much lower bid offered in London in connection with the Ganz system and said that he would regret it if American manufacturers did not obtain the work.

Mr. Scott said that the papers which had been read confirmed calculations that had been made by Westinghouse engineers. He gave some figures which confirmed those arrived at by Mr. Berg, and said that the conclusions of the Westinghouse engineers coincided with those of the General Electric engineers to the effect that the saving with the polyphase system would be negative. As to the saving from braking with the latter system, since braking cannot be done under half speed, the saving would be slight, and the increased weight of apparatus would more than take this up. He said it was better to coast and to give up braking. He said that the opinion of the company engineers was also confirmed by Mr. Stillwell in connection with the New York elevated system. The advantage of alternating-current motors on grades was, in fact, a disadvantage. The same

size of direct-current motor would give higher speed on the level or low grades and thus make up for the lesser speed on high grades.

Mr. Scott referred to a remark made by one of the foreign guests, who said he did not understand the position of the American company's engineers in their antagonism to polyphase railways, but ascribed it as a commercial policy of their employers. Mr. Scott repelled this insinuation, and said that the commercial departments of the companies were, on the other hand, constantly urging the engineers toward the alternating-current system. He said the question was really not one of alternating current vs. direct current, but that of series vs. shunt motors. If direct-current shunt motors are not good for railway service the induction motor is not good. The invention of a speed-changing device might change the situation. In conclusion, he said that he coincided with the authors of the papers in that the induction motor is not applicable for electric railway service.

Mr. Potts asked to be allowed to make a personal explanation concerning a remark he had made as to the influence of manufacturing companies with respect to the position taken by their engineers on the polyphase railway question, which he did not wish to be applied in any personal sense. One could, however, generally take it for granted that manufacturers are in favor of the apparatus they can supply with the most profit to themselves. Mr. Steinmetz said that this latter point was true, but it was a serious matter for companies to be left behind and that, in fact, they are always seeking to make advances. He said that his company had done a great deal of work on the problem under discussion, but there were no results thus far, except in the supply of six induction motor cars, and these for a railway of Italy.

Mr. Stillwell said that direct-current systems, although used on the New York and Chicago railways, were not in themselves ideal. With reference to the greater efficiency of the direct current over the induction motor, he pointed out that in the case of the former there may be 35 per cent difference between the energy delivered to a car and that used. He expressed the strong hope that our manufacturing companies would not accept the direct-current system as perfect and bury the alternating-current system, and said that if the latter system were adopted and found successful in London, it would be a blow to American electrical engineering prestige.

Mr. Steinmetz said that the advantage of the return of energy to the line by braking was not borne out. The solution of the traction problem was to accelerate as fast as possible, then coast, and then in stopping let the energy be dissipated by rolling friction. Mr. Stearns expressed the opinion that the alternating-current system is best for long runs on interurban roads. Mr. Spalding described a speed-changing device, which he thought might be applicable to electric railway motors. This consisted of a pair of disks, each with a beveled face, one disk being adjustable. A beveled belt runs between the two disks, which may be adjusted to give different transmission diameters. Mr. Holmes said he had seen a car driven by this device, and expressed the opinion that the alternating current would prove an economical substitute for steam between New York to Albany.

Mr. Mailloux said that an important favor in the problem of high-speed railways was that of air resistance. At high speeds the rolling friction is negligible in comparison with the air friction, and he hoped that some data would soon be forthcoming relating to the latter. The problem is rendered indeterminate at high speed, and the supply of data calls for the joint effort of all interested. Mr. Armstrong said that the General Electric engineers had been disappointed at the inapplicability of the induction motor in railway work. As to its application to suburban roads, he said these were governed by the same conditions as city roads, the higher speed schedule counteracting the effect of stops at longer intervals.

At the conclusion of the discussion, Secretary Pope read a telegram from Mr. William Stanley, Jr., inviting the Institute to hold its next annual convention in the Berkshire Hills.

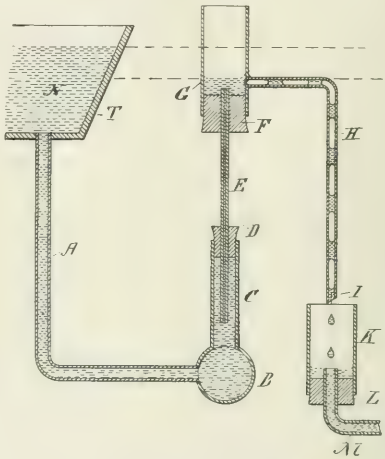
During the session resolutions were unanimously adopted for presentation to Dr. Schuyler Skatts Wheeler and Mr. Andrew Carnegie, expressing the high appreciation of the Institute for the gift, from the former, of the Latimer Clark Library, and, from the latter, of $6,880.20 for cataloging, housing and completing of the same.

British Pacific Cable.

The bill for the construction of a Pacific cable by the Imperial Government and the Australasian colonies has passed the House of Lords on its final reading.

Supply Device for Electrolytic Cells.

An ingenious contrivance, designed for feeding the electrolyte to decomposition cells, and in particular to those operating upon salt solutions for the production of caustic alkali and chlorine, forms the subject of a patent recently granted to Raoul Girouard, of Westbrook, Me. In electrolytic plants of this character it is essential that the concentration of the chloride solution shall be equal in all cells, and this renders it desirable to supply all cells from a common reservoir, which, however, is impracticable with any continuous system of piping, for even though the conduits be of insulating material, the continuous column of electrolyte will serve as a path for the leakage of appreciable amounts of current from cell to cell. Accordingly, it has been the practice to interpose in each supply pipe a circuit-breaking device, usually with moving parts, and generally operating as a ladle, to dip up at regular intervals a quantity of electrolyte from the common supply tank and deliver it to the feed pipes of the electrolyzer. Carmichael, for instance, has employed for this purpose a tube, bent roughly into the shape of the letter S, and so mounted upon a revolving shaft as to dip up a small quantity of electrolyte and by further rotation to deliver it to the supply funnels of the cells. Recently he has described and patented a modified form of the apparatus in which the parts are so arranged and formed that the quantity of electrolyte delivered shall be independent of the level in the supply tank, a result simply effected by constructing the ladle in the form of an oscillatory pipe. etc.



SUPPLY DEVICE FOR ELECTROLYTIC CELLS.

Girouard dispenses with moving parts and breaks the continuity of the discharge from the reservoir by the simple expedient of a restricted conduit provided with a free discharge end, the parts being so arranged as to break the outflowing column into a succession of drops. The accompanying figure is almost self-explanatory, *T, N,* representing the main supply reservoir, and *B* the electrolyte main from which all cells are supplied, the reservoir and main being in communication through the conduit *A*. The main *B* is fitted with a series of risers *C*, one opposite each electrolytic cell and each closed by a plug *D*, through which passes snugly the vertical tube *E*. This tube carries upon its upper end a small delivery vessel *G*, closed below as at *F*, but open above to the air. From the side of this vessel an outlet, *H, I,* leads to the funnel *K, L, M,* which is the inlet proper for the electrolyzer.

The operation of the apparatus is dependent upon the relative capacities of the tubes *E* and *H*. The tube *E* must restrict the flow of the electrolyte by virtue of the surface friction which it opposes to the liquid, and the necessary restriction may be obtained either by increasing the length of the tube or by decreasing its bore. The pipe *H*, on the other hand, must be capable of freely conducting away all electrolyte reaching the delivery vessel *G*, and must have such excess of carrying capacity as will permit it to depress intermittently the level of the liquid in the delivery vessel and allow the entrance of a quantity of air sufficient to break the continuity of the column of liquid. Regulation of the feed is readily effected by sliding the tube *E* in the plug *D*, thus varying the head.

CURRENT NEWS AND NOTES.

AUTOMOBILE EXPOSITION IN BUDAPEST.—United States Consul Chester at Budapest, Austria-Hungary, reports the recent opening of the first automobile exposition in that country. About 70 machines are on exhibition. The Locomobile Company of America is the only American concern represented. French, Austrian and German machines are shown.

AUTOMOBILE ROAD RACES.—Owing to the failure of the Pan-American authorities to secure the necessary consent for the proposed 100-mile road race from Buffalo to Erie in September, the Automobile Club of America regrets to announce that its annual sweepstakes race and one-mile record race will not be run over this course. Although the consent has been absolutely promised for some time, it has not been received, and failing such consent no definitive action could be taken by the club. The time is now entirely too short in which to receive entries and successfully organize a race of such an international character as this race was intended to be. The governors of the club have therefore decided to endeavor to hold these events elsewhere in the month of October, preserving its international character by inviting entries from abroad as originally proposed. There will therefore be no week of automobile sports at Buffalo.

ALTERNATING-CURRENT MOTOR METER.—Mr. A. Peloux, of Geneva, Switzerland, is the assignor to the Rittener Electric Meter Company, of that city, of a patent issued here for an alternating-current motor meter based on the principle that a cylinder or disk of metal may be inductively influenced by two alternating currents differing in phase from one another by a fraction of a period, whereby the said cylinder or disk is caused to rotate. In carrying out his invention he provides a disk of metal secured to a shaft and fixed to rotate in suitable bearings; also a main series coil having an independent core and two pressure or shunt coils, one on either side of the series coil, having independent cores and an armature to complete the magnetic circuit through said cores. He places a self-induction coil in the circuit of and in series with the shunt coils and a permanent magnet between whose poles the disk revolves and means for regulating the magnetic reluctance of the magnet.

TELEPHONIC GESTURES.—In the course of the English telephone investigation, it was stated that at Glasgow when people got angry because the line was busy, they threw the instruments around, injuring them. With regard to similar practices in Cuba, the Philadelphia *North American* says: In Cuba and the South to-day the receivers of most telephones are attached to the wall in such a way that they are moved up and down in a slot to the height of the ear of the person who wishes to speak. An American sent to Havana to take charge of a telephone service is the inventor of the method. Soon after his arrival he found that charges for repairing receivers was a large item of expense, and he investigated. He found that his customers soon after they had begun speaking would begin to gesticulate with both hands. The hand that held the receiver generally accented its gesture by jamming the thing into the wall. It was soon out of order. Now that both receiver and transmitter are worked without hands the expenses are much less, besides which the customer has free use of his hands.

OVERHEAD TROLLEY CONTACTS.—Reminiscent of a chapter in trolley history and litigation but recently closed, is a patent just issued to Mr. George Westinghouse, for a means of "getting around" the use of the under contact wheel trolley, which still prevails despite some obvious shortcomings. Mr. Westinghouse's invention involves the employment of an extended contact device, such, for instance, as a cylindrical tube or roller supported in a suitable manner above the car in contact with the under side of the overhead conductor. The cylindrical tube or roller is of such a length that some portion of it will usually remain in contact with the conductor. For the purpose of employing as short a tube or roller as practicable, and yet insure that the contact device shall not escape from the conductor, non-revoluble lateral extensions may be provided at the respective ends of the roller. The extensions are replaceable; but inasmuch as the contact device is for the most part with the roller and the conductor is in contact with the extensions only at intervals the wear upon them would not be excessive.

DYNAMO DESIGN.—Mr. B. G. Lamme, in a recent patent, takes up the subject of armature winding for alternating-current generators. Without a diagram it is not more susceptible of simple description than armature windings usually are, but the underlying idea is thus characterized: "The object is to provide a generator which shall have certain advantages over those heretofore designed and employed in similar relations. Among such advantages are the utilization of an armature which has a large number of slots and a small number of conductors per circuit; one which may have as many circuits in parallel as may be desired without regard to the number of field-magnet poles; one in which each circuit is uniformly distributed entirely around the armature periphery; one in which the coils are so constructed and arranged that in case of accident to any winding the remaining windings will be uniformly distributed and may therefore be used satisfactorily; one in which the windings may be used independently for separate circuits, if desired; one in which part of the windings may be reversed when the number of circuits is an odd number, so as to provide a symmetrical arrangement, and one in which the difference of potential between adjacent end conductors is less than that between the end conductors of any one of the windings that are nearest to each other."

ELECTRIC DRILLS.—Up to the present time little real progress has been made with electric drills, but the subject is in its early stages, and the resources of the art are by no means exhausted. This is shown in the invention recently patented by Mr. Ralph D. Mershon. It has been proposed prior to this to so construct a cylindrical electromagnetic motor or engine that longitudinally-shifting magnetic fields produced therein by means of polyphase currents may be alternately reversed in direction by means of switching devices operated by the generator, which supplies the current to the motor, and thus effect a reciprocatory movement of the secondary member or armature. Such an arrangement is unsatisfactory, because the reversals of the magnetic fields are dependent upon the speed of the generator, which in practice is substantially constant, and are therefore effected without regard to the natural vibratory period of the secondary member or armature, in which case the secondary member will not start up from a state of rest unless its natural vibratory period is the same or approximately the same as that of the reversals produced by the generator-switching devices, and in practice this is a condition extremely difficult to secure. Mr. Mershon describes in detail and has had claims allowed to him for such a drill in which this is improved upon and the desirable object is accomplished of giving the business end of the tool a partial rotation electro-magnetically between two successive strokes, so that the chisel-shaped cutting edge strikes the material operated upon, at different angles, and thus a practically cylindrical hole is drilled.

ELECTRIC FUSE CUT-OUTS.—In a patent just granted to Mr. Louis W. Downes, of Providence, R. I., a plug type fuse is shown, adapted for use on circuits carrying electric current of high capacity, say, for example, 100 amperes, possessing structural compactness and simplicity enabling it to be produced and sold at a comparatively low initial cost and capable of being readily renewed or refused at slight expense after it has burned out. Without this last mentioned qualification the use of high-capacity fuses of this type would be prohibitive, as a repetition of the initial cost every time the fuse burns out would probably involve greater expense than the user could endure. This Downes fuse comprises an insulating casing capable of resisting the destructive forces and gases generated upon the burning out of the fuse-link and a drum or sheath removably inserted in the casing and inclosing the fuse-link and its surrounding non-conducting heat-dissipating material. The casing carries suitable external circuit contacts adapted to engage corresponding contacts when in place in a socket or the like. The drum or sheath has contacts, between which the fuse-link or links are connected, adapted to engage corresponding contacts on the interior of the casing, whereby the circuit is completed through the fuse-link. The interior of the drum is charged with finely divided non-conducting material, such as slaked lime, and a number of minute holes or interstices allow the escape of the gas evolved upon the blowing of the fuse by an excessive current. To renew the fuse a new drum, which is made of light paper or fibrous material, is inserted for that in which the fuse-links have been melted.

SAFEGUARDING ROYAL TOURISTS.—A dispatch from St. John's, N. F., states that the Marconi system of wireless telegraphy will be installed on Cape Race in order to communicate with the British Royal yacht "Ophir," bearing the Duke and Duchess of Cornwall and York, when she approaches the Newfoundland coast in October. The idea is to prevent the possibility of an accident to the "Ophir" in waters where so many vessels have been wrecked during the present season.

POWER TRANSMISSION FOR CHICAGO.—A Chicago newspaper reports that steps have been taken for the development of electric power on the Kankakee River at Kankakee, Ill., and transmitting it to Chicago, where it will be utilized for street railway and power purposes. It is estimated that 15,000 horse-power can be obtained by damming the river according to a system, of which Mr. E. R. Beardsley, of Waldron, Ill., is said to be the inventor. A company has, it is reported, been organized with a capital of $150,000 to carry out the project.

NEW YORK STATE STREET RAILWAYS.—The Street Railway Association of the State of New York is to meet in Rochester, Sept. 10 and 11. Mr. G. T. Rogers is president. The first day will be given up entirely to the business meeting, followed in the evening by the usual banquet, which will probably be held at Ontario Beach. A portion of the second day will be occupied by a business meeting, followed by an excellent programme of entertainment arranged by Mr. T. J. Nicholl and the local committee. Upwards of 600 invitations have been sent to supply houses, asking them to send representatives and make exhibits. From the responses received thus far, a large number of supply men will be present. The usual number of brief and concise papers upon street railway topics of practical interest will be read and discussed. In addition to the papers mentioned and in accordance with the following resolution: "Resolved, That the topic 'How to Increase the Efficiency of Employes' be separated under different heads, to be suggested by Mr. H. H. Vreeland, and that he allot to the various street railway companies throughout the State the various sub-topics suggested, and that representatives of the respective roads prepare to discuss the same at the next annual meeting," the following assignment to make 10-minute addresses upon this subject under the following subdivisions has been made by Mr. Vreeland (for the purpose of opening discussion): "Discipline," E. G. Connette, general manager Syracuse Rapid Transit Company; "Benefit of Benefit Associations," Orrin Root, assistant general manager Metropolitan Street Railway Company, New York; "The Proper Selection and Training," J. P. E. Clark, general manager Binghamton Railroad Company.

INDUCTION MOTOR DESIGN.—A patent, for which application was filed in May, 1899, has just been issued to Mr. B. G. Lamme for an improvement in induction motors, aimed at economical variation of speed. In motors of this general class, such speed variation is obtained by varying the e. m. f.'s applied to the primary members, and it is necessary or at least desirable for satisfactory operation that the secondary members should have windings of relatively high resistance. In order to avoid complication of structure and liability to disarrangement in operation, it is desirable to dispense with collector rings and short circuiting devices for automatically cutting out the major portion of the secondary resistance for high speeds. If such features are dispensed with and the resistance be therefore permanently included in circuit, the resistance must be capable of taking care of comparatively high losses at low speeds, since the losses in the secondary for any given torque are proportional to the slip or the drop in speed. If low-speed running occurs at more or less frequent intervals during a given period of operation, it is desirable to store the heat due to the secondary losses during such low-speed running and to dissipate it during the times when the motor is running at higher speeds, and consequently when it is subject to a lesser degree of loss in its secondary winding. In order to dissipate the heat at low speeds, it is necessary to make the end rings of comparatively small dimensions, such as would be suitable for normal high-speed operation. If a motor that is provided with such rings be operated for a considerable length of time at a low speed, the heat generated in the rings is likely to be so intense as to destroy or to at least seriously impair them. On the other hand, if the rings be made of sufficient size to store the heat generated in them, they will operate without danger of injury until an increase of speed reduces the heat-generating action and permits of dissipation of the stored heat. Under such conditions the secondary resistance proposed by Mr. Lamme constitutes, in effect, a heat flywheel, which tends to promote a maximum degree of economy in the operation of the motor. The section, material, weight, etc., of the secondary conducting bars and end connectors must be such that the losses therein during low-speed running will not raise the temperature above a predetermined degree which represents satisfactory and safe conditions for a given period of operation. By increasing the amount of material in the secondary circuits, especially in the end rings, sufficiently to keep the temperature within the limits of safe operation, the length of time during which the motor may be run at low speeds may be made as great as desired.

LETTERS TO THE EDITORS.

Heating of Rotary Converter Armatures.

To the Editors of Electrical World and Engineer:

Sirs.—May I trespass upon your space to make a remark in regard to the biographical sketch of Mr. Ralph D. Mershon in your issue of Aug. 17? In that sketch there is allusion made to a paper on rotary converters, written in 1894, and published in the *Electrical World* about the same time, which seems to have been almost entirely overlooked by the engineering world. It may therefore not be amiss to call attention to the fact that this paper of Mr. Mershon's is the first which dealt with the development of heat in the armature of a rotary converter and of a double-current generator. The treatment there given is mathematically concise and short, but covers the theory very completely. In this paper Mr. Mershon arrived to the logical conclusion that an increase in the number of leads permitted an increase in the rated output of the converter as far as the heating of the armature is concerned. His arrival at this conclusion is a very pretty illustration of the power of logical analysis as applied to engineering problems.

In view of the great influence that the rotary converter has exercised of late on the development of heavy electrical engineering, Mr. Mershon's paper, given seven years ago, should deserve more attention than has hitherto been paid to it.

SOUTH NORWOOD, OHIO. B. A. BEHREND.

Power Distribution in Steel Works.

To the Editors of Electrical World and Engineer:

Sirs.—I read with interest the article in your issue of Aug. 17 concerning the power plant in the Brooklyn Navy Yard, and think that we have quite a power plant in the works of the Lorain Steel Company, as we operate over 170 motors, ranging from 5 horse-power to 75 horse-power, under as trying conditions probably as exist anywhere.

These motors, which are all direct-current wound for 220 volts, are of all makers, principally General Electric. They run continuously 24 hours a day, exposed to the fiercest heat, dampness, and are manipulated by unskilled operators, yet their operation will compare favorably with that of any power plant I have handled under far more favorable conditions.

We have a generating plant consisting of four Siemens & Halske direct-connected generators, and one Westinghouse generator, the total capacity of all being 1300 kilowatts. In addition to these we have two Brush, 100-light arc machines, and two 500-light Westinghouse alternators, and all these operate daily in heat, dampness, steel dust and flying graphite, yet the percentage of shut downs will compare favorably with any central station operating under better conditions.

I shall watch with much interest the operation of a similar plant operated with induction motors, and shall hope to read further accounts of it in your valuable paper.

LORAIN, OHIO. C. H. HINES.

Humming in Church.

To the Editors of Electrical World and Engineer:

Sirs.—The following little incident may be of some interest to electrical contractors: A certain church in New Jersey had been equipped with an electric light system, the conductors being in-

stalled in regular iron pipe, or conduit. The installation seemed satisfactory in every respect and the contractor was complimented on his work. When the electric light company connected the system with the alternating-current transformer, a very distinct humming noise was heard in all parts of the building. It was so loud that the clergyman could be heard with difficulty. Experts worked over the matter for two or three days, without avail, and finally decided that it must be the inductive vibrations of the transformer, transmitted along the conductors, and multiplied by the galvanized iron ventilating ducts, on which the conduit had been laid. The conduits were removed from the ducts, which were suspended from the basement ceiling, and the humming had ceased.

What electrical contractor would not have taken advantage of those ducts for the same purpose? A great deal of time could be saved and few contractors would have thought for a moment of the results. There are many well educated engineers, but who among the wise will claim that he "has nothing to learn"?

Newark, N. J. G. W. Cook.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers

Induction Motor with Power Factor Equal to Unity.—A. Heyland.—An illustrated description of an induction motor without phase difference between e. m. f. and current. The principal features is that the rotary field is produced not by the primary, but directly from the secondary. To explain the principle of his motor, he starts from the explanation of the action of a three-phase induction motor with an ordinary short circuited armature of the squirrel cage type, as shown in the adjoining diagram. *A* is the

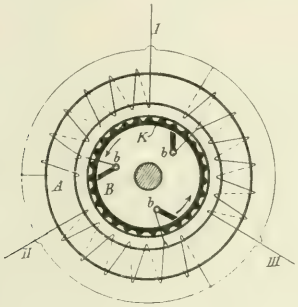


DIAGRAM OF INDUCTION MOTOR.

primary, *B* the secondary, with copper bars laid in slots and connected at both ends by short circuiting metallic rings *K*. A three-phase alternating-current supplied to *A* produces a rotary field which passes through both the primary *A* and the secondary *B* and causes the torque, as well known. The exciting currents in the primary are alternating currents of the full period and do not correspond therefore to the required field excitation, but are much greater. As is well known, in alternating-current circuits of high frequency, there is a large counter e. m. f., and the magnetizing current is produced only by the relatively small difference of the voltage at the terminals and the counter e. m. f. This causes a large phase difference. The energy of these currents, changed into heat in the copper, is very small. All these consequences are avoided by generating the rotary field directly in the short circuited armature and not in the primary. In the short circuited armature *B* there is only a very small small counter e. m. f., the frequency is here very small and depends upon the slip of the motor. While the e. m. f. in the primary is great, that in the secondary is relatively very small. Hence if the magnetizing currents required for the generation of the rotary field are supplied to the secondary, all the consequences of the high counter e. m. f. which exists in the primary are avoided. The only problem is to send the magnetizing currents into the closed winding of the secondary in such a manner that they have exactly the same direction and phase as the magnetizing currents of the stator which they must compensate. This is done in a very simple manner, illustrated in the diagram by means of three brushes *b b b*, which slide upon the ring *K*. Their position relatively to the primary is so adjusted that the currents supplied to the secondary have exactly the same direction which the magnetizing currents of the primary had. The voltage of these currents needs to be only very small, and they may be taken from a few windings of the primary. What takes place here is a conversion of the current from a high frequency (in the primary) to a lower frequency (in the secondary short circuited armature), but for this conversion no commutator in the ordinary sense is required, but a continuous ring is used, as in the diagram. In practice, however, one should not in general use a so-called squirrel cage armature, because the current density at the brushes would be too large, but one may close a wound armature by a ring, the resistance of which is in a certain proportion to that of the winding. This has no great influence upon the efficiency. The most particular feature of the motor is the conversion of the currents by means of a closed ring as commutator. It is evident that such a "commutator" is not complicated at all, but just as simple and sparkless as a slipring. It is true that a part of the magnetizing current is lost in the ring which is shunted to the armature; but the magnetizing current itself is reduced to such a degree that this loss is of no importance. In the practical application it is to be recommended, not to use a uniform ring, but a "commutator," the segments of which are connected together by conductors of low resistance, this makes no difference in the principle, and sparking at the brushes is here also avoided. Finally, it is posible to use at the same time a short circuited armature and a second magnetizing winding with commutator. The self-inductance of the commutator winding is then annulled by the short circuited winding, and sparks at the brushes are avoided. He points out the disadvantage which follow from the phase difference in the induction motor, and the advantages which his motor has for this reason. He also points out that such a motor may be used as generator and has then great advantages, especially when operating in parallel with other generators. Many of the greatest difficulties, which are inherent in the ordinary generator, are here missing. Several experimental motors are being built by two of the largest German electric companies.—*Elek. Zeit.*, Aug. 8.

Design of Large Generators.—A. Heyland.—An illustrated paper, read before the Electrotechnical Society, of Vienna, on "General principles of the modern design of large direct current and alternating-current generators." He first draws some general conclusions which are valid for both direct and alternating-current machines, and which follow from the problem to obtain as good an efficiency as possible and to reduce the cost of materials to a minimum, with a given temperature limit for continuous load. These general conclusions are: Breadth of the slots equal to breadth of the teeth; poles of square or circular cross-section; breadth of the armature equal to the ratio of the circumference to the number of poles. In the design of direct-current machines these general rules can be strictly followed, as the choice of the number of poles is not restricted; in alternating-current machines, however, when a certain frequency and speed are wanted, the number of poles is given. In order to avoid sparking at the brushes of direct-current machines he recommends to use broad, open and not too deep slots, and, laminates poleshoes, to avoid too high a temperature in the same. In direct-current machines the armature reactance is not of great importance. In general for the excitation so many ampere windings are chosen, as required for the air-gap. The ratio of the field ampere turns at no load to the armature ampere turns is often unity or still smaller. If one would use such a direct-current machine as an alternating-current machine by replacing the commutator by slip-rings, the machine would give alternating current, but of a lower frequency than is generally used. But it would not be a good alter-

nating-current machine, because the large armature reactance would produce too large a voltage drop with non-inductive load and still more with inductive load. Moreover, such a machine would not operate well when connected in parallel with other machines. For a good alternator the following main points must be obtained: Small armature reaction, hence a relatively large number of excitation ampere windings is to be placed on the magnet pole; the ratio of field ampere windings to armature ampere windings is generally chosen between 3 and 5. To avoid hunting, the poleshoes should not be laminated, but should consist of solid iron or steel. The slots should not be open, but closed. The general differences between the designs of direct-current and alternating-current machines are therefore as follows: For the direct-current machine relatively large armature reactance, open slots, laminated poles or poleshoes; for the alternator small armature reaction, solid damping poles and poleshoes, suitably closed slots. He then speaks about windings and gives a graphical representation of Arnold's series parallel winding. An important point is the saturation of the iron in the magnet poles, especially of the self-exciting direct-current dynamo. High saturation reduces the effect of armature reaction; the best magnetic density is about 17,000. Regarding the choice of the number of poles, he shows that machines with few poles become heavier, but have a better efficiency than machines with more poles. Regarding the speed, he shows that high speed means saving of material as well as high efficiency. These statements are mathematically represented by very simple formulas. In the discussion which followed, Eichberg criticized some smaller points of the paper. Regarding the theory of commutation of direct-current machines he called attention to the importance of the theories of Arnold, Fischer-Hinnen, and especially of Ryan.—*Zeit. f. Elek.*, June 16, 23.

REFERENCES.

Short-Circuit Current of Three-Phase Induction Motors.—SIEWERT.—A long illustrated theoretical article in which he develops a formula for the short-circuit current of three-phase induction motors. It appears from it that a variation of the breadth of the air-gap can have almost no influence upon the value of the short-circuit current, and that the latter increases with increasing magnetization; in general, it is of advantage to make the slots as deep as possible and not too narrow. Four numerical examples are added.—*Elek. Zeit.*, Aug. 1.

LIGHTS AND LIGHTING.

Nernst Lamp.—A. H.—An article giving an account of experiments made with three commercial 220-volt, 200-watt Nernst lamps. They were continually tested until they failed. The life of the three lamps was 124, 293 and 369 hours, respectively. All three lamps were destroyed because the glower feeding wire melted close to the incandescent body. The results of photometric tests of the lamp, the life of which was 369 hours, are given in a diagram and a table. The voltage was continually 220 volts, the candle-power dropped from 146 candles at the start to 99 after 100 hours, 81 after 220 hours, 60 after 300 hours, and 48 after 350 hours, the watts consumed per candle being 1.33, 1.91, 2.19, 2.68 and 2.89, respectively. In practice it seems preferable to use a lamp not more than 200 hours, i. e., down to about 80 candles. He estimates that with a lamp used to this point, the cost of the candle-hour (including cost of operation and amortization), is 0.035 cent, against 0.055 cent with an ordinary incandescent lamp, consuming 3.25 watts per candle. (See also the extended tests of Wedding, noticed in last week's Digest.)—*Elek. Anz.*, July 4.

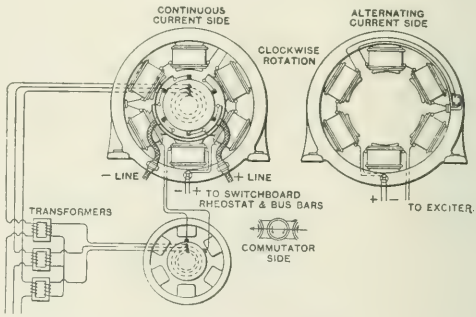
REFERENCES.

Refuse Destructors.—HIGHFIELD.—A reprint in full of his Brit. Mun. Elec. Ass'n paper on "Refuse destructors in combination with electric power stations," and also of the discussion which followed, abstracts of which have already been noticed in the Digest.—Lond. *Elec.*, Aug. 9.

Electric Cranes.—WELLNER.—A description of several cranes recently made by the Co. Internationale d'Electricite.—*Zeit. Ver Deutsch. Ing.*, Mar. 2; abstracted in *Science Abstracts*, July.

TRACTION.

Dublin Tramway System.—The first part of a very well illustrated description of the Dublin tramway system which has been developed under the direction of H. F. Parshall, the well-known former American engineer. Although the main system has been running for over 18 months, several important extension works have been carried out. The two original generating stations have been shut down, and the whole power is now supplied from one plant, and existing sub-stations are changed over from motor-generator to rotary converter sub-stations. The total length of the route is 50 miles and the length of single track 89 miles, served by a total number of 250 cars normally. About 40 miles of the system is supplied with current direct from the generating station. The remainder or suburban part of the system is supplied from three sub-stations. The main or city system is divided up into 19 sections independently supplied and controlled from the generating station, but these can be interconnected at will. In order to reduce the leakage from the rails which are used for the return currents four negative booster points have been provided which are connected to the generating stations by means of insulated cables, connected in series with the armature of the "negative boosters," the fields of which are placed in series with certain of the positive feeders. The power plant contains five direct-current dynamos for supplying the main part of the system, and one three-phase generator for supplying the sub-stations, the voltage of the three-phase currents in the transmission line being 2500. In addition to this, there are two synchronous converters as a reserve to the three-phase generator. Their normal function is to convert from direct-current to three-phase alternating current which is then transformed up by means of transformers to the transmission voltage of 2500, as during hours of light load the load on the three-phase side is not sufficient to warrant the running of a three-phase generator. A peculiar feature of the synchronous converters is that each converter has a small booster attached to the end of the shaft. This booster is really another synchronous converter and consists of an armature with three collector rings and a commutator revolving in the field ring with six poles, but without any field winding. The function of this booster is, in conjunction with three series transformers, to keep the speed of the synchronous converter constant, and thus maintain its periodicity and synchronism. The necessity for this apparatus arises in this way. When converting from alternating to direct current, the speed of the converter is fixed by the frequency and cannot be varied by altering the field excitation. When converting, however, from direct to alternating current, the speed of the converter, as in a direct-current motor, depends upon the field strength, being increased by a weak field and decreased by a strong field. It is evident, therefore, that it is liable to a charge in speed under conditions of increased load and phase displacement, and will deliver alternating current at a varying frequency in consequence. An alternating lagging current weakens the field, thus tending to increase the speed and frequency, so that, under certain conditions with an induction load, a converter may get out of synchronism. To meet this difficulty, the main current on the alternating side is made to pass through three small transformers, one in each phase. The secondary windings of these three transformers are connected together in star fashion, and the three leads carried to the collector rings of the auxiliary synchronous converter or booster, the commutator of which is in series with the field winding of the main converter. By this means the field current is varied to correspond with the load and power factor. The connections for the converter and its auxiliary are shown in the adjoining diagram.—Lond. *Elec.*, Aug. 9.



CONNECTIONS BETWEEN ROTARY CONVERTERS AND BOOSTER.

Rosenfeld and Zelenay System of Electric Traction.—GERARD.—A description of their so-called "tangential traction" system. It can only be operated economically on very high-speed railways, the

trains running at least 60 miles an hour. For speeds below this, the system is unsuitable and would be very costly. In addition to the ordinary rails, a second pair of light and insulated rails is laid between them, about 27 inches apart. Along the center of the line rectangular blocks of laminated iron are fixed in the ballast at intervals of 55 yards. The length of each block is 11 yards. The blocks are arranged at a certain distance apart, owing to the prohibitive cost of a continuous series. These blocks are wound with a three-phase winding, and may be regarded as constituting the stator of an induction motor. What corresponds to the rotor is a similar block of laminated iron, fixed on the axles of a truck that runs on the insulated rails, the said truck being beneath the main body of the car, and attached to it by hooks and chains. The winding of the rotor block is under the control of the driver, who can insert resistances at will. The air gap between rotor and stator is about two-fifths of an inch. When the stator blocks are excited by current from the power house, they exert a horizontal pull on the rotor blocks, which sets the train in motion. The propelling force on the train becomes practically very small unless the rotor block is immediately over a stator block, and the driving force is applied in jerks and not continuously. The line is divided into sections of 550 yards, and only that section is excited on which the train is passing, the switching being done automatically by the train. The author gives an estimate for running trains at high speeds on this system, and according to these figures the system would be cheaper than the ordinary direct current system. An experimental line is to be constructed.—*Soc. Belge Elec. Bull.*, 18, Feb.; abstracted in *Science Abstracts*, July.

High-Speed Electric Traction.—Reymond-Schiller.—Continuations of his article, the first part of which was abstracted in the Digest, June 1. He makes some critical remarks on several new systems of traction, especially on the Langen suspended railway and the Behr monorail railway. He does not believe that they are suitable for high-speed electric railways. He recommends not to look for new extraordinary systems, but to work out the best solution for a double-track railroad, similar to the present standard railroads. He endeavors to show that on such a railway indeed a speed of 250 kilometers (155 miles) per hour can be attained. He recommends a gauge of 4½ meters (nearly 15 ft.).—*Zeit. f. Elek.*, June 30, Aug. 4.

REFERENCES.

Permanent Way for Electric Tramways.—Howard-Smith.—An illustrated paper read before the Ass'n of Munic & Corpn. Engineers at Leicester, on track construction. He discusses the construction of the rails, the standard rail section, rail lengths, rail joints, the design of wheel tires, the life of rails, and the cost of construction. An account is also given of the discussion which followed.—Lond. *Elec. Eng.*, July 19, Aug. 9.

Paris.—Kohlfuerst.—An illustrated description of the large electric railways in Paris. The road from Quai d'Austerlitz to Quai d'Orsay, of the Orleans Railway, and the Metropolitan Railway.—*Zeit. f. Elek.*, June 16, 23, 30, July 7.

Installations. Systems and Appliances.

Australia.—A table, with a brief article, of the electric supply stations of Australia, giving information about various items. It appears that the electrical industry is rather backward in Australia, as in the whole of that continent there are only 27 towns that have electric supply stations. In Sydney, with a population of over 426,000 inhabitants, only one station of a capacity of 625 kilowatts has been installed.—*Austral. Hardware and Mach'y*, June 1; Lond. *Elec.*, Aug. 9.

REFERENCE.

Brooklyn.—An illustrated description of the Kings County Station of the Edison Illuminating Co., of Brooklyn.—*Elec. Rev.*, Aug. 17.

Electro-Physics and Magnetism.

Spectrum of Hydrogen.—Parsons.—There are two distinct spectra of hydrogen, one the "four-line spectrum," consisting of some 15 lines, four of which are in the visible part of the spectrum, the other the "compound spectrum," consisting of more than a hundred lines. He gives a preliminary account of experiments, for which he built a storage battery of 2000 cells. The discharge was sent directly through a vacuum tube, having a capillary of about 1 mm. diameter, with a water resistance of about 1½ megohms in series. He intends to double the number of cells. In experiments with a tube of 4 mm. internal diameter and electrodes of heavy aluminum wire about 1 cm. apart, an induction coil being used without spark-gap or condenser in the secondary circuit, the color of the discharge was red, and it was less than a millimeter wide. The introduction of the spark-gap and condenser greatly increased the diameter of the red discharge and also the intensity of the four lines. At lower pressures without capacity, a blue glow discharge could be obtained. The observations show that the intensity of the four lines is in some way intimately associated with the intensity of the red discharge, and further that the introduction of capacity always has a tendency to increase the red in the discharge, and under certain pressure conditions to change the blue discharge into the red. The battery gives essentially the same spectrum as the induction coil without the condenser.—*John Hopkins Un. Circ.*, v. 20, No. 152, May-June.

REFERENCES.

The Electric Spark and Its Spectrum.—Schenck.—An account of an investigation, the object of which was to divide the principal lines in the spark spectrum of cadmium into three groups, each having characteristics peculiar to itself, and to study some of the properties of the spark and its spectrum by means of photographs taken with a revolving mirror.—*Johns Hopkins Univ. Circ.*, vol. 20, No. 152, May-June.

Zeeman Effect.—Kent.—Some "Notes on the Zeeman effect." He gives an account of an investigation in which he extended Reese's investigations on zinc using higher field strengths. He also made a more exhaustive investigation of the spectrum of iron.—*Johns Hopkins Univ. Circ.*, vol. 20, No. 152, May-June.

Electro-Chemistry and Batteries.

Storage Batteries of Other Metals Than Lead.—Von Laszczynski.—An article on several storage batteries, invented in recent years, which consist of other metals than lead, especially on the cells of Jungner, Michalowski and Edison. He thinks that Jungner's suggestion to use peroxide of silver as a depolarizer is not a bad one, but that silver is too expensive. Michalowski's suggestion to use peroxide of nickel as material of the positive electrode is very good for the reason that the formation of Ni_2O_3 from 2 NIO and O is an endothermic reaction, i. e., this reaction occurs with absorption of heat. When, therefore, in the discharge of the battery the reverse action takes place and electrical energy is produced, this fact is of the greatest importance for the e. m. f. of the cell, as may be seen from a comparison of two cells, both having hydroxyde of potassium as electrolyte and zinc as negative electrode, while in the one cell cuprous oxide is used for the positive electrode, and in the other peroxide of nickel. The e. m. f's of both cells can be calculated by Thomson's rule from the heat-tonings of the chemical processes. To the formation of zincoxide from zinc and oxygen corresponds an e. m. f. of 1.80 volts. This refers to both cells. (He does not take into account the formation heat of zincate, which he ought to do.) The reduction of cuprous oxide to pure copper corresponds to a negative e. m. f. of —0.95 volt, while, for the reason mentioned above, the reduction of peroxide of nickel to nickel oxide corresponds to a positive e. m. f. of + 0.04 volt. Hence the e. m. f. of the zinc-copper cell is $1.80 - 0.95 = 0.85$ volt, and that of the zinc-nickel cell is $1.80 + 0.04 = 1.84$ volts, which is in good agreement with measurements. (This result becomes quite clear when expressed in terms recently introduced by Reed. "Electrogenic" for those reactions in which chemical energy is changed itno electrical energy, and "electrothanic" for those in which electrical energy is changed into chemical energy. The former represents a positive e. m. f., the latter a negative one. In the zinc-copper cell the reaction at the zinc electrode is electrogenic, that at the copper electrode electrothanic, hence we get a difference of two e. m. f.'s. In the zinc-nickel cell the reaction at both electrodes are electrogenic, hence we have here a sum of two e. m. f.'s). Both the oxide and peroxide of nickel are said to be entirely insoluble in alkaline lyes. It is, however, not enough to know this very favorable property of nickel, when used as positive electrode, but a method must be found by which an active nickel oxide electrode can be made. It is not sufficient to cover the positive electrode (a copper plate or something similar) with a paste of nickel oxide. "One could just as well cover it with sand or powdered glass." (He evidently means that the structure of the active mass must be such that a large surface is always in contact with the electrolyte so that the chemical reactions can take place. This is not the case when a paste of the active material is simply put around a sheet of, say, copper, and then dried.) After a few remarks on unsuccessful attempts to prepare good peroxide of nickel electrodes, he describes the following one, which he thinks to be the

most promising for future development. An alloy of nickel and zinc is electrolytically deposited on a network of very fine nickel wire. After electrolysis, this is placed in a concentrated alkali lye, local action takes place, the zinc being dissolved and hydrogen being developed. In this way the zinc is removed and a firm compact framework of nickel is produced with molecular pores where the zinc had been. These pores are then filled by a special process with nickel oxide. Such plates can be compared to both the Plante type and the grid type of lead plates. There is here a grid, namely, the porous nickel, but the meshes are of molecular dimensions so that "nearly every molecule of nickel oxide is in contact with the bearing." The plates behave therefore like Plante plates, they can be charged and discharged at high rates. The capacity obtained with them "is 25 ampere-hours per kilogram of positive electrode, with a discharge current of 20 amperes" (no dimensions of the cell being given), each electrode consists of several such layers of network. Edison uses also a higher oxide of nickel as material of the positive electrode in his new battery, but he prepares the electrode by quite a different and very simple method. The present author raises the following objections to Edison's method. "The model was probably the preparation of most of our present dry cells, in which a compressed mixture of graphite and pyrolusite serves as depolarizer. We know, however, that even the best of these cells are not constant, and fail at latest after two hours, when discharged with 2 amperes per kilogram of positive electrode. A rest of 24 hours is necessary before another discharge can be made. They would certainly fail usually after a few minutes, if the pyrolusite mixture had been compressed hydraulically, because the electrolyte could not enter into the interior of the anode. One therefore applies to the mass only a rather light pressure which is just sufficient to ensure that the mixture is not a loose powder. A slightly compressed mixture of nickel oxide and graphite, however, is burst during the charge by the developing oxygen, and a loose powder is obtained which has no capacity. It makes also a great difference whether such an electrode is used as depolarizer in a solution of chloride of ammonium or in hydroxide of sodium. The solution of chloride of ammonium dissolves the protoxide of manganese reduced during discharge, so that the particles of the dioxide which have not yet been consumed, are uncovered and the cell recovers. This is not the case with hydroxide of sodium, as the protoxide of manganese which is a poor conductor, remains at its place and covers the dioxide. The case should be similar with the graphite-nickel peroxide electrode. Finally, it is very doubtful whether the graphite is able to resist continually against nascent oxygen in alkaline lye. What we know so far makes it very doubtful." The author agrees, however, that the higher oxide of nickel is a very suitable material for the positive electrode, and that its practicability has been proven beyond doubt. This is not the case with the material of the negative electrode. He first discusses the use of zinc. A cell with hydroxide of potassium or sodium as electrolyte and with a zinc electrode and an electrode of peroxide of nickel has an e. m. f. of 1.84. It acts well as a reversible cell, results of tests being given, but it is necessary to have a large amount of electrolyte. This makes this cell heavy and unsuitable for automobiles, etc. He then discusses the type of cell in which the electrolyte is not changed at all, and the process during charge and discharge consists in the transport of oxygen from one plate to the other. The first cell of this type (1896) seems to be a cell of Pollak with compounds of iron used for both electrodes (see ELECTRICAL WORLD AND ENGINEER, July 6, page 25). Other examples are Jungner's (1898) copper-silver cell and cadmium-silver cell, and Edison's new nickel-iron cell. The present author doubts whether iron is a suitable material for the negative electrode. He then describes a cell which he has designed. He uses a nickel oxide plate and a zinc plate, covered with a paste of zinc carbonate and water, in a solution of carbonate of potassium. When this cell is charged, at one end metallic zinc is formed and at the other peroxide of nickel while the carbonate of potassium is changed into bicarbonate of potassium. During discharge the reverse action takes place, the e. m. f. is 2.10 to 2.20 volts. This cell is theoretically interesting, but practically of no value, because nickel dissolves in a concentrated solution of bicarbonate, which results finally in local action at the zinc.—*Zeit. f. Elektrochemie,* Aug. 8.

The Influence of the Temperature of the Acid Upon the Capacity of the Lead Accumulator.—M. U. SCHOOP.—An illustrated account of an experimental investigation, in which he has reached the following results. Heating of the acid can be regarded as a means of increasing the capacity of a lead accumulator. This increase of capacity is due, first, to the increase of the conductivity of the acid, and, second, to an increase of diffusion. The efficiency is also increased. The peroxide plate takes a larger share in the increase of capacity than the lead plate. The increase of capacity which is obtained by heating the acid, is the greater, the thicker the electrodes and the smaller the porosity of the active material and the greater the discharge current density and the greater concentration of the acid used. When after a discharge with heating of the acid, the battery was charged again at normal temperature and then discharged also at normal temperature, the capacity obtained was much too small on account of formation of sulphate on the spongy lead plates. He remarks that until detailed investigations have been made he cannot recommend to use in practice heating of the acid as a means of increasing the capacity. Experience shows that batteries in warm rooms have a much shorter life than batteries placed in rooms of normal temperature.—*Zeit. f. Elek.,* July 21, 28.

REFERENCES.

E. M. F. Between Adjoining Electrolytes.—SACKUR.—It is known that the e. m. f. between two different concentrations of an aqueous solution can be greatly diminished by an "electrolytic short circuit," namely, by the addition, to both sides, of a solution of an electrolyte with the same positive ion. A mathematical theory of this case has been developed by Abegg and Bose. The present author has made an experimental investigation, the results of which are in fair agreement with the theory.—*Zeit. f. Elektrochemie,* July 18.

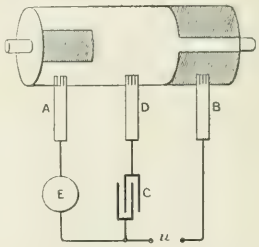
Electrolysis of Mixed Solutions of Iron and Nickel Sulphates.—KUESTER.—A German Electrochem. Soc'y paper, giving an account of an experimental investigation of the simultaneous deposition of iron and nickel from the mixed solutions of the sulphates.—*Zeit. f. Elektrochemie,* June 6.

Dissociation of Strong Electrolytes.—SACKUR.—An article on the disagreement between Ostwald's law for the influence of the concentration upon the conductivity and the results of measurements in the case of strong electrolytes. John's investigations in which he tried to settle this disagreement, are discussed in detail. But it is evident that this question has not yet been settled.—*Zeit. f. Electrochemie,* July 18.

Ozone.—A summary of recent developments in the ozone industry. Descriptions, mainly taken from patent specifications, of quite a number of new apparatus and processes are given.—*Zeit. f. Elektrochemie,* July 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Plotting Alternating Waves.—HOSPITALIER.—An illustrated description of a new instrument devised by him, for plotting the wave form of an alternating current, or e. m. f., or power, etc. He calls his instrument "ondographe" or "cymatographe." It appears to be simpler than all similar instruments. It traces directly a continuous record of the wave form on a slip of paper. It works very quickly, giving the record of a wave in 10 to 30 seconds, while, for instance, the Callendar cycle-curve recorder requires an hour for the same purpose. The instrument is based upon the principle of Jou-



PLOTTING ALTERNATING WAVES.

bert's method of plotting the wave form by means of instantaneous contacts, the different points of the wave being obtained by making the contact at moments corresponding to different phases. The different parts of the new instrument are the following: A synchronous motor, driven by the source of e. m. f., the wave of which is to be traced. This motor drives the commutator by means of a train of

gearing, of such design that when the motor makes n revolutions, corresponding to n periods, the commutator makes only $n - 1$ revolutions. The commutator consists of a cylinder of insulated material covered by a copper or brass tube, of which certain parts are cut away, as will be seen in the adjoining diagram which shows the connections: u are the points at which the electric phenomenon takes place, the wave form of which is to be plotted; C is a condenser, E is the registering apparatus, A B D are three brushes; the operation consists of two steps. In the first step the condenser is charged, in the second it discharges through the measuring instrument. The measuring instrument may be any form of the moving coil type, for instance, a Weston instrument. The record is plotted on a revolving cylinder.—*L'Ind. Elec.*, July 10; another description by Blondin, of the instrument in *L'Eclairage Elec.*, July 13.—A nice and interesting series of records of waves, obtained with the new instrument, is given in *L'Ind. Elec.*, July 25.

Quadrant Electrometer.—Dolezalek.—A description of a simple and very sensitive quadrant electrometer. The needle or needles in this quadrant electrometer are made of silver paper for lightness and are suspended on a quartz fiber. After the fiber has been attached to its end fastenings by sealing-wax, it is dipped into a solution of hygroscopic salt, such as calcium or magnesium chloride. The fibre and wax thus get a thin coat of the salt which always contains sufficient moisture to make the surface conducting so that the needle can be charged along the fiber. The instrument can be made extremely sensitive by choosing a fine fiber. With the needle charged to 110 volts and a fiber 0.009 mm. diameter, the period of the needle was 18 seconds and the sensitiveness 0.1 scale divisions at 2 meters distance for 0.00004 volt.—*Deutsch. Phys. Ges. Verh.*, 3, 2, p. 18, 1901; abstracted in *Science Abstracts*, July.

Energy Measurements with Approximate Methods.—Stern.—An article in which he first discusses the error of a "three-wire" meter for measuring the energy of a three-wire system. The fixed main coils of the meter are inserted in the outer conductors of the three-wire system, while the shunt coils are connected across the outers. He shows that the maximum theoretical error of a three-wire meter, in per cent, is about half the voltage difference of the two halves of the system, in per cent. He then discusses at some length induction meters, based upon Ferraris' principle. They can only be considered as approximately correct. He shows this analytically.—*Elek. Zeit.*, July 18.

REFERENCE.

Measuring the Resistance of Storage Batteries.—Bruger.—An illustrated description of a quick and rather exact workshop method for measuring the internal resistance of storage batteries.—*Centralblatt. f. Accum.*, July 15.

Telegraphy, Telephony and Signals.

REFERENCES.

Cleveland.—An illustrated description of the new Western Union Telegraph plant in Cleveland.—*West. Elec.*, Aug. 10.

Wireless Telegraphy.—A note on experiments with wireless telegraphy in recent naval manœuvres in the Mediterranean. Wireless telegraphy proved very successful for quickly transmitting messages to ships scattered over a wide area.—Lond. *Elec. Rev.*, Aug. 9.

British Telephone Exchange.—An illustrated description of the Tunbridge-Wells Telephone system, the number of subscribers being 330.—Lond. *Elec. Eng.*, Aug. 2.

Loud-Speaking Telephone.—Krejsa.—An illustrated description of the Roeder-Oprendak loud-speaking microphone. The arrangement of the induction coil differs from that ordinarily used.—*Zeit. f. Elek.*, June 23.

Miscellaneous.

REFERENCES.

Westinghouse Electric Co. in Great Britain.—Articles on the proceedings at the laying of the corner-stone of the Westinghouse Works, at Trafford Park, Manchester.—Lond. *Eng'ing, Elec. Rev., Elec. Eng.*, Aug. 9.

British Manufacturing Plant.—A description of the British Thomson-Houston Co.'s manufacturing plant at Rugby, which is now nearly completed.—Lond. *Elec. Eng.*, Aug. 9.

German Manufacturing Plant.—In a continuation of the serial on the recent visit of the British Inst. of Elec. Eng. to Germany, a well illustrated description of the dynamo works of Siemens & Halske is given.—Lond. *Elec.*, Aug. 9.

Glasgow Exhibition.—A continuation of the illustrated serial, giving brief descriptions of a small ship-lighting set, two small induction motors, and two direct-current generating sets, all of British make. —Lond. *Elec.*, Aug. 2.

An illustrated description of several steam generating sets. All the dynamos described generate direct current.—Lond. *Elec. Rev.*, Aug. 9.

New Books.

A Hand-Book for Apprenticed Machinists. By Oscar J. Beale. Providence, R. I.: Brown & Sharpe Manufacturing Company. 141 pages, illustrated. Price, 50 cents.

The opening sentence of the preface is as follows: "This book is for learners in the use of machine tools, and is the outgrowth of the needs of the Brown & Sharpe Manufacturing Company in the instructing of apprentices." In view of this announcement, it is only natural that the book should be to some extent an advertisement of the Brown & Sharpe Company, but this does not alter the fact that it is an excellent book for apprentices.

Attention is called in the preface to the difference between knowledge and skill. "Skill is largely a matter of labor and time—of unwearied labor and much time." "There are, however, important points in the use of machine tools that are more matters of knowledge than skill. This book aims to present a few of these points, which should be learned early and remembered late." We think the book has succeeded in this laudable purpose. First, there are some excellent instructions for the proper handling of machine tools, with regard to the personal safety of the operator and the safety of the tools themselves. By using reasonable care a machinist may work to a good old age without being hurt, yet by a single careless act, like one described in the book, he may be instantly killed.

The book goes on to explain how to do different kinds of work, and—what is quite as important for beginners—how not to do it. One cut will show a piece of work properly executed, while several other cuts show the same piece of work with various mistakes selected from those most frequently made by apprentices. Although this book is intensely practical, we find the following statement in the chapter on signs and formulas: "Formulas will express more on a square inch of paper than words on a whole sheet. The meaning of formulas is clearer also, and they can be understood more quickly than words." It is refreshing to mark the growing confidence of practical mechanics in the utility of simple algebra. In the not very distant past anything approaching to algebra was regarded by most practical mechanics as a sort of pedantic fad; something to be avoided by the practical man who has serious work to attend to, as he would avoid a contagious disease.

The editor modestly states in the preface, speaking of the book, "It does not aim to take the place of the excellent engineers' pocket-books already published, some one of which an apprentice should obtain. He should also subscribe for a mechanical paper." We think the book fulfills the purpose for which it was written, and we recommend it to young machinists.

Handbuch der Electrotechnik. Elektromotoren und Electrische Arbeitsubertragung. Neunter Band. Von F. Nethammer und E. Schultz. Leipsiz: Verlag von S. Hirzel. 416 pages, 356 illustrations. Price, 18 marks.

This is the ninth of an as yet incomplete series of volumes intended to review the whole field of modern electrical practice. No less than 15 prominent German authorities are co-operating toward this end, the present book being written by Dr. Neithammer and Mr. Schultz. According to its title, it should treat of electric motors and the electrical transmission and application of energy. The transmission portion is, however, not touched upon, this being reserved for another volume. Neithammer has written of the motors themselves, but his work is in part overlapped by Schultz, who also handles the application of motors to various pieces of machinery.

The theoretical portion of the volume is handled in a gratifyingly clear and simple manner, the relations between weight, speed and capacity being concisely explained, as are also the questions of sparking, starting and regulating. Naturally alternating current motors are the subject of more extended mathematical treatment, owing to the greater diversity of types and the greater complication of their theory and principles. It is not claimed that there are

any new contributions toward either, but the whole forms an excellent recapitulation of the best and most recent literature on the subject.

The manufacturers of both direct and alternating-current motors have been liberal with photographs, cross sections and descriptions of their various machines, and while none of these go into detail the pages devoted to them should be of much interest to others in that line. Of course, German apparatus receives almost exclusive mention.

The portion of the work devoted to motor-driven machine tools contains but little of interest. Not only is there nothing novel, but many applications common in the United States are not mentioned at all. From those that are it would seem that the European manufacturers had to learn from us not we from them.

In conclusion, the reviewer wishes to offer a gentle but firm protest against the use of the word "Handbook," to describe a volume measuring 8 by 11 by 1½ inches, and weighing in the neighborhood of 6 lbs., these dimensions being too great for even the quart size hip-pocket indulged in by some members of the fraternity. As a reference work, the series is most valuable, and should find a place in the bookcase of every engineer. It is to be regretted that there is no similar series printed in English.

ELECTRICAL TRADES DIRECTORY. Handbook for 1901. Nineteenth year. London: "The Electrician" Printing & Publishing Company. 1354 and 125 pages. Price, postpaid, 15 shillings.

The 1901 edition of this extremely useful handbook contains 1354 pages of text, not including a biographical division of 125 pages in the form of an appendix. Much new matter has been introduced, particularly in the legal section and the section on "Standard Forms of Accounts." The directory section has also been much enlarged, particularly in the British and colonial divisions. Two huge sheets giving the data of all British central stations and electric railways are contained in a pocket in the back cover of the volume.

One of the most valuable sections of the Directory for other than British readers is the directory of professions and trades connected with electricity and its application, which covers the entire world. That for the United States occupies 37 closely-printed pages and includes the names and addresses of more than 1500 electrical engineers and manufacturing companies. Each division of the Directory is in two sections, one alphabetical by names and the other classified according to branches of the industry. The Continental section is still more extensive, including not far from 3000 names and addresses. Other divisions of the Directory aside from the British and those above mentioned are a colonial division, an Asiatic division and a Central and South American division. In addition, the names are given of all the officials connected with the electrical departments of the principal governments of the world. The biographical section contains biographies of several hundred of the leading electrical engineers and physicists of the world, many of the sketches being accompanied by portraits. We note that not a few American names are included. An obituary section contains biographical sketches of prominent electrical engineers, and members of the electrical industry who have died during 1901.

An immense amount of miscellaneous information of interest to those engaged in electrical pursuits is contained in the first part of the book, there being about 250 entries in the contents of this department, which covers more than 500 pages. Among the subjects covered are the submarine cables and the cable fleet of the world; the underwriters' rules of the more important countries; a digest of British and foreign tariffs on electrical apparatus, etc.; the officers of the leading electrical and scientific societies of the world; a directory of directors of British electrical companies and financial particulars of the same. About 50 pages are devoted to electrical data, such as tables of fuse constants and sparking distances, copper wire tables, steam tables, etc. One section is devoted to the patent rules of Great Britain and foreign countries. A list appears of the British electrical patents expiring in 1901, which includes many patents granted to Americans.

As will be seen, the volume forms a surprisingly complete compendium of information useful to those engaged in electrical pursuits. It is, however, open to the objection that the matter is thrown together with little regard to arrangement. A more careful selection of subjects and some attempt at condensation would, we believe, greatly decrease the size of the book without greatly detracting from its value.

BOOKS RECEIVED.

ELECTRICAL TRADES DIRECTORY. Handbook for 1901. Nineteenth year. London: "The Electrician" Printing & Publishing Company. 1354 pages. Price, postpaid, 15 shillings.

LES AUTOMOBILES ELECTRIQUES. By Gaston Sencier and A. Delasalle. With a preface by Charles Jeantaud. Paris: Vve. Ch. Dunod. 390 pages, 192 illustrations. Price, 15 francs.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Buffalo, Sept. 10, 11 and 12, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., Sept. 2, 3 and 4, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., Sept. 10 and 11, 1901.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., October, 1901.

An Electric Voting Machine.

An electric voting machine is on exhibition in Indianapolis, Ind. If the voter has cast a ballot for one man for each office without having made a mistake, a bell on the machine rings automatically. If the voter has made a mistake, the bell is silent. The machine is operated by electricity, and is attracting favorable attention at the hands of the commission selected by the Governor to procure voting machines. The machine is made by the Electric Ballot Box Company, of Petersburg, Ind.

Effects in Church Lighting.

There is more and more seen a tendency to improve effects in church illumination by using electricity. The "dim religious light" of other days is still admired and has its due devotional effect, but the greater modern ability to secure adequate lighting by means of electricity is now thoroughly recognized by ecclesiastical authorities. In regard to this matter, the *Baltimore American* has the following interesting item:

Mr. S. F. Gray, a local electrician, has just completed what is probably the most beautiful electrical display ever seen in a church in the city. It is the illumination of the statue of Our Lady of Lourdes at the Cathedral. As is well known, especially among Catholics, Our Lady of Lourdes was an apparition which appeared before the child, Bernardette Soubirons, about February, 1858, on a rock at Lourdes. Since then Lourdes has become famous the world over for a fountain, the water of which is said to possess most wonderful healing qualities, and which spring was revealed after the child had dug into the sand at her feet at the command of the apparition. Two magnificent churches have since been built near the fountain, which is visited by many thousands annually to receive the benefit of the water. Many miraculous cures are attributed to the properties of the water. The apparition appeared to the child on 18 different occasions, and a statue of Our Lady of Lourdes stands on the left side of the altar at the Cathedral. The statue is of Italian marble. On its head is a magnificently designed brass crown studded with tiny incandescent bulbs. The roses about the feet of the apparition, so the story of Bernadette goes, grew out of the rocks in a day to convince the Bishop of Lourdes of the truth of the child's statement. These roses on the statue are made of Austrian porcelain, while the leaves are of brass and remarkably natural in appearance. Inside each rose is small bulb, the soft rays of which contrast most beautifully with the brilliant illumination of the circle about the head of the statue upon which are inscribed the words: "I am the Immaculate Conception." The lettering is of gilt and lends additional splendor to the brilliancy of the lights. Each group of lights about the statue can be used separately. The display was designed and executed by Mr. I. P. Frink, New York.

American Incandescent Lamp Company.

The American Incandescent Lamp Company, of York, Pa., proposes to manufacture the "American" lamp, and has as its officers, Mr. E. K. McConkey, as president, and Mr. Paul McJunkin, as general manager. The product will not embody any radical departure from the present best practice in the manufacture of incandescent lamps, but the company relies upon a perfected system of automatic machinery, and great care in the production of the lamp. The works manager has had experience in charge of the technical work of one of the largest factories for a considerable time, and the present equipment will consist of apparatus designed by him since leaving there, and perfected in the company's own experimental laboratory.

The American line will include, at present, all the standard types and sizes of lamps adapted for use on regular lighting circuits and for the ordinary sockets, i. e., 50 to 250 volts and 2 to 150 candle-power. The factory is being equipped for an output of 1000 per day, at the start, and is to be ready in time to take advantage of the winter trade, which promises to be excellent. Mr. McJunkin says: "We shall not start until we are sure that everything is in the desired shape for turning out our best product, and without more delays than are absolutely unavoidable, for we expect to build up a reputation as being a firm who either keep their word or do not give it."

Morse Twist Drills at Buffalo.

The exhibit of the Morse Twist Drill & Machine Company at the Pan-American Exposition at Buffalo occupies space 43 in Machinery Building, and is displayed in three cases representing every department in its factory. The cases include twist drills of various sizes, and special attention is called to the large display of oil drills of their special pattern, with holes through the solid stock, oil sockets, three-groove chucking reamers, chucks, various kinds of formed cutters and milling cutters, straight and taper reamers, mandrels with expanding sleeves, gang cutters, cutters with radial grooves, plug, ring and wire gauges, counterbores, countersinks, taper pins, screw-slotting cutters, end mills, cutters with spiral teeth, taps, dies and screwplates. The largest drill exhibited is 5 inches in diameter, and the smallest drill, No. 80, is .0135 of an inch in dimeter.

This company has had exhibits at and received medals from the following international expositions: Vienna, 1873; Philadelphia, 1876; Paris, 1878; Melbourne, 1880; Paris, 1889; Chicago, 1893; Brussels, 1897; Paris, 1900; also for exhibits at Boston, 1865, 1869; New York, 1874; Cincinnati, 1879; Atlanta, 1895.

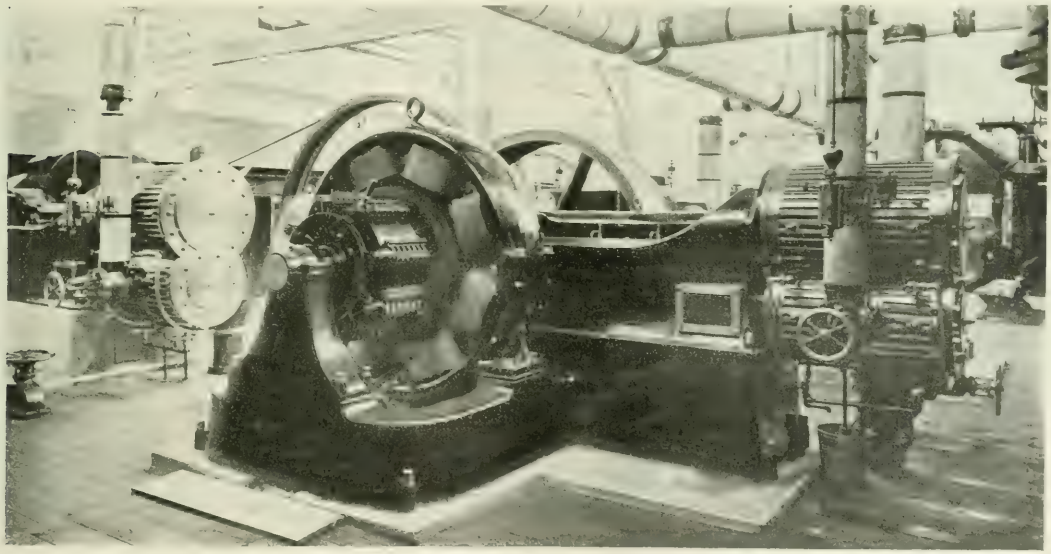
Electrical Engine-Stop System.

An application of electrically-operated control for the steam engine at the Buffalo Pan-American Exposition is shown in the Monarch engine-stop system, applied to the Fitchburg engine in the pumping plant. This engine is 18 inches by 42 inches, developing 225 horse-power at 87 r. p. m., operating one of the Root's rotary pumps. The Monarch is the only safety system connected directly with the throttle-valve of the engine. It is operated by electricity and gravity combined. The electric part of the device serves to connect as many different parts of the plant as may be desired, near or remote, with the throttle valve, by means of push buttons. Pressing the button at any point in case of accident will unlock the system, closing the throttle valve by gravity, and in much less time than the engineer could do it were he at the throttle.

The automatic speed-limit used in the Monarch system is connected with the main, or flywheel, shaft of the engine, and can be set at any desired number of revolutions of the engine above the normal, and operates only in case of increased speed above that point at which it is set. If any part of the regular governor breaks, or fails for any reason to control the speed of the engine, the speed limit instantly operates the stop automatically by electric contact, which immediately closes the throttle, thus absolutely preventing the engine from racing. The apparatus is made by the Monarch Manufacturing Company, of Waterbury, Conn.

American Engine Company's Pan-American Exhibit.

One of the most notable of the steam and electric exhibits at the Pan-American Exposition is that of the American Engine Company, of Bound Brook, N. J. A view of the main display is herewith presented. The largest plant installed by the concern comprises a 325-hp engine, driving one of the fountain pumps by belt. A smaller plant is a 200-hp American Ball engine driving a 125-kw generator of the same make. This unit furnishes current around the fountain but is also used to charge the batteries for the fleet of electric launches. The results obtained are eminently satisfactory, and the exhibit attracts deserved attention. It is worthy of note that the first duplex compound engine of the company was shown at the electrical exhibition in Madison Square Garden in 1898, since when its popularity and use have become widespread. Their multipolar dynamos and motors are also well known in the art, and a great many direct-connected units of this type are now being installed.



Engine and Generator Exhibit at Pan-American Exposition.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call loans ranged between 2@3 per cent, 2¼@2½ per cent being the selling quotation, and time money was held at 4½ per cent and 4½@5 per cent for longer periods. Mercantile paper is quoted at 4½ per cent for prime double names. The stock market exhibited a better tone and greater activity, although the volume of trade was narrow. The more favorable crop reports, continued good railway earnings and the growing belief that the steel strike will soon end, created renewed confidence in the market. The steel stocks closed higher, although they were irregular at the beginning of the week. There was no special activity in any of the other industrial stocks. Brooklyn Rapid Transit had support and was the object of bull tips. Following are the closing quotations of Aug. 26, compared with those of the previous week:

NEW YORK.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug 27.
American Tel. & Cable..			General Carriage.....	⅞	¾
American Dist. Tel.....	—	—	Hudson River Tel.....	120	120
Brooklyn Rapid Transit..	74¼	75¼	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry...	166	167¼
Electric Boat.....	18	19	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	40	48	N. Y. Elec. Veh. Tran....	10¼	10½
Electric Lead Reduc'n .	1½	1½	N. Y. & N. J. Tel.....	168	168
Electric Vehicle.....	5½	5	Tel. & Tel. Co. of Am....	3	3
Electric Vehicle pfd.....	10	10	Western Union Tel.....	93⅛	93
General Electric.....	263	265½			

BOSTON.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
Am. Tel. & Tel.....	161	164½	Mexican Telephone	2⅛	2½
Cumberland Telephone...	—	-	New England Telephone.		—
Edison Electric Light...	*256	250	Westinghouse Elec.....		—
Erie Telephone.....	48	45	Westinghouse Elec. pfd..	—	—
General Electric pfd ..					

PHILADELPHIA.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
American Railways.....	40	40	Phila. Traction.....	95¾	97½
Electric Storage Battery..	75	74	Philadelphia Electric.....	5	5⅜
Elec. Storage Batt'y pfd..	75	74	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	7¼	7⅜	Pa. Elec. Veh. pfd.....	¾	¾

CHICAGO.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
Central Union Telephone.	—	—	National Carbon pfd.....	83	84
Chicago Edison	155	162½	Northwest Elev. com.....	36	38
Chicago City Ry.....	201	209	Union Traction.....	15½	17⅜
Chicago Telep. Co.....	*273	268	Union Traction pfd.....	59	60
National Carbon.....	17	17			

*Asked.

GENERAL CARRIAGE COMPANY.—O. F. Thomas has been appointed receiver of the property in this State of the General Carriage Company, whose office is at 135 Broadway, and place of business at Forty-third Street and Sixth Avenue, New York, by Judge O'Gorman, of the Supreme Court, in a suit brought by Henry C. Hepburn, holder of 100 shares of stock, in proceedings for the voluntary dissolution of the corporation. The receiver's bond was fixed at $5,000. A meeting of the executive committee was held on the 8th inst., the minutes of which show that it was stated that it was impossible to continue the business in its present condition, as an attachment for over $4,000 had been placed on the company's property here, a second attachment for $11,000 was placed on its cabs sent to Chicago for repairs, and a third attachment for $45,000 was obtained against the company here on the 7th inst. A resolution was adopted by the committee that it is desirable in the interests of the stockholders that a receiver be appointed. An order was filed in the Court of Chancery at Trenton, N. J., appointing William C. E. See receiver of the General Carriage Company, a New Jersey corporation. The receiver was appointed at the instance of Montgomery & Co., to whom the company is indebted to the extent of $120,71. The application for the appointment of a receiver alleged that an attachment for $400,500 against the company is now in the hands of the Sheriff in New York City. It was also ordered that the company show cause at Jersey City on Aug. 26 why the appointment of Mr. See as receiver should not be made permanent.

CENTRAL UNION TELEPHONE.—The directors of the Central Union Telephone Co. have issued this statement: "It is the opinion of the directors that the money necessary for the present rapid development of the company's property should be secured by reducing the present issue of capital stock one-half and then increasing the capital stock so reduced, 100 per cent, which will bring into the treasury substantially $3,500,000 in cash. Immediate steps will be taken to bring the matter before the stockholders for the necessary action on their part." Inasmuch as the directors representing the Bell Telephone control enough stock to carry the proposition the announcement of the plan by the board of directors is tantamount to its enforcement. It is understood that the Bell interest has taken a large part of the stock sold recently on the Chicago Exchange, and that the objectors to the plan of assessment in any form have been the sellers. The company has outstanding $6,962,100 stock. The value of the stock after the reduction and the increase have been completed ought to be about 97. The price now rules around 47.

TO REDUCE CAPITAL STOCK.—Stockholders of the Railways Company General have received notice that, owing to shrinkage in the value of assets, the general stock is to be reduced. A special meeting has been called for Sept. 30, at which will be submitted the proposition to reduce the outstanding capital from $1,500,000 to $1,200,000 by exchanging four new shares, each of the par value of $10, for each 10 of the present shares, the par value of which is $5. The Railways Company General was organized three years ago, with L. M. Downs as president, J. M. McAfee vice-president and Taylor Faunce secretary and treasurer. It acquired the Newtown Electric Railway, and later the Lewisburg, Milton & Watsontown Passenger Railway Company, the Montoursville Passenger Railway Company and the Michigan Traction Company. The assets are figured as follows: $510,000 bonds, $250,000 stock and $395,000 cash and notes on hand.

INTERNATIONAL POWER COMPANY.—If there is a more liberal charter than the one granted by the Connecticut State Legislature to the International Power Company it is yet to be heard from. In brief, the company may engage in any business, in any part of the world, the only limitations imposed are that the capital must not exceed $250,000,000. The State is to receive an annual franchise tax of 1-100th of 1 per cent on a market valuation of the capital stock actually issued and 1 per cent on all shares owned in Connecticut. The men whose names are mentioned in the charter as incorporators are E. F. Harding, R. S. Masterson, C. B. Wilson, D. B. Giddings, and W. S. Downs, of Bridgeport, where the principal office of the concern will be located.

AMERICAN TELEPHONE.—An official of the American Telephone & Telegraph Company says: "The shares of the American Telephone Company will, without doubt, be traded in on the New York Stock Exchange within the next two weeks; to be more exact, probably Sept. 3. The listing commitee of the New York Exchange late in June recommended the listing of $15,000,000 4 per cent collateral bonds of 1929, and $94,237,500 capital stock, but the stock has not been traded in owing to delays in the engraving of new securities made necessary for trading on the New York board. The listing committee also recommended the listing from time to time of $20,709,000 additional stock."

SWARTS METAL COMPANY.—Creditors of the Swarts Metal Refining Company, which was recently declared an involuntary bankrupt upon the representations of Eastern dealers that it had sold for less than cost price $100,000 of raw material bought upon long time, have found that there are practically no tangible assets and that they will be heavy losers on account of the alleged unbusiness-like dealings of the company. The tangible assets were sold last week by the Referee in Bankruptcy for $4,050. The intangible assets amount to $20,000, while the claims of creditors amount to $130,000. Most of the creditors are New York and Eastern business houses.

SCHENECTADY RAILWAY BONDS.—The Schenectady Railway Company, controlling the entire railway and electric lighting business in the city of Schenectady, all of whose stock is owned by the General Electric Company, has built a double track extension to Albany, and has in course of construction a line to Troy. Other extensions are also in contemplation, which, with those mentioned, will make a property of considerable magnitude. Funds for the extensions are to be provided by an issue of $1,250,000 first mortgage bonds, which have been sold to N. W. Harris & Co.

WESTERN UNION.—A director of the Western Union Telegraph Company says that the earnings are continuing to show decided increases, although the full measure of business that obtained previous to the declaration of the steel strike is not being handled. Immediately before the steel strike the increase in the weekly earnings ran as high as $46,000, but the recent showing has been about $28,000 to $30,000 a week increase over the corresponding weeks of last year. The firmness of Western Union stock has been due to purchases by insiders.

DIVIDENDS.—The Chicago Telephone Company has declared the regular quarterly dividend of 3 per cent, payable Oct. 9. The Safety Car Heating & Lighting Company will, on Sept. 1, distribute

a 10 per cent stock dividend, and on Oct. 1 pay a cash dividend of 5 per cent., comprising a 2 per cent quarterly payment and an extra payment of 3 per cent. The stock dividend will be paid out of treasury stock. The directors of the Kings County Electric Light & Power Company has declared the regular quarterly dividend of 1 per cent, payable Sept. 1.

TELEPHONE SECURITIES.—G. H. Ginther & Co., investment securities brokers, with offices in New York and Pittsburg, have opened offices in the Electric Building, Cleveland, Ohio. The firm makes a specialty of telephone bonds, and naturally turned to Cleveland as a center of the independent movement. The company will handle an issue of $600,000 in bonds, which will be placed on the market by the Consolidated Telephone Company and the Inter-Ocean Telephone & Telegraph Company, of Cleveland.

TELEPHONE MORTGAGE.—A $5,000,000 mortgage has been filed by the Illinois Telephone & Telegraph Company in favor of the Equitable Trust Company, as trustee. The money is to be used to complete the company's telephone system in Chicago and $3,000,000 has been obtained on the bond issue. The company will use the Strowger automatic system.

CHICAGO TELEPHONE.—Stockholders of record Sept. 26 will have the privilege of buying on Oct. 9 at par pro rata to their present holdings of stock $1,000,000 of the new stock to be issued by the Chicago (Bell) Telephone Company.

MEXICAN TELEPHONE.—The Mexican Telephone Company reports an increase of 15 per cent in earnings for the month of June and of 16 per cent since March 1.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports from trade centers indicate that trade during the week tended toward enlargement, at steady and higher prices. Crop improvement, particularly in the Central West and Mississippi Valley, has been the mainspring of the more cheerful tone of advices and enlarged fall trade operations at such cities as Chicago, St. Louis and Kansas City. From the South better advices come, and at the great Eastern centers distribution is as good, at least, if not better, in volume than a year ago. Iron and steel show little change, accessions to the strikers in the case of the leading tube works of the country having been balanced by the reopening of "struck" mills in the Pittsburg district. Chicago iron and steel jobbers are reported besieged by buyers, and some Western consumers may have to shut down if supplies are not shortly forthcoming. It is interesting to note in this connection that the rail mills and concerns producing structural material have as yet not been affected by the strike. Building material is quite active, although the steel strike interferes with progress at some centers. The strike is, of course, the chief disturbing feature in the situation in the iron and steel trades. Net railway earnings for the half year are very encouraging. Reports by 126 systems, according to *Bradstreet's*, show an aggregate of $623,853,560 in gross, and of $195,629,942 in net, gains of, respectively, 10.5 and 14.9 over a year ago. Despite the damage to the spring wheat crop a year ago, the granger roads gained 7.4 per cent in net, while the coal roads lead the list of gains with 29.2 per cent; the Southwestern roads gained 26.4 per cent. In the metal market copper displayed greater activity, and large transactions took place in the home market both for early and distant deliveries. The export demand has also improved, but prices do not show any change. The following are the quotations: Lake copper, 16½ cents; electrolytic in cakes, bars or ingots, 16¼ cents; cathodes, 16 cents, and casting copper, 15⅞ cents. The failures for the week, as reported by *Bradstreet's*, aggregated 162 as against 178 the week previous, and 135 the same week last year.

BIG COPPER DEALS.—Arrangements are said to be under way for the incorporation of a new copper company with a proposed capital of $50,000,000. It is asserted that the contemplated corporation is designed to take over some seven or eight mines, including a number of the Clark properties. Amalgamated Copper interests decline to discuss a report that this concern has to do with the rumored impending copper combination for the entire United States. The prospective company is probably intended to play a part in the planned copper trust, which, it is thought, may embrace the Amalgamated, Anaconda, Calumet and Hecla, Rothschild, Lewisohn, and minor interests. The *Daily Chronicle* has obtained from Lord Rothschild a denial of any connection with or knowledge of the reported American copper trust. "My firm has no copper mines," he is represented as having said, "and I never heard before of Senator Clark." On the London Metal Exchange the report that the Rio Tinto would enter such a trust was discredited. The General Electric people are alleged to be spending considerable time and money endeavoring to get a suitable copper property; in fact, they have had experts looking over the field for many months. The company purchases between 30,000,000 and 40,000,000 lbs. of copper a year at a cost of between $5,000,000 and $6,000,000. If a good property could be secured which would be capable of development into a mine producing, say, 1,000,000 lbs. of copper per month, it would be a profitable investment for the General Electric Company.

CONSOLIDATION IN SOUTHERN CALIFORNIA.—It is reported that a combination of electric power concerns has been effected in Southern California by W. S. Tevis, president of the Kern Land Company, and Henry Fisher, of Redlands. The consolidated corporation, which aims to control all the water-power electric systems of the lower part of the State, will be known as the Southern California Power Company. It is said that contracts have been closed for the transmission of 15,000 horse-power to Los Angeles, delivery to be made through the Edison Electric Company, which has been consolidated with the Power Development Company and the original Southern California Power Company. Work has been commenced on the project of greatly increasing the output of the Bakersfield water power. New tunnels will be bored and hydraulic work done to provide for utilizing 5000 inches of water just above the Power Development Company's present electric plant, and thus the same water will be used twice. The new electric power plant to be installed in the Kern River Cañon will transmit current to Los Angeles via the old S. P. R. R. right of way, and its estimated cost is $2,000,000. It will be possible along this route to supply electric power to all the pumping plants in the Antelope Valley, the Kern River oil fields, Newhall oil fields and the towns in the San Fernando Valley. The San Gabriel Valley can easily be covered via Redlands.

DOMESTIC ORDERS FOR MOTOR TRUCKS, ETC.—The Peckham Manufacturing Company, whose New York offices are located in the Havemeyer Building, 26 Cortlandt Street, reports receipt of a number of contracts calling for trucks of heavy, high-speed types for utilization by Western interurban electric traction systems. Sixty trucks of this description have been recently ordered on behalf of the Chicago, Aurora & Elgin Railway, while seven pairs have been requisitioned for by the Columbus & Newark Traction Company. Other orders secured within the last week or two comprise 60 swing bolster maximum traction trucks for the Metropolitan system, Washington, D. C., and 40 pairs of short-wheel base swing bolster trucks for the North Jersey Railway. The Peckham Company also reports having received numerous inquiries for the Ruggles rotary snow plow, several of which have already been ordered for late fall delivery. Among the contracts lately obtained figure those from the Camden (N. J.) & Suburban Railway; Lehigh Valley Traction Company, Allentown, Pa., and the Somerset Traction Company, Skowhegan, Me.

SALES OF C & C MOTORS.—The Chicago office of the C & C Electric Company has just sent in orders for some seven or eight motors to go to St. Louis, Chicago and Milwaukee, besides an order for 11 motors in sizes ranging from 2 to 35 horse-power for the William J. Moxley Company, of Chicago. The Locomobile Company, of Bridgeport, Conn., has placed an order for a 60-hp motor. The company reports a number of recent orders for generating sets, and a decided improvement in the sale of motors for use on the Edison circuits in New York.

ELECTRICAL MACHINERY FOR JAPAN.—The American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, is about to make shipment, by the General Electric Company, of some 125 tons of various equipment, which is intended to be used by one of the Japanese street railways now under construction. The Bagnall & Hilles people are reported to have secured another substantial contract for the equipment of a new electric traction system in that part of the world.

BALL ENGINE ORDERS.—The Yorkville Independent Hygeia Ice Company, New York City, has recently purchased an engine from the Ball Engine Company, Erie, Pa., for electric lighting. The National Carbon Company, Cleveland, Ohio, has purchased for electric light and power purposes, a 350-hp engine direct connected to a General Electric generator. The Ball Engine Company will furnish the engine.

MONTREAL SUB-STATION CONTRACT.—The contract for the construction of a new sub-station for the Royal Electric Company, of Montreal, Que., has been awarded to Messrs. P. Lyall & Sons, of that city, for all trades. The building will be fire-proof, and will cost about $100,000.

PLANT FOR MALDEN, MASS.—Mr. F. P. Royce, treasurer of the Malden, Mass., Electric Company, informs us that they are adding another direct-connected set of 500 kilowatts, making the third such set installed. They are also adding a cooling tower, induced draft system, and new buildings.

MACHINE TOOLS.—A $40,000 order for machine tools has been given to the Niles-Bement-Pond Company, by the Westinghouse plant in Manchester, England.

General News.

THE TELEPHONE.

GREENWOOD, ARK.—Mr. Jim McConnell is putting in a telephone system at Greenwood.

OZARK, ARK.—The Home Telephone Company, of Ozark, organized and elected the following officers: W. M. Quaile, president; L. R. A. Wallace, vice-president; G. W. Russell, treasurer; Tom Carter, secretary, and J. R. Davidson, J. C. Carter and M. B. Conaster, directors.

WASHINGTON, D. C.—In a series of suits instituted by the Chesapeake & Potomac Telephone Company against subscribers whose telephones had been withdrawn by the company for non-payment of bills rendered and the collection of which claims would soon have been barred by the statute of limitations, Justice J. Barton Miller gave judgment for the plaintiff. The Congressional rate was allowed in all cases where claims were proved. The statute governing cost of service was set up as defence.

CARTERSVILLE, GA.—The Southern Bell Telephone Company is preparing to establish a telephone system here.

ROME, GA.—The Bell Telephone Company is replacing its old instruments with new, and making other improvements to its system.

GAINESVILLE, GA.—Dr. Hardeman, of Harmony Grave, is erecting telephone lines from Jefferson to Gainesville along the Gainesville, Jefferson & Southern Railroad, and the road will use telephones.

WASHINGTON, GA.—The local telephone system will be connected with the long-distance system extending over Georgia and reaching outside the State. The local system is owned by T. W. Fitzpatrick and brother.

GAINESVILLE, GA.—J. M. Oliver is making rapid headway with his Mountain telephone system, that will connect Gainesville with nearly all the small towns and villages in the mountain counties above here.

CHICAGO, ILL.—The Eureka Telephone & Construction Company, Chicago, capital $50,000, has been incorporated by H. R. Platt, J. H. Rollins, and Sydney Stein.

EL PASO, ILL.—The El Paso Telephone Company has been incorporated; capital stock, $5,000. Incorporators: A. E. Fleming, J. L. Boner and R. E. Gordon.

PEKIN, ILL.—A Chicago firm was awarded the contract for the construction of the Citizens' telephone system, an independent company at Pekin, the bid being $26,600.

SPRINGFIELD, ILL.—The Humboldt Telephone Company, Humboldt, has been incorporated; capital, $2,500. Incorporators: James McDougle, S. C. Ashbrook, E. M. Mulliken.

ALTON, ILL.—The Kinloch Telephone Company has set its poles from the eastern limits of the city to the main business district, and work of stringing wires is now in progress.

SPRINGFIELD, ILL.—An independent telephone company which has been operating in Pekin, Lincoln and neighboring cities is endeavoring to secure a franchise in this city. A few years ago a local company was organized for the same purpose, but it allowed its franchise to lapse, and the effort died out.

EDWARDSVILLE, ILL.—At the conference between representatives of the Kinloch Telephone Company, of St. Louis, and the city authorities, nearly all the differences existing between the parties in interest relative to the granting of a franchise to the company permitting it to construct and operate a telephone exchange in this city were amicably settled, and it is now stated that an ordinance granting such franchise will be passed at the September meeting of the Council.

VALPARAISO, IND.—The Northwestern Indiana Telephone Company is building a new line from Hebron to Valparaiso.

WASHINGTON, IND.—The Central Union Telephone Company will in a few weeks commence the construction of a telephone line from this city to Odon and Elnora.

LYNN, IND.—The Lynn local telephone company, which was recently incorporated has been organized, and is now beginning business. It is using Stromberg-Carlson apparatus. The officers of the company are: S. C. Bowen, president; Daniel Hecker, treasurer, and W. E. Henshaw, secretary.

FRANKLIN, IND.—There is a strong prospect of a war between the local and Bell telephone companies at this place. The Bell Company says an exchange will be established here, and will cut the price of the local company. Public sentiment seems to be against the Bell Company, and its methods. The company has a long-time franchise, but has contented itself with operating a single pay station. The local company is affiliated with the New Company, of Indianapolis, and will make a strong fight to protect its territory.

WHITELAND, IND.—A few months ago the Town Board granted the Striekler local telephone company a franchise to use certain streets and alleys, and maintain a local telephone exchange here. The public station was opened and a switch was put in, but for some cause the local subscribers were not supplied with telephones. On August 17 the Central Union Telephone Company preempted the territory by swooping down on the town with a crowd of solicitors on a gorgeous tallyho, drawn by four gayly bedecked horses. A heavy wagon also entered the city unannounced, laden with tools and men and telephones, together with a complete switchboard. The company had not asked the town for a franchise, and as fast as the Central Union employes dug the post holes the town marshal and employes filled them up. Finally, the town marshal was called off, the town board deciding on another line of action. The Central Union erected several poles inside the corporation, but the trouble is not yet officially settled.

INDIANAPOLIS, IND.—S. P. Sheerin, vice-president of the New Telephone Company, says that his company will not cut its rates to meet the party line cuts announced by the Central Union. "We made our cut at the very beginning," he said, "and are supplying telephone service now for nearly 50 per cent less than the same class of service was at that time being furnished by the Central Union. We fixed our rates at a point where we felt sure of a fair profit, and have no intention of running our business at a loss. We do not believe the fair-minded people expect us to furnish them service of any kind at a loss to our company. We do not believe that the people of this city desire a cheap, inefficient, party-line service. The evidence that comes to us points very strongly the other way. It is our duty to give the people what they want. With our fingers at the public pulse all the time, we are satisfied that they want no such service as party-line service. Our demand for single-line service is greater than we are able to meet, and our only embarrassment comes from the difficulty in getting material to make extensions as quickly as they are needed. We have just completed plans which will increase our capacity to 7000 telephones."

INDIANAPOLIS, IND.—The Tax Board was kept unusually busy during the past week listening to the protests against assessments made against telephone companies. The Home Telephone Company, of Richmond, was the first heard. Perry J Freeman, president of the company, contended that by comparison with telephone properties in Anderson, Elkhart and elsewhere, its plant had been assessed too high. R. E. Niven, a Thorntown banker, and president of the Thorntown Telephone Company, which was assessed last year at $1,000, and this year at $1,500, insisted that the increased assessment was a grievous error. He asserted that his company's income has been less this year than last, while its expenses have been increased. He said the company is seriously handicapped by a co-operative telephone company, formed by a number of farmers in the county, and that the latter company fights the Thorntown Company "tooth and nail," because the city company is owned by business men. C. M. Zion, representing the Lebanon Telephone Company, drew a picture of distress that was almost identical with that painted by Mr. Niven, including bitter competition with a farmers' co-operative telephone company. The Otterbein and Monon telephone companies sent a written protest, in which the claim of poor profits and cheap construction was made. It asks to be let down with one-half of the proposed assessment. S. P. Sheerin, speaking for the New Telephone Company, of Indianapolis, argued that the assessment of his companies—the New and the New Long-Distance Telephone companies—ought not to be more than $20,000 in view of the bitter competition they have and of the expensive improvements which they must frequently install. A. G. Lupton, of Hartford City, made a plea for a reduction for the Indiana Telephone Company, of Hartford City, and its lately acquired property, the Marion Telephone Company. He said the Marion plant was in poor physical condition, and will have to be practically replaced by a new one at a considerable expense. He said the net earnings of the companies were comparatively insignificant. C. E. Mills, speaking for the Jasper County Telephone Company, said that the company had made errors in making out its tax return, which if corrected the companies' net income would be materially lessened, and asked that the board take in consideration that much of the line was made up of barbed wire fence, therefore, the assessment ought to be reduced. The Prairie Telephone Company, of Brookston, was represented by its secretary, J. L. Boardman, who said that this property was acquired from the Jasper County Long-Distance Telephone Company, and it ought not to be assessed higher than it was last year. He said no profits had accrued during the year. The Board fixed the assessment at $8,100, and Mr. Boardman said the figure ought to be reduced to $4,500. Other companies will plead.

GRUNDY CENTER, IA.—The Grundy County Telephone Company has been organized here. Contracts have been placed for the construction of an exchange in this city and the line will eventually be extended throughout the county. The authorized capital stock of the company is $10,000. The officers are: President, F. J. Frost; Treasurer, R. M. Finlayson; Secretary, F. W. Reisinger.

CHICAGO, ILL.—The Illinois Manufacturers' Association has decided to begin legal proceedings against the Chicago Telephone Company, which charges $175 a year for a business telephone, to compel it to refund the difference between that sum and $128, the limit fixed by its charter granted in 1889.

NEW ORLEANS, LA.—The Cumberland Telephone & Telegraph Company has been summoned to show cause why it should not be fined for violating the rules of the Commission by increasing the rate for a three minute conversation between Homer and Shreveport. This company has also been summoned to show cause why its rates in Shreveport should not be reduced on account of the extremely poor service which is being rendered there.

BALTIMORE, MD.—The Delmarvia Telephone Company and the Maryland Telephone Company are having a line built from Wilmington to Elkton, and from Elkton to North East, thence to Perryville, where connections will be made with a line which runs into Baltimore.

ALMA, MICH.—The Union Telephone Company has increased its capital stock from $150,000 to $200,000.

BAY CITY, MICH.—The Valley Telephone Company is installing a new switchboard in its exchange in this city.

SAGINAW, MICH.—The Valley Telephone Company, of Saginaw and Bay City, has completed its lines to Sebewaing. Many farmers along the route have put telephones into their residences.

JACKSON, MICH.—Articles of incorporation of the People's Telephone Company have been prepared, and are nearly ready for filing. The capital stock is fixed at $200,000. At a meeting of the stockholders the first board of directors was chosen, as follows: J. C. Richardson, Z. C. Eldred, G. W. Carter, G. A. Matthews, W. H. Maloney, M. F. Cottrell and Thos. M. Smith, of Jackson, and Arthur Pack, of Orchard Lake, and Joseph B. Ware, of Detroit.

MINNEAPOLIS, MINN.—The city hospital has just been equipped with a complete intercommunicating telephone system, connected with the Twin City Telephone Company's exchange. The switchboard at the hospital is similar to the one recently installed at the Courthouse.

MINNEAPOLIS, MINN.—The Twin City Telephone Company is preparing a novel and useful exhibit at the State fair, and at the same time will institute telephonic connections with both cities. A switchboard of the latest style lamp-signal board has been placed in the manufacturers' building, and with it will be

a complete exhibit of all instruments necessary in telephone construction. More than twelve miles of wire are being stretched on the grounds, and about thirty telephones will be placed in the various buildings. A toll of 5 cents will be charged to telephone to either city.

WINONA, MINN.—The Winona Telephone Company is just completing extensions and improvements that have been made this summer at an expense of close to $2,500, increasing the number of telephones having direct connection with the Winona exchange to close to a thousand. Twenty-five farms between Altura and Minneiska have been given telephone connection, and a line is now being finished from Witoka to Pickwick and La Moille that will add as many more farms to the exchange. The Winona company was the fourth independent company to be established in the United States, and has grown steadily from the start.

JACKSON, MISS.—The Mississippi Telephone Company, Laurel, Miss., has been incorporated, with a capital of $30,000. The incorporators are W. C. Welborn, E. D. Pierce, J. W. Watt and N. P. Welborn. The company has authority to build and operate lines between New Orleans and Meridian, Mobile and Jackson, Laurel and Kingston, and most any other place it may desire.

HELENA, MONT.—It is said that an agreement has been reached between the Rocky Mountain Telephone Company and the Northwestern Company by which the former will build at once from its present eastern terminus at Billings to Miles City, Mont., while the Northwestern Company will build west from its North Dakota terminus to Miles City.

HENDERSON, N. C.—The Henderson and Carolina & Virginia telephone companies have now under construction a double metallic circuit from Henderson via Rocky Mountain, Goldsboro, Kinston, New Berne and intermediate points to Morehead and Beaufort. One circuit is of iron for local business, and one of copper for through service. The completion of this line about October 15 will connect all the principal East Carolina cities with the rest of the State and give these companies over 1200 miles of metallic toll line in Carolina and Virginia. Exchanges will be built at Morehead and Beaufort, which are important fish, oyster and lumber points, and the former one of the finest summer resorts on the south Atlantic coast. The Henderson Telephone Company is now installing at New Berne a 450 metallic Couch & Seely board equipped with an improved lamp transfer system, the invention of Mr. F. C. Toepleman, general superintendent of the companies.

RALEIGH, N. C.—Judge W. S. O'B. Robinson has granted a temporary restraining order to the American Electric Telephone Company to show cause why the Raleigh Telephone Company should not be placed in the hands of a receiver. The application for a receiver will be determined August 29. The local company claims that this action is unwarranted, and that it is perfectly solvent. The plaintiff alleges that the incorporation of the company was not legal, and that it has failed to comply with the provisions of the articles of agreement, etc.; also plaintiff claims $3,500 due by note given December 22, 1900, and due in 60 days; also plaintiff alleges that it is informed of other debts of this company.

TRENTON, N. J.—The Delaware & Atlantic Telephone Company, has reduced the rate for local calls from ten to five cents. Cuts have also been made in the long distance service, it being the intention of the company to charge, in the future, about one-third less for out-of-town calls than has been demanded in the past.

JAMESTOWN, N. Y.—The Home Telephone Company, of Jamestown, has secured 400 contracts out of 500 desired.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has just placed in operation a scheme which will prove of great service to passengers on the transatlantic liners that sail from Hoboken. On the steamships Deutschland and Columbia the company has placed "nickel in the slot" telephone instruments, which are connected with the shore by a wire attached to the ship as she lies in her pier. The wire remains connected up to the last moment of sailing. When the ship moves out the cord is disconnected. Likewise when either of the ships arrives the telephone cord is the first thing to be connected.

FT. RECOVERY, OHIO.—The Ft. Recovery Telephone Company has been incorporated.

HILLSBORO, OHIO.—The New Home Telephone Company of this place has begun stringing wires here.

HUBBARD, OHIO.—The Youngstown Telephone Company has been granted a franchise to install an independent telephone exchange in this place.

PAINESVILLE, OHIO.—The Painesville Telephone Company has increased its capital stock from $20,000 to $75,000 to provide for improvements.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has secured the franchise for an independent telephone line through Zanesfield.

CINCINNATI, OHIO.—An independent telephone syndicate is making efforts to get a foothold in this city. It is understood that the company now has a fair show of success.

CINCINNATI, OHIO.—About 500 employes of the Cincinnati Telephone Company enjoyed their annual outing a few days ago, the Mutual Benefit Association organization of employes defraying all expenses.

FREMONT, OHIO.—J. P. McGahan, for several years manager of the Central Union Telephone Company's (Bell) exchange at this point has been appointed assistant superintendent of the properties in Ohio.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association, of Cincinnati, will establish a complete exchange at the Cincinnati Fall Festival, which opens September 16. The workings of the modern telephone exchange will be shown in all its completeness.

CALDWELL, OHIO.—The Woodsfield Telephone Company has organized by electing J. B. Rhodes, of Zanesville, president; L. E. Stegner, Lewisville, vice-president; J. S. Cawley, Woodsfield, secretary and treasurer. The board of directors is composed of the above-named gentlemen and E. A. Culbertson, of Coreapolis, Pa.

TOLEDO, OHIO.—Manager Frank Graves, of the Toledo Home Telephone Company, denies that the Everett-Moore syndicate has any financial interest in his company, and claims that the organization is controlled by Toledo people. He says, however, that the company will work in harmony with the Everett-Moore system of long-distance lines.

PORT CLINTON, OHIO.—The successful stringing of the telephone cable from Put-in Bay three miles across to the Catawba Island mainland has been tested, and is now in service. The cable was laid by the Port Clinton Home Telephone Company at a cost of $10,000. Connection from Put-in Bay to Middle Bass by cable is also being made, and exchanges will be established here and at Put-in Bay.

HOPEDALE, OHIO.—The Home Telephone Company, of this place, has been organized by the following persons: W. H. Copeland, John B. Beadle, Asbury Cole, Martin Snyder, J. M. Copeland, J. G. Dixon, J. P. Ligett, Jacob Copeland, I. M. Irwin, J. R. Skelley, J. M. Kile, William Holmes, Winfield Holmes, W. V. Scott, J. B. Francis and N. B. Buckingham. They will build lines in Hopedale, Miller station and Greenough, with a farmers' system through out the community.

TORONTO, ONT.—Mr. Wayling, of Buffalo, N. Y., one of the company which offers to establish an independent telephone system in the city of Toronto, Ont., says that after the holiday season closes negotiations will be resumed with the Toronto City Council if the latter shows any desire to talk business. Mr. Wayling said: "As a guarantee of good faith we offered to put up a bond of $50,000 as security that we would install a plant and fulfil our contract to the letter. If we get a franchise, we will give Toronto a thoroughly up-to-date system at a cost of about $1,200,000. Every instrument would be on a metallic circuit of its own. Our rates would be $36 for a business telephone, or $50 for both a business and a residence telephone on one circuit. If two house subscribers choose to go on one line, a rate of $18 or $20 each would be allowed. It is for the civic authorities to decide whether they want relief from the present situation or not."

PORTLAND, ORE.—Napoleon Davis and John Lamont, president and vice-president, respectively, of the Columbia Telephone Company, have disposed of their interest to a syndicate of capitalists from Ohio and will retire from the company. All parties to the deal decline to give the purchasing price. The new owners of the system are the same men that are putting in an independent telephone system in Seattle. The intention is to unite the two systems, and establish long-distance connection between Portland and Puget Sound points. Eventually, it is said, the system will be extended so as to include all points of importance in Washington and Oregon, but for the present the connection will be between Seattle and Puget Sound. In addition it is proposed to improve the Columbia Telephone system in Portland, and an effort will be made to extend the service throughout the city.

MANSFIELD, PA.—The Citizens' Mutual Telephone & Telegraph Company, of Mansfield, capital $1,000, has been incorporated.

PITTSTON, PA.—A movement is on foot for consolidation of the Central Pennsylvania and People's Telephone lines. The People's Company is a young concern, with lines extending from Hazleton to Carbondale.

PITTSBURG, PA.—About 100 linemen of the Federal Telephone Company organized in the International Brotherhood of Electrical Workers have gone on a strike in this city upon a refusal on the part of the management of the company to sign a new scale of wages. The scale provides for a rate of $2.50 for a nine-hour day, with extra pay for overtime, Sundays and holidays, and a day's wages for men reporting for work on inclement days. This last feature was a material feature in causing a failure to arrange an agreement with the company.

SPARTANSBURG, S. C.—The Bell Telephone Company has secured the franchise from the City Council at Union, and will build an exchange.

CANTON, S. D.—The work of connecting Mitchell and Woonsocket by telephone is expected to be completed about Sept. 1.

ERIN, TENN.—The Hamilton County Telephone Company has just completed a telephone exchange at Stewart Station, Tenn.

DAYTON, TENN.—J. H. Hood, local manager of the Cumberland Telephone Company's exchange, states that the company will at an early date complete its lines from Chattanooga via Dayton to Cincinnati.

TEXARKANA, TEX.—The East Side City Council has granted a Mr. Richardson and associates the right to maintain and operate a new telephone system in Texarkana, Ark.

GALVESTON, TEX.—President H. M. Aubrey, of the Commercial Telephone Company, with headquarters in San Antonio, has arranged the details for the entrance of his company into Galveston.

NEWPORT NEWS, VA.—It is stated that the Long-Distance Telephone Company, of Virginia, will complete the line connecting Newport News, Williamsburg and Richmond within 30 days.

GRAFTON, W. VA.—The People's Telephone Company has been reorganized at Grafton, W. Va., and will be known as the Taylor, Preston & Barbour Telephone Company. The line penetrates the counties named and will be put in first class order.

PARKERSBURG, W. VA.—A deal has been closed here whereby the lines owned by the West Virginia Telephone & Telegraph Company, formerly operated by the Bell Company, pass into the possession of A. C. Davis, G. A. Davis and R. H. Rutherford, all of them local capitalists and interested in the West Virginia and Western Telephone Company. The lines purchased extend from this city to Volcano and through a part of Ritchie County.

RACINE, WIS.—Four men were sentenced a few days ago to five months in jail for stealing 2000 lbs. of copper wire from the Wisconsin Telephone Company.

SPOKANE, WASH.—The Pacific States Telephone Company has absorbed its only rival in the Inland Empire, the Spokane & British Columbia Telephone & Telegraph Company. The $205,000 damage suit of Spokane & British Columbia Telephone & Telegraph Company against the Inland Telephone & Telegraph Company was settled out of court, and there is a rumor out to the effect that the former company has been absorbed by the latter.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Tuolumne River Mining & Power Company was recently incorporated, with Los Angeles, Calif., the principal place of business. Directors: L. M. Gregory, R. B. Dickinson, E. B. Landt, H. V. Cator and S. V. Landt. Capital stock, $200,000.

SAN FRANCISCO, CALIF.—The People's Gas & Electric Company has been incorporated, with San Francisco as the principal place of business. Directors: G. D. Clark, F. G. Breekman, F. J. Byington, B. F. Clark, W. M. Abbott, G. A. Stutevant and C. O. Gale. Capital stock, $3,000,000; subscribed, $700.

NORWALK, CONN.—The Heating & Lighting Corporation has been incorporated here.

ATLANTA, GA.—A. E. Thornton, J. L. Anderson and W. R. Power have filed application for an injunction against Joseph S. Sliver and others, asking that the defendants be restrained from building a dam six miles above Bolton across the Chattahoochee, alleging that the dam would change the course of the stream. This action is regarded as the opening fight between the two corporations formed to build power plants on the Chattahoochee. A temporary restraining order was granted and the case will be heard later.

INDIANAPOLIS, IND.—The American Light & Water Company has been incorporated here.

WINDFALL, IND.—The town trustees of Windfall have approved the estimate for an electric light plant and are now inviting bids for the construction of the plant.

BATESVILLE, IND.—The American Furniture Company, of this city, has completed and installed an electric plant at a cost of $25,000. The company will furnish light to the city and light and power to other manufacturing enterprises

INDIANAPOLIS, IND.—The Council has decided to refuse to ratify any contracts made by the city administration for electric lighting between now and the city election in October. The whole franchise question is sure to get into the campaign and the people generally are calling on the Council to stand firm, as no interests will suffer by the delay. The belief is general that there has been an attempt to favor one of the two prospective bidders. The court, having enjoined the letting under the original specifications, the amended specifications are equally objectionable on the ground of discrimination. Hence, the Council will hold the matter up, and if necessary another appeal to the court will be taken.

INDIANAPOLIS, IND.—The new specifications for the electric lighting contract for this city have been held up again on the ground of discriminating against the Indianapolis Light & Power Company, in that they require enclosed arc lamps, the latter company now using open arcs. The matter of merit was submitted to Professor Goldsborough, of Purdue University. For two years, he says, experiments have been conducted at Purdue University under his direction at a considerable outlay of time and expense on these two types of lamps, and the results obtained have been of the highest value to the electrical profession. The Professor concluded by advising the city to adopt the enclosed arc lamps with the amount of reserve power specified and install the most improved and modern machinery. If this is done the citizens would never have cause to complain of their illuminating facilities, and the city would be one of the best illuminated in the country.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company has submitted a proposition to sell its electric light and water works plant to the city for the sum of $140,000.

READING, MICH.—This town is to have an electric light plant of its own; the appropriation has been made, contracts have been signed, and all that now remains is for the contractors to perform their work.

MAUTON, MICH.—The municipal lighting plant here has at last been completed. While not so quickly as was at first anticipated, it is nevertheless now running, and the villagers are having a sort of a celebration in honor of the event.

GRAND RAPIDS, MICH.—The Michigan Soldiers' Home a short time ago closed a contract with the General Electric Company for a 60-kw, 125-volt generator, direct-connected to an Ideal engine, set ready to run, and including all instruments, wiring, etc. The Home is also making extensive alterations and additions to its power-house and pumping station.

GRAND RAPIDS, MICH.—The Masonic Home, located near the outskirts of the city, is now installing a system of storage batteries and motor-generator for lighting its building and running an electric hoist which was formerly operated by hydraulic power. The current for operating the motor-generator will be furnished by the Grand Rapids Railway Company.

GRAND ISLAND, NEB.—The City Electric Light & Ice Company has been incorporated, with a capital stock of $200,000.

AUBURN, NEB.—The Auburn Mutual Light & Power Company has been incorporated, with a capital stock of $30,000.

FREMONT, OHIO.—The water in the Sandusky River dropped to such a low point last week that the lighting plant was obliged to close down, leaving the city in darkness.

GENEVA, OHIO.—The Geneva Electric Lighting Company has been given a contract to light the village streets until the Everett-Moore syndicate completes its plant here, when it is to have the contract.

LIMA, OHIO.—Joseph Mayer, president of the Lima Electric Light & Street Railway Company, has secured a franchise to install a steam heating plant in this city, to be operated in connection with the lighting plant.

CLEVELAND, OHIO.—The County Commissioners have decided to readvertise for bids for the equipment of a lighting plant to furnish current to illuminate the various county buildings. George S. Rider is engineer for the city.

BOWLING GREEN, OHIO.—The Citizen's Electric Light & Power Company has been absorbed by a new company, to be known as the Bowling Green Light, Heat & Power Company. It is stated that the company will furnish power to two electric railways, besides illuminating the city.

BARBERTON, OHIO.—O. C. Barber, the millionaire match manufacturer, and founder of this town, has made a proposition to the village Council to build a $75,000 water works and electric light plant, if the Council will agree to drive wells on his property and give him the use of water mains in use. The proposition was accepted.

DOYLESTOWN, OHIO.—A number of citizens have secured an injunction restraining the Council from issuing bonds for the purpose of building a municipal lighting plant. At the time of the election to pass the issue of bonds, it was understood that the plant was to be furnished as a bonus to secure an electric railway, but the project has been abandoned and the majority of people are now averse to a municipal plant.

CINCINNATI, OHIO.—General Manager W. F. White, of the new combination of Cincinnati illuminating interests, the Cincinnati Gas & Electric Company, has been entertaining a dozen bidders on machinery, etc., to be taken out of the to be dismantled plants. Among these are included the plant of the Cincinnati Gaslight & Coke Company, the First Cincinnati Edison Company, the Brush Electric Company, and the Jones Bros. Electric Company, which latter will not be dismantled until the first of the year.

CLEVELAND, OHIO.—Evidence that the Everett-Moore syndicate proposes to engage in the electric lighting business in points touched by its traction lines is shown by several recent developments. The recent purchase of the system of the Toledo Traction Company included a large lighting plant, and through a consolidation last week of the Sandusky city lines with the interurban roads radiating from that point, the syndicate secured control of the plant of the Sandusky Gas & Electric Company. At Geneva, Ohio, Fred. Storm, a prominent member of the syndicate, has secured a contract to furnish light to the city, and it is announced that the plant will be operated in connection with the plant for the extension of one of the traction lines to Geneva and Ashtabula. This plant will be built at once. At Akron, Ohio, the Northern Ohio Traction Company, one of the syndicate properties, holds a contract to light the city, and the same is true at Barberton. It is reported at Massillon that the syndicate has secured an option on the plant of the Massillon Light, Heat & Power Company. The syndicate is building a branch line to Massillon.

HAMILTON, ONT.—The Napanee Electric Light Company has absorbed the John R. Scott Company, which controlled the lighting along the Napanee River.

KINGSTON, ONT.—The arbitration proceedings to determine the value of the electric light and gas plants in this city, is progressing slowly. The expenses are stated to be $600 per day. The company says that its electric plant is worth $97,000, and it has a guaranteed offer of $120,000 for it and its franchise. The arbitration will last for some time.

OTTAWA, ONT.—The work of setting the plant for the lighting of Lachine Canal by electricity has been commenced, and will, it is expected, be completed in time for next season's business. The Canadian Electric Company has been given the contract for building the machinery, and Messrs. Ahearn & Soper, of Ottawa, have the contract for the poles and wires. The Government is building a power-house at St. Paul, and with the completion of the entire work, the canal will be lighted, for the first time, by electricity entirely.

OTTAWA, ONT.—The new No. 2 power-house of the Ottawa Electric Company is constructed of concrete, brick and iron. It will be equipped with Westinghouse alternating-current generators, rotary converters and induction motors, also arc machines, of the Western Electric Company's make. The units will consist of three 700-kw machines direct-connected to water-wheels, and two 700-kw belted to water-wheels; the arc machines will be of 150 lights capacity, direct-connected in pairs to induction motors. There will be six of the latter units. The plant will also contain 250 cells of chloride accumulators, and Westinghouse boosters. There will also be a Wheeler tandem-compound condensing engine of 1000-hp.

LANCASTER, PA.—The Lancaster County Railway & Light Company has awarded contracts for a power plant, to cost $500,000. The company will furnish power to all the electric car companies and electric lights to all the villages and boroughs in the county.

WHARTON, TEX.—A franchise has just been granted by the Commissioners of Wharton County for the establishment of a big electric plant at El Campo and the right to string wires along the public highways. The scheme is to supply power to the pumps which are used to flood the rice fields in this section, and which are now costly to operate by the single traction engine process. The projectors of the enterprise are also interested in the rice business, and own a big canal. They believe that the demand for the power will be so great that there will be a profit after they have paid the expenses of the plant and of operating their own machinery.

RICHMOND, VA.—The Virginia Electrical Railway & Development Company will greatly enlarge its plant on James River. When the contemplated improvements are made, the capacity will be 12,000 horse-power. Something like $200,000 will be spent in the proposed improvements. Plans are now being prepared. The power-house will be enlarged and room made for more machinery for the conversion of the river's power into electrical power.

EVANSVILLE, WIS.—The Evansville Water, Light & Power Company has been incorporated, with an authorized capital stock of $10,000.

LA CROSSE, WIS.—The new consolidated lighting company has asked for a 25-year extension of its franchise. The present franchise of the company expires in 1907

MILWAUKEE, WIS.—The Wisconsin Bridge & Iron Company is enlarging its electric power plant. A new switchboard and an additional 50-kw generator and also 20 motors will be installed.

LA CROSSE, WIS.—An entire block in the business part of this city will be lighted electrically. The power is to be furnished by an isolated electric plant installed by the property owners in that block wishing electric lights. The rates charged by the new lighting company which bought out all the plants in the city are considered exorbitant, and for this reason the independent plant is to be built. It is probable that other plants will be established.

The Electric Railway.

BESSEMER, ALA.—The city has granted a franchise to the Steel Cities Railway Company, R. F. Hanneman representing the company. The company proposes to connect Ensley, Ala., and Bessemer, a distance of about seven miles.

BIRMINGHAM, ALA.—The stockholders of the Birmingham Railway, Light & Power Company, in accordance with the recent deal consolidating the several properties, have increased the directorate by adding six members to the Board. The officers are: William Jemison, president; William A. Walker, vice-president; J. P. Ross, secretary and treasurer.

NEW HAVEN, CONN.—The incorporators of the Windsor Locks and Rainbow Street Railway Company, which was chartered at the recent session of the general assembly, have organized by electing the following officers and directors: President, Henry A. Huntington, Windsor; Secretary and Treasurer, Frank E. Healy, Windsor Locks.

DANBURY, CONN.—The promoters of the interstate trolley line being built between Danbury, Conn., and Golden's Bridge, N. Y., seventeen miles, state that the road will be opened for traffic not later than December 1. Delays from the excessive prices which owners put upon land desired for rights of way have been practically overcome, and the construction force is being largely increased. The company has issued $300,000 stock and $200,000 bonds, which has not all been disposed of.

EAST ST. LOUIS, ILL.—The proposed electric line from East St. Louis to Chester, passing through Millstadt, Columbia, Waterloo, the Mammoth Cave grounds, and Red Bud, is now a certainty. The St. Louis and Belleville Suburban Railway Company, which is the promoter, has a line to Collinsville and Edwardsville, and is building between O'Fallon and Lebanon, with the expectation of completing it in four months.

KANSAS CITY, MO.—A syndicate of Boston people are considering a project to build a high-speed electric road between Kansas City and St. Joseph, Mo., a distance of fifty-three miles. Such a project would require the building of a bridge across the Missouri River at a cost of about $1,000,000, and the plan involves an expenditure of between $2,500,000 and $3,000,000. At the present time these cities are connected by two roads, the Burlington and Chicago Great Western, but the distance by steam road is sixty-two miles. If the electric road as contemplated is built the time between the two cities would be cut down, and fares cut in half. The road would do a freight as well as a passenger business.

WATERVLIET, N. Y.—The Common Council of Watervliet has dealt the United Traction Company a blow by refusing the application of the corporation for new franchise privileges.

ALBANY, N. Y.—A suit has been begun by the United Traction Company to recover damages from the City and County of Albany on account of the destruction of cars and other property during the strike. The suit is based upon the alleged failure of the authorities to afford the company ample protection.

LOCKPORT, N. Y.—At a recent meeting of the Elmwood Avenue & Tonawanda Electric Railway Company the following directors were elected: W. Caryl Ely, William B. Rankine, Burt Van Horn, Francis Lynde Stetson, T. Dewitt Cuyler, Robert Bacon, Daniel S. Lamont, E. G. S. Miller and Joseph B. Mayer.

WHITE PLAINS, N. Y.—The New York and Stamford Railway Company has formed at White Plains with a capital of $500,000 to build a through trolley line to Boston. The company represents the consolidation of the Larchmont and Port Chester electric companies, which now operate trolley systems from Larchmont to Port Chester. The new company is now building a road to Greenwich, and as soon as this line is completed the road will be extended to Stamford and afterward to Boston.

LIMA, OHIO.—The County Commissioners have granted the Defiance, Ottawa, Kenton & Columbus Interurban Railway the right of way through this county.

WARREN, OHIO.—Work has been started on the erection of the Mahoning Valley electric line from Warren to Leavittsburg. By October 1 electric cars will be available from Leavittsburg to New Castle, Pa.

TORONTO, ONT.—Plans and profiles for the Fort Erie Ferry Electric Railway have been submitted to the Minister of Public Works for approval at Toronto, Ont. The plans show an electric road running along the bank of the Niagara River, from Chippewa to Fort Erie, a distance of about twenty miles.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has been incorporated, the capital stock being $100,000. The object of the company is stated to be an electric line between the cities named. Incorporators: Ellis Bartholomew, Wm. P. Hester, Wm. T. Stephens, Samuel Chester and Claude Wyant. The headquarters of the company are at Toledo.

UPPER SANDUSKY, OHIO.—The County Commissioners have granted Dr. O. C. Stutz, as trustee, the right of way to construct an electric interurban railway from this city to the county line beyond Sycamore. The road will run north to what is known as the Kilbourne road, one mile north of here; thence northeast through Belle Vernon to Sycamore, and from Sycamore to Melmore and Tiffin.

TORONTO, ONT.—The Toronto Railway Company contemplates making some extensions.

OTTAWA, ONT.—The Huron, Goderich & Middlesex Electric Railway Company, of Goderich, Ont., has been formed to construct an electric railway from Goderich to Wingham and Seaforth, Ont.

OTTAWA, ONT.—The electric street railway company, of Ottawa, proposes to elaborately decorate its lines in view of the royal visit at the capital next month, and all the cross wires on the principal streets will be hung with colored lanterns. The estimated cost of this work amounts to many thousands of dollars.

ELLWOOD CITY, PA.—The Ellwood Street Railway Company has been formed; capital, $9,000. President, A. W. K. Billings, Pittsburg.

MECHANICSBURG, PA.—The Star Street Railway Company has been formed. The line is three miles long, to Bowmansdale; capital, $18,000.

BLOOMSBURG, PA.—The Bloomsburg & Benton Street Railway Company has been incorporated; capital, $120,000. President, William S. Moyer.

QUAKERTOWN, PA.—The absorption of the Quakertown Traction Company by a company which is building a road southward from Bethlehem is practically completed. This new road to Quakertown will give a continuous line from Allentown to Philadelphia.

SCRANTON, PA.—The agreement has been signed by the city and the Coalville and the Wilkesbarre & Wyoming Traction Company by which the company in return for the franchises on a number of streets gives the city $15,000 in cash and agrees to do paving worth $35,000.

SOUTH BETHLEHEM, PA.—The South Bethlehem & Center Valley Street Railway Company, six miles long, has been formed to run from South Bethlehem to Soudersville, to Colesville, to Friedensville, to Center Valley and return. capital, $36,000. M. Hale Jones, of Easton, is president.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company, whose trolley lines are to connect McKeesport and Uniontown and most of the smaller towns between those points, is making preparations for the construction of about twenty five miles more of track, on branches between the two main points.

YORK, PA.—The York & Dallastown Electric Railway has been opened. The road is seven miles long and is the first of a number of trolley lines that will be built from York by the York County Traction Company. William H. Lanius is president of the company. The company is also building a line from York to Dover, where it will connect with the Harrisburg and Mechanicsburg lines.

LANCASTER, PA.—The capital stock of the Lancaster & Mount Joy Electric Railway has been increased from $78,000 to $400,000, and arrangements have been made by the company for leasing its line to the Conestoga Traction Company for 999 years, at an annual rental equal to 6 per cent interest upon the actual cost of the road.

SEWICKLEY, PA.—The following new corporations have been filed: The Wampum & Hoytdale Street Railway Company; capital, $15,000; President, Richard R. Quay. Hoytdale & Beaver Falls Street Railway Company; capital, $30,000. Moravia & Wampum Street Railway Company; capital, $9,000. Wampum Street Railway Company; capital, $6,000. The officers of these three companies are the same as those of the Wampum & Hoytdale Company. New Castle & Moravia Street Railway Company; capital, $30,000; President, Richard R. Quay.

HARRISBURG, PA.—The following companies have been chartered here: The Beaver & New Brighton Electric Street Railway Company, to build a line five miles long; capital, $30,000. The Beaver Falls & New Brighton Electric Street Railway Company, to build a line four miles long; capital, $24,000. The Freedom & North Rochester Electric Street Railway Company, to run from Freedom, through Rochester and return, a distance of three miles; capital, $18,000. The Union Electric Street Railway Company, to build a line one mile long; capital, $6,000.

POTTSTOWN, PA.—The Ringing Rocks Traction Company has been granted a charter to connect with the Ringing Rocks line and Boyertown. It will run nine miles through a thickly-settled territory, and its route will touch New Berlinville, Morysville and Fagleysville. Three other companies, the Boyertown Electric Railway Company, the Boyertown & Limerick Company and the Pottstown & Sanatoga Company, were all after the same route. The company's capital stock is $54,000, and the officers are: President, Lynn Q. Guldin, of Reading, A. K. Shaner, Ralph E. Shaner and Dr. W. B. Shaner, of Pottstown; L. E. Lefever, of Boyertown, and Cyrus Q. Guldin.

PITTSBURG, PA.—The Councils of Allegheny City last week passed a number of ordinances granting street railroad franchises, which will bring an entirely new element into the street railway business of that city. The men at the head of this new system are the Mellons, powerful bankers of the city of Pittsburg, who also control the Monongahela Traction Company's lines, as well as the Monongahela Electric Light & Power Company. The franchises granted are for the City View Street Railway Company, the Allegheny Hilltop Street Railway Company, the Benton Avenue Street Railway Company, the Howard and East Street Railway Company, the Superior Avenue and Shady Avenue Street Railway Company and the East Street & Evergreen Street Railway Company.

QUAKERTOWN, PA.—The Quakertown Traction Company has just completed a survey for a 12-mile extension from Perkasie to Doylestown. This will give a continuous line from Quakertown to Philadelphia, a distance of about forty miles. The fare for this distance will be about 40 cents, against $1.52 by the Philadelphia & Reading Railroad. Three bridges will have to be erected on the new extension. The contracts for these have not yet been given out. The equipment and roadbed material have already been contracted for. The company will build a new power-house at Perkasie, and abandon the present temporary power-house in Quakertown. All of the equipment for the new plant has been ordered. Mr. W. H. Davies is treasurer and general manager of the company.

PITTSBURG, PA.—The following new corporations have been filed: The Sheridan Avenue Street Railway Company; capital, $6,000; President, Thomas S. Bigelow. The Atlantic & Neville Street Railway Company; capital, $6,000; Matilda & Dauphin Street Railway Company; capital, $12,000. The officers of these companies are the same as those of the Sheridan Avenue Street Railway Company. The Kentucky Avenue & Howe Street Railway Company; capital, $12,000; President, Thomas S. Bigelow. Bellefield Street Railway Company; capital, $3,000; President, Thomas S. Bigelow. Bellefield & Oakland Street Railway Company; capital, $9,000; President, Thomas S. Bigelow. Stanton Avenue Street Railway Company, Pittsburg; capital, $3,000; President, John Jenkins, Pittsburg. Beatty Street & Highland Park Street Railway Company; capital, $75,000; President, John Jenkins. The East End & Wilkinsburg Street Railway Company; capital, $12,000.

SAN ANTONIO, TEX.—The San Antonio Traction Company has commenced work on the West End line.

EL PASO, TEX.—The City Council has granted an amended franchise to the Goodrich Street Railway Company.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has placed an order for 150 tons of street car rails with the Pennsylvania Steel Company of Pittsburg. This is the first step in the improvements of the road since the issue of $350,000 in mortgage bonds for that purpose.

NASHVILLE, TENN.—The Hambleton syndicate has withdrawn from active control in the Nashville Railway Company and the Nashville Electric Light & Power Company. Percy Warner has been elected president of both companies. The Nashville railway was placed in the hands of a receiver some time ago, but all outstanding bonds were not represented in the litigation.

CHARLESTON, W. VA.—The Charleston & Kanawha Valley Power & Railway Company has been chartered; capital, $500,000. It is proposed to build an interurban electric railway to Montgomery and St. Albans. Howard T. Goodwin, John W. Coburn and C. M. Coburn, of Philadelphia; E. D. R. Sutton, of Wilmington, Del., and T. J. Carmack, of Charleston are the incorporators.

WHEELING, W. VA.—The contract for grading, masonry, trestling and furnishing timber for the construction of the new Panhandle Traction Company line has been awarded to Stringer & Hallock, of Wheeling, for $190,000. The contract for the rails was let to the Cambria Steel Company, Johnstown, Pa. This is the electric line between Wheeling and Wellsburg, and cars will run between the two points in about 45 minutes.

JANESVILLE, WIS.—Franchises are being asked for an electric railroad to run between Geneva Lake and Janesville, through Elkhorn and Delavan, a distance of thirty-four miles. Philadelphia capital is back of the deal.

MADISON, WIS.—Mr. P. L. Spooner is promoting an electric railway to connect Madison with Janesville, via Stoughton and Edgerton, a distance of about 40 miles. Mr. Spooner expressed himself as very sanguine of the building of the line.

MADISON, WIS.—Work has been begun on the erection by Philip L. Spooner of a $20,000 electric power-house to furnish power for the Madison street railway system, of which he is president, until the power from the Kilbourn dam is brought into service.

WEST SUPERIOR, WIS.—The Duluth-Superior Traction Company has had its franchise extended 12 years. The company's franchise is at present good for 18 years, but in order to make contemplated improvements in its present system an extension was desired.

GRAND RAPIDS, WIS.—That an electric line will shortly be constructed between this city and Stevens Point is now an assured fact, and this will be the beginning of a road which will traverse the whole length of the Wisconsin River Valley. The stretch which will be completed first is about thirty miles in length, and the water power of the valley will be utilized.

OSHKOSH, WIS.—The Winnebago Street Railway Company has been sold by Emerson McMillin & Company to F. S. Donnell and Boston associates. The deal was consummated August 12. The company is capitalized at $650,000, and owns about 25 miles of tracks, including a line from this city to Neenah. The distance between the terminals of the Fond du Lac electric line and the Oshkosh line is about 14 miles and a line covering this distance will probably be built.

THE AUTOMOBILE.

THE STUDEBAKER WAGON & CARRIAGE WORKS, of South Bend, Ind., has entered upon the manufacture of automobiles.

AUTOMOBILE RACES AT NEWPORT.—The announcement is made that the races of the National Automobile Racing Association at Newport will take place on the afternoon of Aug. 30, as follows: Once around the course for tricycles and two-wheeled vehicles for two prizes; once around the course for all classes of steam vehicles, two prizes; once around the course for electric racing machines, two prizes; once around the course for special class of De Dion five-horse-power voiturettes in ordinary running trim, two prizes; once around the course for gasoline vehicles not developing more than twelve horse-power, two prizes; once around the course for gasoline vehicles developing more than twelve horse-power, and once around the course for winners in all classes. The prizes are cups offered by John Jacob Astor, Mr. and Mrs. O. H. P. Belmont, Mrs. Herman Oelrichs, J. Livermore, Mr. Drexel, Mr. and Mrs. W. K. Vanderbilt, Jr., H. O. Havemeyer, Jr., the National Automobile Racing Association, and others. The start in the first race will be made at 2 P. M. from "Crossways," and the course is nine miles. Entries will be received until midnight on Aug. 28, and may be sent to W. K. Vanderbilt, Jr., or the Association at the Reading Room, Newport. The races may, however, be prevented by an injunction obtained by some of the residents.

NEW INDUSTRIAL COMPANIES.

THE STERLING ELECTRIC MOTOR COMPANY has been incorporated at Dayton, Ohio, with a capital stock of $30,000.

THE ELECTRO-CHEMICAL REDUCTION COMPANY has been incorporated at Helena, Mont., with a capital stock of $50,000.

THE NORTH AMERICAN CARBIDE COMPANY, of Newark, N. J., has been incorporated to manufacture carbide; capital, $100,000. Incorporators: William H. Wells, Joseph P. Wiswall, Charles E. Wiswall.

THE DUNMOLIN-PIERCE ELECTRIC SMELTER COMPANY, of Jersey City, N. J., capital $200,000, has been incorporated by Leonard Dunmolin, Simeon Pierce, Charles Burton, Edw. A. Greeley, John A. Quinn.

ALBANY, N. Y.—The Consolidated Battery Company, of New York City, has been incorporated, with a capital stock of $1,000,000, to manufacture electric apparatus. The directors are Daniel C. Knowlton, Arthur A. Mosher and Wm. C. Nicholas, of New York City.

THE COOPER ELECTRIC RAILROAD GATE COMPANY has been chartered at Dover, Del., to deal in all kinds of electrical work, motors, etc. Incorporators: Thomas O. Cooper, Wilmington; John L. Hall, Philadelphia; James F. Dunleady, Camden, N. J. Capital, $150,000.

THE NEW STORAGE BATTERY COMPANY, of Boston, was chartered at Dover, Del., Aug. 22, to manufacture the Redding new storage battery. Incorporators: Jerome Redding and I. W. Deering, of Boston; L. D. Lathrop, of Gloucester, Mass., and Gardner W. Kimball, of this city.

THE NATIONAL AUTOMATIC FIRE ALARM COMPANY has applied for a charter at Atlanta, Ga; capital, $50,000. J. M. Stevens, G. T. Crawford and others are interested. The company in its petition states that it desires to establish a system of electric fire alarms, to construct plants for manufacturing equipment, etc.

ALBANY, N. Y.—The Swan Electric Manufacturing Company, of New York City, has been incorporated, with a capital of $250,000, to "construct and operate plants for the production of electricity and to manufacture electrical appliances." The directors are William J. Swan, William J. Berg, Herman A. Metz, Daniel Nason and John S. Comfort, of New York.

LEGAL.

SUSTAINING TESLA PATENTS.—In the United States Circuit Court of Appeals, for the Second Circuit, Judge Shipman has handed down a decision confirming that of Judge Townsend sustaining the Tesla patents, Nos. 381,968, 382,279 and 382,280, which relate broadly to the polyphase system or rotating field. The case is the well known one of the Westinghouse Electric & Manufacturing Company against the New England Granite Company. Another decision has also been given by Judge Lacombe, in the United States Circuit Court, Southern District of New York, in the case of the Westinghouse Electric Manufacturing Company against the Catskill Illuminating & Power Company for infringement of what are generally known as the Tesla "split phase" patents Nos. 511,559 and 511,560, of Dec. 26, 1893. The judge holds that the meter in suit infringes both claims of the first patent, and the first claim of the second patent named.

OBITUARY.

O. B. CHASE.—The death is announced of Mr. Orville B. Chase, secretary of the Chase Construction Company, Detroit, Mich., in an accident.

MR. H. MACKENZIE.—Hector MacKenzie, head of the well known wholesale dry goods firm of J. G. Mackenzie & Company, of Montreal, and vice-president of the Montreal Telegraph Company, died last week.

PERSONAL.

PRESIDENT C. A. COFFIN, of the General Electric Company, has sailed again for England.

DR. A. E. KENNELLY has an interesting article in the *Saturday Evening Post* on the development of telegraphy.

MR. C. O. BAKER, JR., has just returned to the city, after a prolonged absence, and is well and hearty, but quite reticent about his foreign travels.

MR. GEORGE WESTINGHOUSE returned from England last week, having, it is said, transacted some very important business while abroad.

PROF. J. J. THOMSON has in *Harper's Magazine* for September an excellent popular article on the cathode rays, Röntgen rays, etc., and their relation to the corpuscular theory that he has been advancing.

DR. M. I. PUPIN contributes to the *Cosmopolitan Magazine* an excellent article on recent work in electrical science and discovery. It accompanies a series of articles relative to the Pan-American Exposition.

MR. CAMPBELL SCOTT, the secretary and general manager of the C & C Electric Company, of New York, sailed for England on the "Oceanic" on Aug. 21, to be gone about three or four weeks on business for his company.

MR. A. R. BREWER, the well known secretary of the Western Union Telegraph Company, has just issued an admirable, illustrated brochure, celebrating the jubilee of the company and narrating the interesting story of its growth.

MR. T. P. McCRAY, who was formerly with the New York Telephone Company, has purchased the contracting and wiring business of Mayers & Company, of Fairmont, W. Va., and will continue it under the name of McCray & Wayman, doing business throughout a large section of West Virginia.

MR. B. J. ARNOLD, of Chicago, has, it is rumored, been retained by the New York Central Railroad on the work of electrifying the terminal tunnel in New York City. It is further reported that Mr. Arnold has been commissioned to study the problem of operating electrically the whole road between this city and Albany.

MR. A. J. J. PFEIFFER, until recently with the Compania Thomson-Houston della Mediterranea, of Milan, Italy, has completed the third rail, high speed, electric traction work on the old steam road, Milan-Gallarate-Varese-Porto Ceriso, which he went to Milan to study and execute some two years ago. He has now severed his connection with that company, and has gone to London to identify himself with the J. G. White & Company interests there. In this country Mr. Pfeiffer was connected with the General Electric Company.

Trade Notes.

THE ELWELL-PARKER ELECTRIC COMPANY, of Cleveland, Ohio, is putting up a two-story addition to its main building.

CHANGE OF NAME.—The Victor Telephone Manufacturing Company, of Chicago, has changed its name to International Globe Company.

THE NATIONAL BRIDGE COMPANY, of 45 Broadway, New York, have just just completed the erection of a bridge for the Lehigh Valley Railroad at Copley, Pa.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, have recently made a large shipment of Cross oil filters and Burt exhaust heads to Copenhagen, Denmark.

CATALOGUES WANTED.—The Central Electric Company, 101 North Fourth Street, Harrisburg, Pa., desires to receive catalogues and price lists from manufacturers of electrical house goods.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has just issued a "Complimentary Meter Book." This book is a small edition of the regular F. & H. meter book, and is being sent free to the trade.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, Boston, Mass., reports that the demand for its goods has increased to such an extent that it has been obliged to move its factory to larger quarters at Quincy, Mass.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, recently organized in Niles, Ohio, has commenced the manufacture of incandescent lamps. Only a few hands are at work at present, but the number will be increased to the full capacity of the plant in the near future.

COAL HANDLING MACHINERY.—A general idea of the line of machinery manufactured by the Jeffrey Manufacturing Company, of Columbus, Ohio, is obtained from a little pamphlet of recent issue by that company. The pamphlet contains illustrations showing the various uses to which this conveying apparatus can be adapted.

RESISTANCE UNITS.—Bulletin No. 8, just issued by the Carpenter Enclosed Resistance Company, 79 East 130th Street, New York, contains a price list of Carpenter resistance units of various sizes. These units are stated to have an ample margin of safety for overload, low temperature rise, and will not burn out in service.

THE NATIONAL BATTERY COMPANY, of Cleveland, Ohio, manufacturer of the Sperry storage battery, is preparing to remove its plant from Cleveland to Buffalo, where the plant is to be run with power from Niagara Falls. An office has been established in Buffalo. Mr. J. P. Devine, formerly a branch manager for the American Bicycle Company, has accepted the position of manager of the National Battery Company.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., reports that it has been obliged to run its bevel gear planing machines nights during the past week in order to rush through a number of large bevel gear wheels to repair a breakdown for a big New England wire drawing concern. The bevels are of cast iron with teeth planed accurately to cone lines, and are to take the place of cast gearing.

JUBILEE EXHIBIT.—In a pamphlet just issued is given a report of the Jubilee Exhibit held in connection with the Jubilee International Convention of the Young Men's Christian Associations of North America, in Boston last June; also a report of the boards of judges and lists of awards of merit. Several full-page illustrations show exhibits of Associations from different cities. Mr. Geo. B. Hodge is secretary of the Educational Department.

FUSE BLOCK.—In our issue of Aug. 3 was described and illustrated a new fuse block, the invention being ascribed to "Mr. W. R. Goodwin," of the Chicago Fuse-Wire & Manufacturing Company. The types unfortunately gave the credit to the wrong man, in changing the name Goodman to Goodwin. The friends of Mr. Goodman no doubt, however, recognized in the published name that of Mr. W. R. Goodman, manager of the company.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently marketed, under its own name, a new dry battery called the "Wesco." It states that this battery is meeting with an extremely flattering success, as the demand is very large. The company is also getting out a new brand of friction tape called "Wesco." It has done this to fill a long-felt demand for tape which is moderate in price, and at the same time first-class in quality.

TRAVELLING CRANES.—The Cleveland Crane & Car Company, of Cleveland, Ohio, manufacturer of electric traveling cranes, reports a very satisfactory demand during the usually quiet summer months. It is furnishing a 30-ton, 4-motor electric crane with 75 ft. span, to the J. S. Coxey Foundry Company, Mt. Vernon, Ohio; a 15-ton, 3-motor crane, with 50-ft span to the Boston Elevated Railway Company, Boston, and a number of smaller shipments.

220-VOLT LAMPS.—The Central Electric Company, of Chicago, claims a high quality for the Columbia high-volt lamps, and solicits a trial order, which it believes will convince the purchaser as to their superiority. The Columbia 110-volt lamps have proven a success for the past twelve years, and from the outlook its 220-volt lamps will enjoy the same experience. The Central Electric Company carries a large stock of lamps in all voltages and candle powers, also street railway lamps.

SIGNS OF THE TIMES.—The Electric Motor & Equipment Company, 12 Beaver Street, Newark, N. J., has issued a very complete catalogue of 80 pages describing its electrical decorative devices and advertising effects. Many of these devices have moving parts, and others produce the effect of movement by the alternate illuminating and extinguishing of adjacent lamps of different colors. This field is a rapidly growing one, and the catalogue will be of interest to those in this expanding trade.

THE ONONDAGA DYNAMO COMPANY, of Syracuse, N. Y., has just added to its types of "power producers" a special motor (6 and 8-pole) for running printing presses and tools requiring slow and variable speeds. These motors run at from 100 to 200 revolutions and in their construction space is economized to the highest degree. Their compactness is shown in the statement that a 10 horse-power at 200 revolutions is only 35 inches extreme diameter. Already these neat little machines are meeting with a ready sale.

THE SPRAGUE ELECTRIC COMPANY has been obliged to run the New York factory at night for some time to meet the demand for its flexible conduits for interior wiring. The new flexible products are very popular, and will continue the reputation for superiority that the Sprague Company's conduits always have enjoyed. The superior qualities of the Greenfield flexible steel armored conductors and cords are simplicity of installation, thorough protection of wire and insulation from mechanical and other injury, and high grade insulation at low cost.

GRAPHITE FOR AUTOMOBILES.—The Joseph Dixon Crucible Company, Jersey City, N. J., has developed a new field for the application of graphite, namely, for steam, gas and electric automobiles. In a little 12-page pamphlet published, some experiences with graphite lubrication of automobile bearings are given. It is pointed out in the pamphlet that graphite has a strong mechanical affinity for metallic surfaces and makes a veneer-like coating of marvelous smoothness and endurance. The company will be glad to send samples of its graphite lubricants to responsible and interested parties.

THE GRANT TOOL COMPANY has removed its plant from Cleveland, Ohio, to Franklin, Pa., and is prepared to fill orders from its new factory. Mr. John J. Grant, who has had a long and comprehensive experience, has personally designed the tools built by this company, which are unique in many of the details of their construction, as the result of his careful personal attention. The line includes hand lathes, upright drills, milling machines, positive taper stud and bolt lathes, automatic worm-wheel cutting machines, heavy turret chucking and turning machines, etc. The catalogue the company issues is well worth studying.

DURAX GLASSES.—Messrs. Schaffer & Budenberg, Brooklyn, N. Y., are placing upon the market a new steam gauge glass known as "Durax Glass." This glass is stated to be an improvement on the compound glass introduced in this country some years ago and known as the "Jena Compound Glass." The Durax glasses have a light blue stripe as a trade mark, which distinguishes them from all other gauge glasses. In a circular of recent issue the firm gives a table of results of comparative trials with these glasses to determine the resistance against sudden changes of temperature and drops of cold water blown against them. According to the table Durax glasses appear to be four to six times stronger than the average English or French glass, and have such an advantage over compound glasses as to justify their use in preference. Durax glasses are recommended for use on all boilers, especially those exposed to the weather and sudden change of atmospheric temperatures.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, general sales agent for the Browning Manufacturing Company, reports that the success of the new type small Browning generators and motors has been extremely gratifying. Wherever it has installed them, they have given entire satisfaction. It further states that these small machines are the very highest grade obtainable, the material and workmanship the best, being tested by four-hour run at a 10 per cent overload and a one-hour run at a 50 per cent overload before leaving the factory. They are made of the best cast dynamo steel, slotted armatures, with self-oiling bearings and carbon brushes. These machines were especially designed to fill a long-felt want, that is, a perfect small motor or generator. They are made in sizes from 1-5 to 3½-hopse-power and from ⅙ to 2½ kilowatts. They are especially adapted for both heavy and light work and are sold under the strongest guarantee. The company has got out a very attractive Bulletin on these motors and dynamos, which will be sent on application.

FIRE IN "NEW STANDARD" BATTERY WORKS.—A disastrous fire broke out early Monday morning, Aug. 19, in the five-story building occupied exclusively by Wm. Roche, the manufacturer of the New Standard Dry Battery, at 42 Vesey Street, New York City. The fire was discovered on the fifth floor, where the batteries are manufactured and ingredients prepared. The damage extended to the fourth floor, where the connections on the batteries are made, and where they are packed; and also to the third floor, where the zinc cups are made and the labels are put on. The first and second floors, where offices, shipping and store rooms are located, escaped serious damage, except by water. Mr. Roche stated to a representative of Electrical World and Engineer that his loss would exceed $10,000, partially covered by insurance. He further says that when he remodels the floors that were burned out he will put in new machinery, and will be able to increase his facilities over what they were before the fire. He hopes to be able to resume manufacturing in about a week. Orders were especially plentiful when fir occurred.

DRAKE, BREED & COMPANY.—The firm of Drake, Breed & Company, of Philadelphia, was incorporated July 24, 1901. Messrs. Drake and Breed are both men of long experience in the electric railway field. Mr. Drake was for years the right-hand man of the late Albert L. Johnson, and at the time of the latter's death was at the head of the great electric railway system centering in Allentown with the roads projected and building to connect New York and Philadelphia. He was for a number of years vice-president and general manager of the Nassau system in Brooklyn, and in an important capacity in the street railway system of St. Louis. Mr. Geo. Breed is a graduate of the United States Naval Academy, and was from 1890 until the time of the war with Spain connected with the General Electric and Westinghouse companies. He was retained by Mr. Johnson to design the power stations and supervise the electric equipments of his projected roads. The new company was formed with a view to completing this work and to enable it to push efficiently other large enterprises now in hand.

RUBEROID EXHIBITION ROOFS.—One of the main topics of discussion in Central Europe is the Art Exhibition which will be held at Karlsruhe, Baden, next year. This exhibition is one of great international interest, and its opening will find many American connoisseurs present. The buildings in which it will be held will be works of art. As usual, American products will figure prominently, not alone in the exhibition itself, but in the actual equipment of the magnificent buildings in which it will be held. For instance, the well

known Ruberoid roofing, manufactured by the Standard Paint Company, will cover the roofs of the immense buildings. Through their Hamburg (Ger.) factory, the Standard Paint Company have delivered the very large quantity that is necessary to roof the big structures. Recently a large lot of Ruberoid was delivered to the Russian South West Railway to cover a number of buildings which they are erecting. The Baldwin-Ziegler Polar Expedition took a lot of it. The United States and German troops in China live in barracks roofed with Ruberoid. In the De Beers mines, South Africa, Ruberoid is also in use. From there to the Klondike gold fields is a long jump, but there also is Ruberoid doing duty. Australia, Scandinavia, Germany, Spain, Austria, Italy, Egypt, West Indies, Philippine and Hawaiian Islands—every part of the world, in fact, knows of and uses Ruberoid, which has proved itself adaptable to any climate.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUGUST, 20, 1901.
[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

680,693. PRINTING TELEGRAPH; J. Burry, Fort Lee, N. J. App. filed April 13, 1900. General improvements throughout a printing telegraph instrument designed to increase the speed and efficiency.

680,695. TRANSMITTER FOR EDUCATIONAL PURPOSES; C. S. Comins, Quincy, Mass. App. filed March 26, 1900. A perforated strip transmitter intended to operate a sounder in a local circuit to familiarize the student with the sounds of the different characters.

680,704. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed Nov. 24, 1900. The studs in the roadbed contain a quantity of metallic spherical bodies which are lifted into contact with the head of the stud by a magnet on the car, and thus establish connection between the feeder and exposed conductor.

680,792. ALTERNATING-CURRENT INDUCTION MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed May 24, 1899. (See Current News and Notes.)

680,793. DYNAMO ELECTRIC GENERATOR; B. G. Lamme, Pittsburg, Pa. App. filed June 28, 1900. (See Current News and Notes.)

680,795. STRAP COIL FOR ELECTRICAL MACHINES; J. P. Mallett, Pittsburg, Pa. App. filed Oct. 17, 1899. A strap coil for electrical machines comprising a plurality of separately insulated, complete, side-by-side turns without joints.

680,797. ELECTROMAGNETIC MOTOR OR RECIPROCATING ENGINE; R. D. Mershon, New York, N. Y. App. filed Nov. 2, 1899. (See Current News and Notes.)

680,798. MECHANISM FOR GENERATING VARIABLE ELECTROMOTIVE FORCE; J. E. Miller, Edgewood Park, Pa. App. filed March 1, 1900. Means for producing a variable electro-motive force comprising an electric motor driven from an approximately constant potential circuit, a generator mechanically connected to and driven by said motor, and means for increasing the field magnet strength of the generator and decreasing that of the motor simultaneously, and vice versa.

680,804. ELECTRICALLY PROPELLED VEHICLE; F. J. Newman and J. Ledwinka, Chicago, Ill. App. filed Jan. 18, 1901. A motor embodied in the hub of the wheel, its parts being supported entirely independently of the axle.

680,808. RHEOSTAT; T. S. Perkins, Idlewood, Pa. App. filed Sept. 28, 1898. Comprises a helical, flattened coil of wire in spiral form and a strip of insulating material interposed between adjacent convolutions of the wire.

680,809. SYSTEM OF ELECTRIC LIGHTING ON CONSTANT CURRENT CIRCUITS; H. N. Potter, Halensee, Germany. App. filed Oct. 3, 1900. A pilot lamp is placed in a shunt around a multi-glower lamp and is thrown into circuit when one of the glowers of the main lamp breaks.

680,824. CONTACT DEVICE FOR ELECTRIC RAILWAYS; G. Westinghouse, Pittsburg, Pa. App. filed Feb. 28, 1896. (See Current News and Notes.)

680,834. HOUSE WIRING; F. Bathurst, Southfields, Eng. App. filed Oct. 30, 1899. A conduit having insulating lining, the conduit itself forming one side of the circuit and the inclosed bare conductor forming the other side.

680,848. ZINC ELECTRODE FOR ELECTRIC BATTERIES; W. Erny, Nalle-on-the-Saale, Germany. App. filed March 6, 1901. A spongy zinc amalgam is applied to the side of the zinc cylinder and held in place by a second perforated zinc cylinder.

680,879. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Evanston, Ill. App. filed Dec. 26, 1899. In a central energy system, an arrangement of circuits whereby one annunciator at the switchboard will serve for the calling and ring-off signals.

680,880. CONNECTION REGISTER FOR TELEPHONE EXCHANGES; F. R. McBerty, Evanston, Ill. App. filed Dec. 26, 1899. The register is operated by a polarized electro-magnet, current being sent through the magnet automatically when the called subscriber responds.

680,881. SELECTIVE CALLING KEY FOR PARTY LINES; F. R. McBerty, Evanston, Ill. App. filed Jan. 6, 1900. A key pivoted to move in four different directions to make selective connections.

680,890. CONNECTION COUNTER FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed Dec. 26, 1899. One circuit operates the counter when the called subscriber responds and another circuit locks the counter to render it inert to subsequent changes in the electrical condition of the called line.

680,901. SIGNALING DEVICE FOR CARS; W. W. Ward and J. Kean, Fairmont, Minn. App. filed May 15, 1901. Details.

680,919. TROLLEY GUIDE; G. F. Heusner, Portland, Oregon. App. filed Dec. 13, 1900. Outwardly flaring arms attached to the trolley wheel.

680,922. OUTLET BOX; H. Ill, Newark, N. J. App. filed Jan. 11, 1901. The openings are covered by lids connected at one place only in the periphery so that when broken out, they will leave a smooth circular opening for the entrance of wires.

680,932. INCANDESCENT LAMP SOCKET; N. Marshall, Newton, Mass. App. filed Aug. 8, 1900. Detail of fastening the cap and body together.

680,968. ELECTRIC FUSE OR CUT-OUT; L. W. Downes, Providence, R. I. App. filed May 2, 1901. (See Current News and Notes.)

680,981. ELECTRIC SWITCH; M. H. Johnson, Utica, N. Y. App. filed May 27, 1901. Each blade is double and engages with a U-shaped clip.

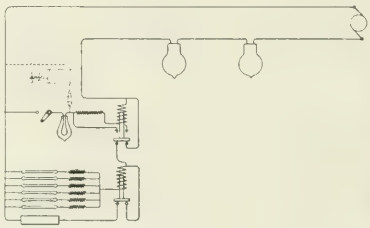
680,982. BURGLAR PROOF DEVICE FOR SAFES; A. T. Metcalf and V. D. Simons, Battle Creek, Mich. App. filed March 5, 1901. Details.

681,002. MOTOR METER FOR ALTERNATING CURRENTS; A. Peloux, Geneva, Switzerland. App. filed March 8, 1901. (See Current News and Notes.)

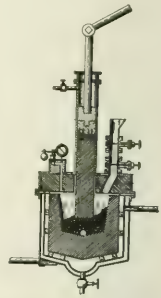
681,030. RAILWAY SIGNALING; F. McBrien, Newark, N. J. App. filed Dec. 3, 1900. The object is to prevent a break in the signal during the operation of the circuit changer, thereby preventing the home signal from going to danger during such operation.

681,039. ELECTRIC RAILWAY; W. Chapman, Washington, D. C. App. filed May 29, 1896. In a system having pick-up and feeder circuits, a motor generator is used which takes current from the feeder circuit and supplies current of lower tension directly to the pick-up circuit.

681,099. METHOD BY WHICH SEVERAL TELEGRAPHIC MESSAGES CAN BE TRANSMITTED AT THE SAME TIME THROUGH ONE CONDUCTOR OR BY WIRELESS TELEGRAPHY; A. Bull, Cologne, Germany. App. filed May 8, 1900. Consists in transmitting each sign by means of series, each series consisting of a pre-determined number of short impulses following one another at different intervals of time.



680,809.—System of Electric Lighting on Constant Current Circuits.



681,107. Electric Furnace.

681,107. ELECTRIC FURNACE; A. H. Cowles, Cleveland, Ohio. App. filed July 20, 1895. An electric furnace having its walls permeable to vapors and gases and a condensing chamber outside of the permeable wall.

681,112. CARBON BREAK FOR ELECTRIC SWITCHES; H. D'Olier, Jr., Philadelphia, Pa. App. filed May 13, 1901. A carbon member is held in contact with the switch blade during a portion of the movement of the latter.

681,119. TROLLEY SWITCH; W. P. Hines, Portsmouth, Va. App. filed Oct. 20, 1900. Details.

681,127. FIRE ALARM SYSTEM; C. E. Lombard, East Wilton, Me. App. filed March 14, 1901. Details.

681,133. STARTING APPARATUS FOR ELECTRIC MOTORS; T. S. Perkins, Idlewood, Pa. App. filed Sept. 28, 1898. The mechanism includes a double pole line switch.

681,157. CONDUIT; C. A. Wanner, Philadelphia, Pa. App. filed July 6, 1901. A conduit having grooves on two sides and lugs on the other two sides, said lugs being shaped to enter grooves in the adjoining conduit-sections.

681,167. ELECTRICAL CONTROLLER ATTACHMENT; G. L. Fairbrother and A. H. Mathewson, Thompsonville, Conn. App. filed April 19, 1901. The attachment consists of a plate having swinging lugs in the path of the controller handle and the handle carries devices for pushing the lugs out of the way.

11,929. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 18, 1901. The invention contemplates the use of electromagnetic supervisory signals controlled by the relays, each signal having two windings differently disposed, one of which is in a local circuit closed in making connection with a line and the other of which is in a branch of the local circuit controlled by the supervisory relay to be closed when the relay is excited.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, SEPTEMBER 7, 1901. No. 10.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, SEPTEMBER 7, 1901.

CONTENTS.

	PAGE
Editorial	363
Electrical Engineers of the Day—X. A. S. Clift	366
The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour, by Walter Reichel	367
Public Co-operation in Perfecting Telephone Service, by Joseph B. Baker	372
Heat Distribution in the Electric Furnace	373
The Control of High Potential Systems of Large Power, by E. W. Rice, Jr.	374
Power Factor Indicators	378
A Note on English Methods, by E. Kilburn Scott	381
Magnesium Carbide	382
Danger to Firemen from Electrical Wires	382
Independent Telephone Development	382
Tesla Patents	383
Electrical Development in Greece	383
Current News and Notes	384
LETTER TO THE EDITORS:	
The Pan-American Electrical Hazard, by Henry Rustin	385
Digest of Current Electrical Literature	386
The Cable Works of the Allegemeine Elecktricitats Gesellschaft, by E. Kilburn Scott	390
Electric Automobile Tests in Cleveland and Chicago, by Frederick Carrington Phillips	391
New Equipment for Ottawa, Can	392
A Southern Power Plant	393
Electric Reduction Plant in West Virginia	394
A Feature of Three-Wire Secondary Distribution	394
A New Lumen Meter	395
Hand Microphone	395
Pocket Measuring Instruments	396
American Electrical Apparatus for Japan	396
Flexible Steel Armored Conductors	396
The Coal Handling Installation of the Boston Elevated	396
A New Departure in Electric Sign Flashers	397
Telephone Station	398
Electric Circuit Automatic Time Switch	398
The Thompson Electric Automobile	398
Coal Handling at Tacony, Pa	399
Drop Forgings for Automobiles	400
Icing Refrigerating Cars	400
A Small Die Slotter	400
Panel Board with Removable Enclosed Fuse Carrier	401
Arc Lighting at the Pan-American	401
Exhibit of Automatic Telephone Apparatus	402
The E. G. Bernard Company at the Pan-American	402
Exhibit of Steam Engineering Specialties	402
DEPARTMENTS	403

BRITISH PESSIMISM.

One often hears about British conceit and bumptiousness, but it may be questioned whether any people in the world are so frank in dealing with their own real or supposed shortcomings as the English have always been. Mr. Kilburn Scott's article in this issue on electrical conditions in England is a case in point. His criticisms of his fellow countrymen are cynical and almost brutal. We doubt their entire accuracy, but cannot help thinking that where there is such readiness to see the need of improvement, changes for the better cannot be far off. The cocksure spirit that is so often manifested on this side of the water might well be mitigated by a little of this British humility and readiness to learn when the error or defect is seen.

THE COST OF TELEPHONY.

We had occasion to point out recently that the *New York Times*, in comparing the cost of telephony in Stockholm with the cost in New York, did not deal accurately or fairly with the facts in the case, and now the *Times* returns to the charge, with the suggestion that it might "find cause for adverse criticism in its (our) disingenuous presentation of the facts." As to this view of us, we will simply remark that the *Times* alleged that there are only 40,000 telephone stations in New York City, all at $240. Putting aside, without comment, the number, which really happens to be 60,000, all told, we pointed out that only 1400 are now on the flat $240 basis, and we summed up our view of the matter by suggesting that as to telephony —like many other things—"everywhere in the world the cost of operation increases with the size of the city." So far as we can make out, this is the full and total extent of our "disingenuousness," viz., the showing up of the ignorance of the *Times* as to conditions in its own city, and its readiness to accept as true the oft-refuted statements as to telephony abroad.

But this is perhaps all irrelevant to the real issue, which the *Times* raises as follows:

It may be clear to the electrical expert why a telephone service should cost more per unit in a district closely connected and densely populated than in one less compact and containing fewer people, but the average layman will find it difficult to understand why this should be so, or to believe that it is so. In any other business the conditions are exactly the reverse of those claimed to exist in the telephone business. Gas and electric lighting may be taken as illustrations. It might very well be true that at a scale of charges so high as to discourage the use of the telephone the relatively high cost of city installations and operation would appear to show that the cost of operation increases with the size of the city, but probably that is not what our technical contemporary means. If, however, it means anything else, we shall be compelled to insist that we think it mistaken.

It is certainly very clear to us why telephony in a city costs more per unit to operate than it does in a small town or village. It is one of the facts that there is no escape from, and we deny flatly the allegation of the *Times* that "in any other business the conditions are exactly the reverse." The fact that in telephony in New York the greater volume of business has been attended with lowering rates, shows that the use of the telephone here is not "discouraged." Indeed, we believe the ratio of calls per subscriber in New York is one of the highest in the world; but it is equally true that because of the higher cost of operation, the local company gets less out of each call

than it would if operating in a town like Stockholm, or, say, Chattanooga, or Sag Harbor. Many things making for the higher cost of operation could be mentioned; it will suffice to name rent, wages, underground wires, insurance, depreciation. If there is any other telephone system that comes near that of New York in the costliness of these items, we do not know it, and the nearness of the approximation carries with it a proportionately higher telephone charge, for equivalent service. Besides, the great, overhanging problem in telephony is how to maintain a margin of profit as the business grows. To keep ready the plant that will enable 5000 subscribers to talk to each other is to us and others obviously much less expensive than to provide and maintain the plant that will give 50,000 subscribers the same swift intercommunication. In other words, the "stand-by" charges grow out of all proportion to the possible return on any one "call," and in this respect telephony is by no means alone. To go no further than the field of electricity, it is a notorious fact that the cost of telegraphic operation has steadily gone up, with a lessening profit on a larger volume of business; and the problem in electric lighting to-day in great cities is to so adjust the tariff that the increasing cost of the "stand-by" charge for plant and operation shall be borne fairly by the consumers. It might be urged that telephone exchanges should therefore be kept down to a certain size, but that evades the point, namely, that the value and efficiency of the system consists, not in being limited, but in being able to reach every one of the other 50,000, if and when desired. The larger the city the greater the number of possible subscribers, all to be put in touch; and there seems no way of getting around the difficulty. The man who will devise improved scientific checks to telephonic conversation, while adding to the volume of business and maintaining an ordinary rate of return on the investment, will be the telephone manager of the future; but even he cannot avoid providing the plant that must be there when his fifty or one hundred thousand subscribers do want to talk. He will be more than happy if some such device as the "telegraphone" comes in to serve as a storage battery and take care of the "peak of the load."

A reference is made by the *New York Times* to the new system which the English Post Office has been laying down in London. When that system has shown what it can do, it will be time to cite it. The *Times* says: "It may very well be that the officers of the London Post Office do not know what they are at, and that they are about to bankrupt the department by undertaking the impossible; but we should prefer to learn this from authoritative British sources." We are glad once more to furnish the *Times* with the "authoritative" official information it craves. The British Postmaster-General has just confessed in his annual report to a deficit of $3,260,500 for his telegraph and telephone department for 1900, and he has been doing this steadily for years and years past. He is not merely getting ready "to bankrupt his department," but has done it ten times over, with increasing prospect of redoubling his disaster by reckless plunges into "undertaking the impossible" in telephony.

THE HUMAN ELEMENT AS A FACTOR IN ENGINEERING.

Elsewhere in this issue Mr. Joseph D. Baker writes in an interesting manner on the subject of public co-operation in perfecting telephone service, and clearly shows how vastly such service might be improved were the public to realize the important factor it is in its economical conduct, and then act accordingly. It is pointed out that the most consummate skill may be applied in working out all the technical details of an undertaking and then the result aimed at found to be unattainable through the public failing to apreciate that it is a factor, perhaps even more important than those that entered in the calculation of the complex engineering problems involved. In reply, it might be said that every problem should be solved with respect to every factor entering, and that a solution which neglects the human one cannot be said to show, in the broader sense, consummate skill, however much it may deserve that commendation with respect to its purely technical features. However this may be, the fact remains that the public, and particularly the American public, is apt to play its part to a reasonable point of efficiency where it enters as a factor in the attainment of an economical service, as is shown in New York by contrast between the movement of elevated trains at ordinary times, and on exceptional days when a large proportion of the passengers are from out-of-town.

In telephony, however, the matter of inducing the public to play up to the part which has been assigned to it in the efficiency problem is by no means an easy one. In the first place, the telephone user controls the situation, not having before him the fear of being eliminated by the exchange on the score of his inefficiency. Again, he is apt to regard his telephone a purely personal convenience—or more often inconvenience—and is not likely to consider that he should "step lively" to accelerate the exchange service. Moreover, when he goes to the telephone his mind is usually concentrated on the subject of communication, and the slightest delay or interruption is likely to give rise to irritation and to unjust suspicions as to the capacity of telephone operators and the efficiency of exchange management in general. Having thus no means to coerce the telephone subscriber, the only recourse is to his good will. Every civilized man has some inward sense of obligation toward others, and with advantage of this intelligently taken, much may be accomplished. In case of long-distance service, for example, to which Mr. Baker refers, if he knew the various operative steps between his call and the commencement of communication he would be less likely to lose his temper at the delay incident to long-distance connections, and would be aware that the occasional words and syllables from one or more operators which he hears while impatiently waiting, are not impertinences intended to prey still further on his nerves. In other words, we believe it would be to the interest of every telephone exchange to supply subscribers with a clear and tersely-written account of the various steps in exchange connection, and explain the reasons for delays that may reasonably be expected. This information could be made to convey indirectly directions conducive to economical exchange operation, which, if offered on that score alone, would receive little or no attention. In brief, the matter of securing the highest efficiency so far as telephone users are concerned, resolves itself, in the absence of any coercive remedy, in an appeal to the intelligence and good nature of subscribers, to which they will respond where they might consider as an impertinence a request to co-operate with the exchange on the score of the greater commercial advantage which will thereby inure to the latter.

THE NERNST LAMP.

Mr. Wurts' paper on the Nernst lamp recently read before the A. I. E. E. Convention, gives the first official engineering information available concerning the progress of that light source in this country. A perusal of that paper will satisfy all those who are familiar with the experimental difficulties of preparing a device of this kind for commercial use, of the very large amount of labor that must have been expended upon it in order to effect the results already indicated.

If the Nernst lamp, as at present prepared, be compared with the incandescent lamp for purposes to which incandescent lighting is applied, the comparison can only be very unfavorable to the new apparatus. An incandescent lamp is simplicity itself in so far as its con-

nections with the mains are concerned, whereas the Nernst lamp requires an auxiliary heater, a ballast of hot iron wire, and a heater cut-out magnet. The wiring diagram of a six-glower lamp resembles the wiring diagram of a switchboard in complexity. Moreover, an incandescent lamp does not require to be touched until it requires to be renewed; whereas the Nernst lamp requires to be cleaned at regular intervals during its life. The incandescent lamp is used in sizes down to 8 candle-power, whereas the smallest Nernst lamp yet attempted in this country is of 50 candle-power. In this comparison with the incandescent lamp, the only offsets in favor of the Nernst lamp are its color, and its efficiency, which is clearly considerably in excess of incandescent-lamp efficiency. Finally, the expected cost price of the Nernst lamp per candle-power is relatively much higher than that of the incandescent lamp.

If, however, the Nernst lamp is compared with the arc lamp, for purposes to which the arc lamp is ordinarily applied, the comparison is much more favorable to the new device. Its complexity is not much greater than that of an arc lamp. It is likelier to be steadier in action than an arc lamp, and to require considerably less attention during operation, since there are no carbons to be renewed. It is capable of being operated directly from 220-volt mains without the insertion of several lamps in series, and is capable of being adapted to trolley car lighting. It would seem that there may be an extensive field for the Nernst lamp in the direction of the service in which arc lamps are at present retained. The efficiency of the new lamp seems to approach that of the arc lamp. The expected cost price of the new lamp is not far from that of an arc lamp, and the color of the light is also similar. For arc lamp service the delay of the few seconds required aftern turning on the current, in order to light the Nernst lamp, is not usually a serious matter, whereas, in incandescent light service, such a delay might frequently give rise to tersely pronounced objections. A great advantage of the new lamp in comparison with the arc lamp is that it may be operated on low-frequency circuits. Taking the length of the glowing Nernst filament as 2.5 centimeters, the diameter 0.63 millimeter, and the power as 86 watts, the surface activity of the Nernst filament is approximately 172 watts per square centimeter, as compared with some 70 watts per square centimeter in the incandescent lamp and 3000 watts, estimated, per square centimeter in the arc lamp.

Certain Phases of Resonance.

Apropos of the very able paper on this subject by Mr. Steinmetz, we are moved to suggest that it would be highly desirable to collect and collate data on the examples of resonance found on practical alternating circuits. As a study of the theory and calculation of the phenomenon, the president of the Institute's paper left little to be desired, but there is still much work to be done. Given the constants of the system, and the computation of the conditions of resonance becomes a comparatively straightforward problem; but the constants are extremely difficult to determine in any practical case. Inductance and capacity in power transmission systems appear not as definitely located in series or parallel relation, but very irregularly distributed, with all sorts of damping devices between them, and in a mutual relation by no means constant. The line usually has much less inductance and often less capacity than the various translating devices. Instead, therefore, of finding the system with either localized or distributed capacity and inductance, it presents an irregular mixture of both conditions, and, in fact, must be treated as if it were broken up into a group of circuits having each both localized and distributed capacity and inductance in amounts often both variable and unknown, and having constantly shifting material relations. It is this breaking up into irregular electro-dynamical segments which presumably gives rise to the localized resonance that is sometimes unpleasantly in evidence, breaking down insulation near a particular point many times in succession. Thorough study is needed of the inductance and capacity of apparatus and cables in various normal and abnormal connections, and of the effect of grounds and open circuits upon the system at various stages of load. The ideal conditions of uniform distribution or definite location are changed in practice to variable factors on an irregularly loaded network, and with the data now available computation is almost hopeless.

The Synchronous and Induction Motor.

The paper read by Mr. C. F. Scott before the recent A. I. E. E. Convention reopens the old discussion which has so long been maintained between the advocates of the synchronous motor and of the induction motor, respectively. Mr. Scott evidently believes in induction motors, and seems inclined to disparage the use of synchronous motors. The salient facts on both sides of the question are, however, capable of being readily condensed. Where a motor must start with full-load torque there is no choice, and an induction motor must be used. Where a motor starts light and receives its full load after having come up to full speed, then either the synchronous or the asynchronous motor may be used. The synchronous motor—which, however, postulates skilful attendance—has the advantage that its power factor is adjustable, and can be made to suit the requirements of a transmission system, whereas the induction motor has a definite and a lower power factor, that is constant for a given load. Small motors usually have to be induction motors, and so must all motors that start under full load, but otherwise it seems advisable to employ a mixed equipment when possible in order to obtain the best output from the generators, and the best operation on the system.

In the discussion which followed the paper many different opinions were elicited, showing that the preference in any case depended upon the local conditions. It would seem that in time, with development and that reduction of cost which follows development, the induction motor may take the entire ascendency. At all speeds below synchronism, the induction motor is essentially a motor, and does not act as a generator, whereas at any and all speeds the synchronous motor never forgets that it is essentially a generator. At the present time, however, and at present costs, there does not seem to be any marked advantage of one motor over the other for light starting loads. The simplicity of the one is offset by the better power factor of the other.

As regards starting current on light load, the two motors are not dissimilar. Synchronous motors commonly start with reactances in their armature circuits sufficient to keep the starting current down to a value 50 per cent above full-load current. Induction motors starting under light load, and employing short-circuited secondaries, are commonly started by reactances similarly interposed in the main circuit for the purpose of keeping the starting current down to a little more than full-load current. Either motor will pull out if overloaded beyond a certain limit. In that event, the only difference is that whereas the induction motor can recover, the synchronous motor will have to be started afresh. In all cases, the comparison is assumed to be made between induction motors and polyphase synchronous motors as distinguished from the single-phase synchronous motors of the days prior to polyphase alternating-current development. In any comparison, including the single-phase synchronous motor, the disadvantages of this machine, except in small sizes or in special cases, are very conspicuous, particularly from being quite incapable of starting from rest unaided.

The Edison Convention at Buffalo.

Mr. Wilson S. Howell, secretary, states that in accordance with previous announcements, the seventeenth annual meeting, twenty-second convention, of the Association of Edison Illuminating Companies, will be held at the New York State Building, Pan-American Exposition Grounds, Buffalo, N. Y., Sept. 10, 11 and 12, inclusive. It is expected that the following papers will be presented:

"Modern Electric Light Accounting," by Mr. A. S. Knight, Edison Electric Company, Boston; "Competition with Isolated Plants," by Mr. John F. Gilchrist, Chicago Edison Company; "On the Selection of a Cable for a Given Service," by Mr. Wallace Clark, Schenectady; "The Evolution of Exposition Lighting," by Mr. Luther Stieringer, New York; "Some Notes on a Short European Visit," by Mr. Arthur Williams, New York Edison Company; "Timely Lamp Topics," by Mr. F. W. Willcox, Harrison, N. J.; "Spherical candle-power of Incandescent Lamps," by Clayton H. Sharp, lamp-testing bureau; "Progress in Electric Switch Design," by Caryl D. Haskins, Schenectady. A paper is also expected from Mr. Chas. P. Steinmetz, Schenectady, N. Y. Interesting reports will be presented from standing committees on meters, incandescent lamps, automobiles, etc., etc. The official headquarters of the association will be Niagara Hotel, Buffalo, N. Y. The association will be the guest of its local member, the Buffalo General Electric Company.

Long Distance Trolley for Chicago.

Arrangements are being made for the opening of the new electric trolley line between Joliet and Chicago, built by the American Railways Company. The line is 40 miles long, the road-bed is rock-ballasted and laid with 70-lb. steel rails, double track. The running schedule between Joliet and Chicago is 1 hour and 30 minutes, and the fare will be 40 cents in each direction. As soon as the road-bed is settled, faster time will be made. The motors on the cars will be geared to a speed of 40 miles an hour. The cars will be 48 ft. long, and in addition to carrying passengers there will be compartments for carrying baggage and express and package freight. As soon as practicable the company expects to build a spur from the main line near Summit to Riverdale, where connection will be had with the Suburban Railway, which now connects with the Lake Street and Metropolitan Elevated roads. It is hoped to eventually get the running time between Joliet and the City Hall in Chicago down to an hour and a half. Cars are now being operated on the line between Joliet and Lamont. Officers of Rock Island, Alton & Santa Fe say they fear little loss of business by the coming competition of the trolley. It is believed that the trolley will capture a large share of the express and package freight business. The lowest fare by the railroads between the two points is now $1.06 for a one-way ticket, 56 cents on 25-ride tickets, and about 45 cents on monthly tickets.

Submarine Boats.

It is reported that extrordinary efforts are to be made to obtain the passage of a joint resolution in the next Congress authorizing the construction of 50 boats of the Holland type. The Navy Department Board on Construction unanimously advises that no further increase be made along this line, pending the settlement, by exhaustive tests, of the relative efficiency of the submarine boat. The friends of this type of craft argue that, inasmuch as they can be built in three months, whereas it takes five years from the inception of its design to completion to build a battleship, the naval increase of this country for the next seven years should be confined, nearly exclusively, to the submarine type. It is the purpose of the Navy Department to appoint a board of unbiassed officers this winter, and to test conjointly the "Holland" and the "Lake" boats. The naval committees of both Houses of Congress will be invited to be present at the tests, and it is hoped that the general and individual questions relating to submarine boats will be finally settled. A cable dispatch from London of Aug. 30 says: The *Express* states that France and Russia, working in secret, will have built and ready for sea in November 92 sub-marine boats. All the boats will be powerful and of the newest type. England is only constructing five experimental submarine boats. In view of the influential backing of the Holland Company it is probable the naval opposition will, as it has in the past, prove futile.

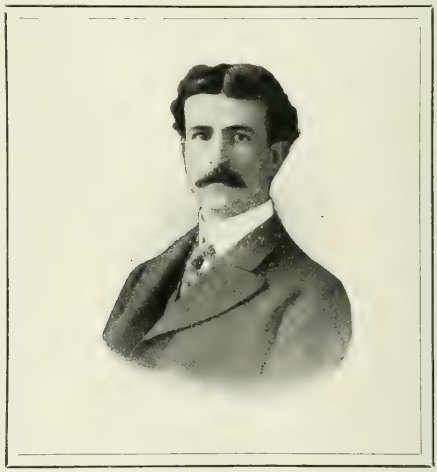
Electrical Engineers of the Day—X.

A. S. CLIFT.

While it is true that the ranks of electrical engineers in this country receive constant accessions from Europe, many of the newcomers making distinguished positions for themselves, it is equally true that of late years American electrical engineers have been welcomed to Europe and are now to be found there in every country in which the electrical industries are progressing.

One of the latest of these American electrical engineers to go abroad is Mr. A. S. Clift, who has become the chief mechanical engineer for Siemens Brothers & Co., Limited, of Woolwich, England, and who is now actively engaged on work for that celebrated concern, which has always shown conspicuous skill in the selection of its staff.

Mr. Clift is the son of the late Captain E. W. Clift, U. S. A., who conducted a large number of important surveys and whose name was associated with other responsible engineering work in the army. Inheriting marked talent from this source, Mr. Clift from the first devoted his attention to engineering studies, and in 1895 he graduated from the Mechanical Engineering Department of Lehigh University, where his record was particularly creditable in mathematics. Leaving college, he went into the General Electric shops at Schenectady, and shortly after was transferred to the drafting room. The work that he did there and in the engineering department in the calculation and design of generators and motors, together with the opportunity enjoyed for studying the construction of a large range of apparatus,



constituted a valuable experience and formed an excellent basis for later work. He was next offered a position with the Crocker-Wheeler Company, and in the fall of 1897 was placed in charge of its mechanical designing. In that capacity he assisted in developing various forms of direct-current apparatus, including complete lines of motors and generators of the several types built by that company.

In all such work Mr. Clift has made a close study of the mechanical design of electrical apparatus, believing that weakness was more often developed there than in the merely electrical features. As a result, he originated several new details of construction, and has met with some measure of success in producing machines combining low shop cost with the elements of good, substantial and symmetrical design. This is more particularly true of applications of electric power where in order to meet the specified conditions, distinctly novel constructions and expedients had to be resorted to.

During the past year Mr. Clift had become very much interested in the development of telpherage, and in conjunction with Mr. H. McL. Harding, he may be credited with the practical development which that new and promising art has made. The first modern telpherage line of any length was erected at the Crocker-Wheeler shops at Ampere, N. J., and was, therefore, under the constant observation of Mr. Clift, so that every experimental advance was tested by him before its adoption as part of the system.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour.

BY WALTER REICHEL.
(*Chief Engineer Siemens & Halske Company.*)

WHEN the author of this paper about a year ago described in a German technical journal a trial road built by Siemens & Halske, giving details of the circuits and the locomotive, which was designed for long-distance service, and employing 10,000 volts, he little thought that so soon afterwards he would have an opportunity to record another step in advance in the polyphase electric railway field. It is nevertheless a fact that the great work about to be described, and which was inaugurated and financially backed by a number of enterprising banking houses, technical and electro-technical firms, and sanctioned by influential officials, will soon be completed and put into operation.

As early as May of last year the "Studiengesellschaft" (Society for Research), inspected the Siemens trial road at Grosslichterfelde, plans were drawn up for a high-speed railway, patterned after this road, and it was concluded to build two experimental cars, which were to run over the tracks of the Royal military road between

FIG. I.—MAP OF ROUTE.

Marienfelde and Zossen. The mechanical work on the two cars was done by Van der Zypen & Charlier, of Cologne, and the electrical equipment of one of the cars was furnished by Siemens & Halske, and that of the other by the Allgemeine Elektricitats Gesellschaft. The Siemens & Halske Company also took the contract of installing the electric line construction while the A. E. G. generated the current in its power station at Oberschonweide and laid the feeders from that place to Marienfelde. The following article describes this interesting electric railway installation:

THE PROBLEM.

The problem may be sub-divided as follows:

1. The single track military road near Berlin, shown in Fig. 1, was selected. It is about 14¼ miles in length between Marienfelde and Zossen. The smallest radius of curvature is 3280 ft. (1000 metres), and there are grades as steep as 3 per cent (1 : 184). The gauge is normal. The rails are laid on wooden ties.

2. The car to seat 50 persons. It is to be no larger in width and height than the standard Prussian State railway car.

3. Two normal gauge trucks, with three axles each, to be employed, and these must be able to support a maximum load of 16 tons per axle inclusive of the passenger load.

4. The current supplied is to be of the three-phase type, 10,000 volts pressure, and having a frequency from 45 to 50 p. p. s.

5. The control and regulation of the motors (the current collector and switching in of all apparatus), to be so arranged that the operations can be performed independently at each end of the car.

6. The speed is to be varied between 125 and 135 miles per hour (200 and 220 km.). The electrical apparatus to be so designed that a round trip on a stretch measuring 155 miles (250 km.) can be made without unduly overheating them.

7. The rates of acceleration and of braking are to be so chosen that between the period of acceleration and the beginning of the period of braking there shall be sufficient time left for the careful observation of the power required for full speed. The length of this time for a distance of, say, 6½ miles (10 km.), is 3 minutes. There are to be two independent brakes, a mechanical as well as an electrical one.

8. The necessary measuring and controlling apparatus are to be furnished.

9. The car is to be electrically lighted, for which purpose a storage battery may be used.

Before the general design and method of construction of the car, etc., and the various details can be discussed, it is necessary to first determine the power requirements, so far as existing knowledge and means at hand will permit. Only after this is done can a general idea as to the capacity and size of the electrical equipment of the car be obtained, upon which the working out of further details largely depends.

POWER REQUIREMENTS.

According to the experience gathered in the railway field it is to be assumed that the air resistance which a vehicle has to overcome when starting and when moving at full speed, is the principal resistance to its motion, and it should therefore be carefully determined. The formulæ used heretofore give values which are too high when employed for speeds as great as 125 miles (200 km.) per hour. Thus, for example, the formula of Grove & Clark:

$$W_L = 2.25 + 0.001\,V^2$$

in which V is the speed in km. per hour, gives as the resistance in kg. per ton of car weight:

$$W_L = 2.25 + 0.001\,(200)^2 = 42.25 \text{ kg. (93 lbs.)},$$

which measured at the rim of the wheel, under normal conditions, is equal to

$$N = \frac{96 \times 42.25 \times 55}{75} = 3000 \text{ H. P.}$$

The above formula, however, is only correct for speeds up to 62 miles (100 km.) per hour, is applicable only to whole trains, and gives the resistance in kilogrammes per ton of weight of train; while in this instance we are dealing with a single car, and besides it would be more correct to separate the air resistance from the frictional resistance. The latter consists of the sliding and rolling friction and the resistance caused by the jars at the rail joints and the bending of the rails. This is usually assumed as 2.5 kg. (5.5 lbs.) per ton, and may be calculated approximately. We will, however, not enter into this, as it would lead us too far, and for safety shall assume 4.5 kg. (10 lbs.) per ton. Then the draw-bar pull at the rim of the wheel, in order to overcome this resistance, must be:

$$P_r = G\,W_r = 96 \times 4.5 = 450 \text{ kg. (approx. 1000 lbs.)}$$

If it be desired to determine the air resistance against the head end of the car, which is assumed to be round and have an area of 10 square meters (12 square yards), using the well-known formulæ (Hutte, Part I., Section F, Wind Pressure and Air Resistance), then the values obtained are again too high. (See Curve I., Fig. 5.)

There can be no doubt as to the correctness of the formula. The constant used, however, might be smaller than 1.85 for a long body. It might therefore be possible to construct a device by which this

constant might be decreased. This might be done by tapering the surfaces, which would undoubtedly have the effect of decreasing the value of the constant. In order to investigate the effect of these tapered (inclined) surfaces, experiments were made, which may be briefly described as follows:

As no claim is made as to absolute scientific accuracy, the only desire being to determine the approximate extent of the air pressure and the influence of specially formed head ends, it was deemed expedient to employ very simple means and to approximate as closely as possible the proportions met with on railway cars.

Naturally, experiments could only be made with revolving wings, as in no other way could a speed of 55 m. (180 ft.) per second be obtained. It was to be expected that the values thus obtained, on account of the centrifugal effect and the doing away with the friction caused by the wind at the sides, would be a trifle too low. This, however, may be corrected for by a corresponding addition to the value of the air resistance against the front surface.

A large motor, from which 200 horse-power could be taken for a short period, was mounted on a solid base, composed of rails, with its shaft in a vertical direction, and was anchored in all directions, as shown in Fig. 2.

At the top of the motor shaft a wheel of an ordinary street car was mounted, and fastened to this by means of heavy pieces of sheet metal was a horizontal plank 85 mm. (3⅜ inches) thick, 500 mm. (20 inches) wide, and 6350 mm. (21 ft.) long, which carried the experimental surfaces or bodies. The field coils of the motor were separately excited, so that the motor would run as a shunt motor

FIG. 2.—AIR RESISTANCE EXPERIMENTS.

having a constant speed at a definite pressure. The armature was excited by a special machine in such a manner that its speed, excitation and pressure could be varied between definite limits. In this way the speed of the motor could be varied at will. The device was started at the beginning of the tests by means of a water rheostat and disconnected by the same means at the close.

For the first experiments plane surfaces made of smooth boards (without having any appreciable thickness in the direction of rotation) were used. These boards were securely fastened to the plank.

These trials showed that the method was a correct one, and would in time give satisfactory results. They also showed that plane surfaces without any inclinations give too high values and that the tapering was very essential. (Fig. 5, Curves II. and III.)

For the experiments which followed and which were to be final, the revolving body had more of a parabolic shape, as shown in Fig. 3, and the experience gained in the preliminary trials was made use of in these final ones. For instance, in the final tests the speed was recorded electrically by means of a double Morse register, which at the same time made dots on the strip of paper at regular time intervals. The make and break contacts for recording the speed were attached to the shaft of the motor, which is shown in Fig. 4. Current and pressure were measured in the usual manner, so as to obtain the power consumption. The latter was also measured for the plank revolving without the parabolic bodies attached, and the heating effect was also measured.

These trials, after some mishaps had been overcome, gave some astonishingly good and accurate results, shown in Fig. 5, Curve VII. The pressure against the parabolic surfaces was only about one-third of that against the flat ones. It must be kept in mind, however, that in the final tests solid, box-like bodies were used, while in the preliminary tests with flat surfaces the air could rush together immediately behind them, and thus have a more pronounced effect.

It should also be mentioned that in order to check the speed of the motor with eye and ear, a carefully woven cloth was attached to the extreme outer surface of the revolving bodies which could be easily seen and the waving of which would be plainly audible. This cloth was entirely torn into shreds after a half hour's usage. These small shreds had deposited themselves onto the roughened surfaces of the other body, and thus indicated the current of the air. The latter streams from a mean pressure line towards the edges of the most forward surface.

Curve VII., Fig. 5, shows a wind pressure of 90 kg. per square inch

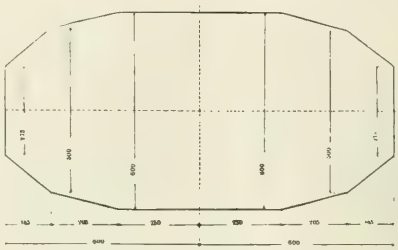


FIG. 3.—AIR RESISTANCE EXPERIMENTS.

(about 19 lbs. per square foot), at a speed of 200 km. (125 miles) per hour. This may be too low, as bodies moving in a straight line may give higher values than revolving bodies. Furthermore, the surface is greater and therefore the pressure coefficient, and, finally, the friction along the sides of a long, moving body must be taken into consideration, all of which could not be determined. It is, however, partially eliminated by not making the roof of the car like the top of the revolving bodies, but by slanting the roof downward in front and rear, which certainly decreases the resistance. The head end of the car is furthermore assumed to have an area of 10 square inches (12 square yards).

The draw-bar pull necessary, therefore, to overcome the wind pressure is

$$P_w = F_p = 10 \times 90 = 900 \text{ kg. } (1980 \text{ lbs.})$$

At a speed of 55 m. (180 ft.) per second the total power of the car, measured at he rim of the wheel, expressed in horse-power, is

$$N = (P_w + P_r)\frac{V}{75} = (900 + 450)\frac{55}{75} = 950$$

or, in round numbers, equals 1000 horse-power.

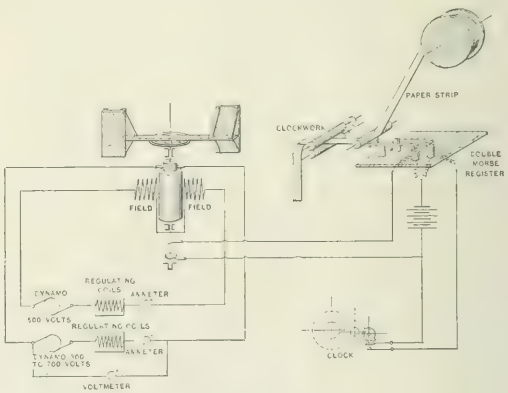


FIG. 4.—APPARATUS FOR DETERMINATION OF AIR RESISTANCE.

Now, that the power capacity of the car has been determined, we will describe the design and equipment of the same.

GENERAL DESIGN OF THE CAR.

Two conditions were imposed upon the builders of the car. First, the capacity had to be 1000 horse-power; second, the maximum weight was to be 96 tons. No restrictions were placed on the elec-

trical equipment, nor the length of time the apparatus was to be kept in service. There is very little data at hand which would assist the designers in determining the proportions of the various electrical devices to meet the desired requirements, but in view of the magnitude of the latter it would appear that the equipment should be as heavy as is permissable within the limits of the prescribed weight of the car, in order to meet the requirements with safety.

In this manner the problem was approached, and the final execution of the plans was the result of numerous designs and calculations (especially of weights), the mechanical and electrical devices being altered in size and capacity and shifted about as was deemed most expedient.

The following table shows the distribution of the weights of the various apparatus:

MECHANICAL PORTION.

	Kg.	Lbs.
Car body, iron frame and metal sub-structure, wood, glass, seats, hand-brake with appurtenances, air brake with pipes and reservoir, floor and roof covering.....	20,700	45,540
Trucks complete, including wheel base, auxiliary air reservoirs and brake cylinder and brake shoes	27,300	60,060
Total	48,000	105,600

ELECTRICAL PORTION.

	Kg.	Lbs.
Motors without axles and wheels, but including support	16,300	35,860
Complete rheostat controller	5,100	11,220
Controller with pneumatic attachment, electrical circuits, safety devices, fuse boxes, switches and levers for motormen.....	4,750	10,450
Large transformers and their support.....	12,300	27,060
Air pumps and supports	1,000	2,200
Small transformers for the same	650	1,430
Current collector with attachments	1,300	2,860
Lighting devices, including battery	500	1,100
	41,900	92,180
Adding for safety	600	1,320
Total	42,500	93,500

PASSENGERS.

	Kg.	Lbs.
Fifty passengers, including motorman and conductor at 80 kg. (176 lbs.).....	4,000	8,800
Total	4,000	8,800

Adding these we get:

$$48{,}000 + 42{,}500 + 4000 = 94{,}500 \text{ kg.} = 207{,}900 \text{ lbs.}$$

which is equal to 94.5 metric tons.

In apportioning the various weights the electrical equipment in the car body was made as light as practicable, and it was so distributed that the car body support might be made as light as possible. This will be evident from the following detailed drawing of the car construction and equipment, shown in Fig. 6.

THE MECHANICAL EQUIPMENT OF THE CAR.

The requirements of the car body are that it shall be of such a size as to accommodate 50 passengers, who are to be provided with cross seats in a center compartment, called salon, and two rooms adjoining the salon. The central room is 7.3 metres (24 ft.) in length, contains 18 seats, while the adjoining compartments are 4 metres (13.12 ft) long and each has a seating capacity of 12. Adjoining these sections is the ante-room or platform on which there are three seats 1.75 metres (5.74 ft) in length. From this platform passengers enter and leave the car. Finally, there are the two platforms (one at each end) for the motorman, which are 1.6 metres (5.24 ft.) in length. The car has therefore 48 seats and is 22 meters (24 yards) in length.

The body is carried on longitudinal girders which are joined together on top and bottom, thus being light in weight, but capable of bearing a heavy load. The plates joining the girders are composed of U and flat iron, and are connected by heavy sheets of iron reaching from the lower end of the windows to the lower edge of the car body.

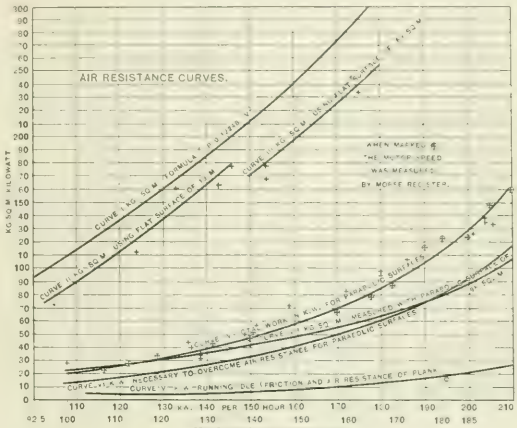


FIG. 5.—AIR RESISTANCE CURVES.

Besides the above, the frame is braced transversely and longitudinally in the usual manner, the arrangement of which depends largely upon the location of the various electrical apparatus. At the front and rear end couplers and bumpers prescribed by the Prussian Railroad Department are attached.

The interior arrangement of the several sections and the entire car body is the same as that of a third-class car of the Prussian State roads. The seats are made of wood and are fixed to iron supports. The car greatly resembles in outward appearance the ordinary train car, except that the front and rear ends are of a special parabolic shape so as to reduce the resistance to the air. The roof also slopes down in front and back. The entire body can be mounted into the truck frame without the use of springs, by means of a projecting pin. The truck frame, however, is separated from the journal boxes by a double set of springs. The structural iron truck frames primarily rest upon spiral springs which are adjustable by means of a bolt. From these the load is transferred to long, flat springs which rest on

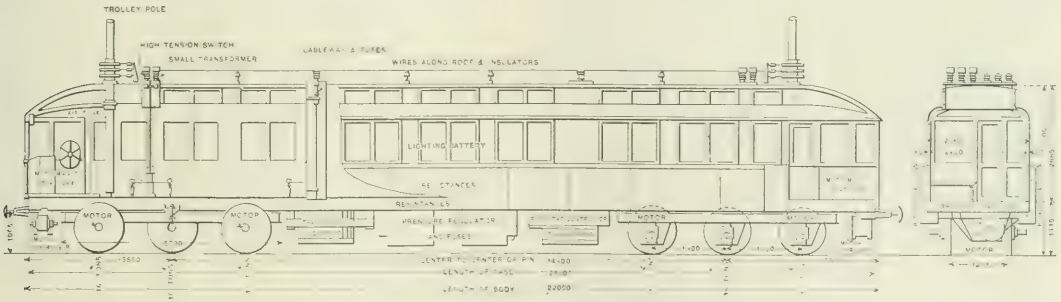


FIG. 6.—HIGH-SPEED RAILWAY CAR.

the journal boxes. The middle one of the three axles is not used for the mounting of the motor, because the space above it has to remain free for the supporting frame for the pin in the car body and the braking apparatus. In order therefore to have an equal load on all the axles, the springs for the running axles must be stronger than those for the motor axles. All of this is clearly shown in Fig. 7.

The braking is accomplished by an automatic Westinghouse brake

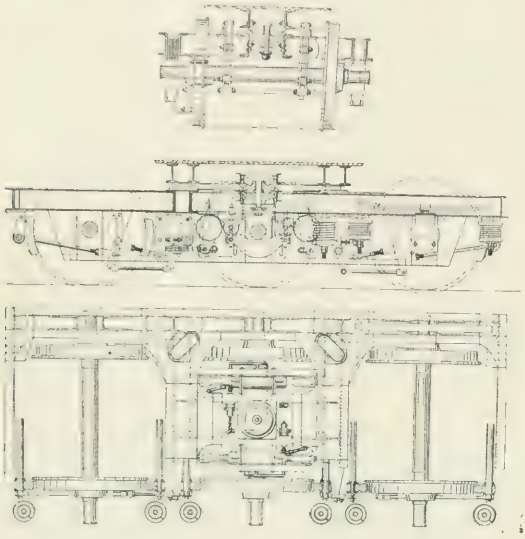


FIG. 7.—TRUCK FOR HIGH-SPEED RAILWAY CAR.

and all wheels are braked on the two sides, so that 100 per cent of the weight of the car is braked. For this purpose two 10-inch brake cylinders are built into each of the trucks. In this way each truck is a distinct operative vehicle by itself, and each has in addition two auxiliary air chambers. The various brake rods of the Westinghouse brake may furthermore be acted upon by a handbrake, by means of which the motorman, stationed at either end of the car, can brake about 80 per cent of the total weight of the car. The outside diameter of the wheels is 1250 mm. (48.21 inches).

All the above conditions were incorporated into the designs of Van der Zypen & Charlier, who built the cars. A cross-section of the car body is shown in Fig. 8, while the truck is shown in three views in Fig. 7.

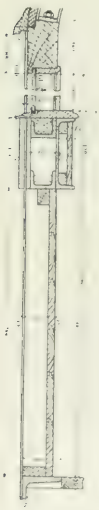


FIG. 8.—CROSS SECTION OF CAR BODY.

ELECTRICAL EQUIPMENT OF THE CAR.

The following conditions have to be complied with in the design of the electrical equipment. In the first place, the passengers and employes must be adequately protected against the danger of high tension currents. This is only possible when all apparatus and wires are situated under the car floor or under the roof, which are connected to the earth by means of sheet metal plates. None of the apparatus is to be made directly operative by the motorman's hand, but by means of a special power device. This also simplifies the operations and does not tax the strength of the motorman. Compressed air seems well adapted for this purpose, as it has to be carried on the car for the operation of the brakes. The air reservoirs for power and brake purposes, however, must be separate.

The equipment must be so arranged that all parts can be easily inspected, be easily attached and removed, and in case any device becomes inoperative, another part of the equipment can supply the deficiency. The load must furthermore not all be concentrated at one point, but must be evenly distributed, the effect of which will be that the heat which is generated will be more easily dissipated.

Compliance with these conditions made it necessary from the start to divide the electrical equipment into two distinct units, each one containing two motors, with two rheostats, two main switches, two fuses, a large transformer, with delta and star switches in the secondary, and primary high-tension switches as well as high-tension protective device; an air pump and small transformer with fuses, a current collector (trolley), an air reservoir, a motorman equipment with compressed air switches and measuring instruments. How these devices are connected together is clearly shown in the diagrams (Figs. 9 and 10).

Although the diameters of the wheels have been made 125 cm. (48.21 inches), the number of revolutions made by the wheels is still so great that it has been deemed advisable to mount the motors directly on the axles. Each truck is supplied with two motors, the

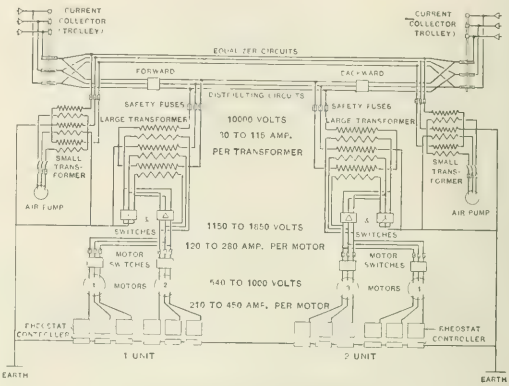


FIG. 9.—DIAGRAM OF CONNECTIONS.

entire car therefore with four, so that each motor only has to furnish one-fourth of the entire 1000 horse-power.

In order not to consume too much time at starting, it has been calculated that the motors must be capable of furnishing 3000 horse-power. The increased capacity is usually obtained by loading the motors more heavily. In case one equipment is disabled, however, the pressure in the primary circuit of the motors will be raised. The pressure has to be so chosen that the current strength will not be too great, so that the contact surfaces of the motor switching devices will not be too large. The primary pressure for full speed has therefore been chosen as 1150 volts, and for starting as 1850 volts. The motor speeds are regulated by means of resistances, which are

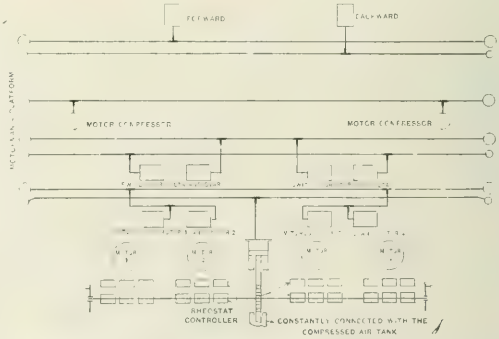


FIG. 10. SYSTEM OF PIPES LEADING TO SWITCHES AND CONTROLLERS.

inserted in the secondary circuit of the motors, and are cut out successively until the induced winding is entirely short circuited. The secondary voltage at a standstill, i. e., at the point of starting, is about 650 volts.

So as to avoid a possible breakdown, metallic resistances are employed. On account of the excessive room which they occupy and

in order to insure their cooling off, the resistances are inclosed in flat cases which are placed along the two side walls of the car between the two doors.

In order to make the connections between the resistance coils and their controllers as short and simple as possible, the controller cylinders are distributed in a similar manner to the coils themselves. For this purpose the space below the resistance boxes between the two trucks was utilized.

The controller cylinders are operated mechanically, and as the power required is quite considerable, an auxiliary compressed air

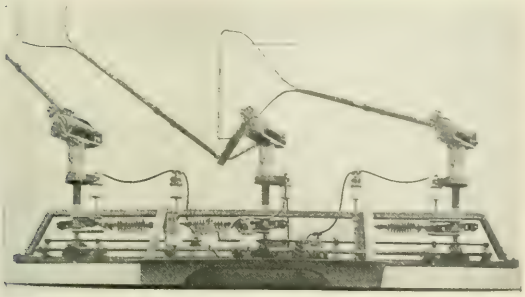


FIG. 11.—DETAIL OF CURRENT COLLECTOR.

mechanism can be brought into action. At all times, however, the motorman has perfect control over the cutting in and out of the coils.

As stated above, the motors receive a primary voltage varying between 1150 and 1850 volts. The resulting currents are sufficiently low to be easily carried by the contact surfaces, and especially if there is a separate controller for each motor. This has the added advantage that in case a motor becomes inoperative it can be cut out of the circuit by its own controller.

The varying voltage is obtained by means of the delta and star connections of the transformer secondaries of which there are two. Each transformer has its delta and its star connection switch. These devices are similar in shape, but differently connected. Four switches are placed together into one case which, for inspection, can be easily removed from the car. The lighter cases and apparatus are symmetrically arranged in the center of the car, while the heavy transformers are attached as closely as possible to the trucks so that the frame supporting the car body is well utilized. The switches are operated by air pressure, which is controlled by the motorman. The safety devices are likewise placed in the switch case.

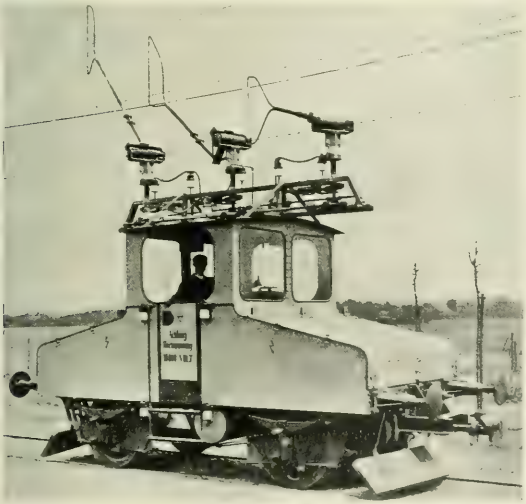
Each of the two transformers is not, as is usual, formed like an equilateral triangle, but the three legs are simply laid flat, next to each other. Their length, in order to be able to establish cooling currents, are coincident with the length of the car. In this way the transformers can be placed under the car floor. The primary, which receives a pressure of 10,000 volts, is permanently connected in star (Y) fashion, and is cut in and out by means of a high-pressure switch which is situated near the trolley directly beneath the car roof. The connections between these switches and the transformers consist of bare wires mounted on high pressure insulators, so as to facilitate inspection. They are run for a short space along the roof and then down an iron cable way, 500 mm. (20 inches) in width, which also serves for ventilating purposes. These cableways adjoin the walls separating the central from the end sections; the safety devices are located at the top of the cableway, and right above the wall separating the end sections from the platforms is an iron trough containing a small transformer for the air pump and a high pressure switch, all of which can be clearly seen in Fig. 6. These last named switches serve also for altering the direction in which the car is to run. For that reason only one of them is closed at a time and, as seen in the diagram, all the energy for the operation of the car must pass through this switch.

The current collectors, or trolleys, must operate without sparking if possible, and must be separated considerable distances from each other. As the trolley wires are suspended vertically beneath each other at the side of the track, the current collectors swing in a horizontal plane around a vertical axis. This axis consists of a stout pole which is almost directly over the center of the truck, measured from side to side, so that the current collectors do not have a very large reach. The trolley pole and its controlling mechanism reaches down to the motorman's platform, from which place it may be revolved in any direction.

The current passes from the contacts into collector rings from which it is taken off by means of brushes, which are connected by wires with the high-pressure switches. The upper part of the pole together with the collector rings can be taken off, while the lower portion remains in the car body in its bearings.

The air pumps are located under the motorman's platforms and are supplied with current from the small transformers, ratio 10,000 : 110.

To the dashboard, in front of the operator, a switchboard is fastened, on which are located the various cocks which connect the air



FIGS. 12 AND 13.—LICHTERFELDE LOCOMOTIVE, SHOWING TROLLEYS.

pressure cylinders of the devices either with air pressure reservoirs or with the outside air. The cocks are turned in this order when starting up: "Forward," or "backward," then "motors" and "rheostat controller," and the reverse order when the car is to be stopped. On the board is also the cock for the Westinghouse brake, the switch for the air pump, and near the table the measuring instruments for air pressure, voltage, current and speed.

The car is electrically lighted by means of a storage battery and in case of necessity stearine candles can be used.

LINE CONSTRUCTION.

The trolley wires are suspended in a manner similar to that employed on the Siemens & Halske experimental road at Grosslichterfelde, ashown in Figs. 11, 12 and 13. The trolley poles are located 2¼ m. (7.38 ft.) from the center of the track and the three wires are each separated 1 m. (3.28 ft.) from each other. The lowest wire is supported 5½ m. (18 ft.) above the surface of the rails. The total line is divided into sections 1 km. (.621 mile) in length, and at the center of each section is an auxiliary feed connection. At the end each section is connected by means of an insulator to a heavy pole. The zero point of the system is grounded, i. e., it is connected with the earth and track. Lightning protective devices have been provided and in case a wire should break, the current is cut off from it, before it falls to the ground. The feeders are connected to the trolley wires in the neighborhood of Marienfelde (Fig. 1).

The above description sets forth the general scheme which has been followed in laying out this installation. In a following article the details of the system will be described, showing in what manner all the foregoing conditions have been fulfilled.

Public Co-operation in Perfecting Telephone Service.

By Joseph B. Baker.

In an account of Superintendent Valentine's recent paper on the use of the telephone in the railroad service, stress was laid by the speaker, and, in discussion, by Mr. Henry W. Pope, of the Buffalo Bell Telephone Company, upon the fact that only a small percentage among the general public know how to use the telephone. The writer was struck by the significance and truth of this observation, and by the bearing of the underlying cause upon the general problems of telephone engineering as an art of quick inter-communication.

In the handling of trains by telephone, railroad men accustomed to electric communication by telegraph and with many years of practice in the oldest electrical art to make them "go in on the wire" for business and "get off the wire" when their business is through, may be relied upon to work out to the limit all the comparative advantages that may be inherent in the telephone. The discussion in the technical press, by practical railroad men, that has followed the paper cited above, is to the writer's mind an indication of the coming use of the telephone to the practical exclusion of the Morse. The pertinent point here is, that, as Mr. Valentine's facts and figures show, the use of the telephone by trained officials results in an enormous expedition of business. The same care that is liable to be a life and death matter when it comes to the handling of train orders, means brevity and dispatch in the co-operation of the officials with the telephone operators. In a word, efficiency and safety go hand in hand in the use of the telephone in railroading, and must win, for the use of a speaking telegraph over a signal telegraph, in the end. Why, then, may not efficiency and economy go hand in hand in the vastly greater volume of public use of the telephone?

For a long time the apparatus—the switchboard replaced with most costly frequency, lines and cables overhauled and renewed with ceaseless vigilance, the operators trained in the newest methods that "Bell" and "independent" skill can devise—has been kept up to date and most sensitively capable of saving the little intervals of time in operating that make such long periods in the aggregate. But is not the public user of the telephone very much the same as he was in the early days? Outside of the telephones connected to branch exchange switchboards, is not the average individual just as much inclined to appear at his mental and temperamental worst when talking into the "hole in the wall" as he was in the ancient days of Blake transmitters and "Hello, Central"? Does not the average telephone user co-operate less than formerly, rather than more, in too many instances, and is not this lack of co-operation a very real and heavy factor of loss in the telephone service? In this paper it is sought to be shown how important this factor of loss is in the handling of toll line telephone calls, or conversation between points connected by trunk lines between exchanges and carrying a toll charge based on the distance between the points and the time consumed in conversation.

In the course of every-day experience in the operating department of a telephone company handling toll line calls, many opportunities are presented to the public to vitiate and make of no effect the most elaborate and hair-splitting refinements in electrical and mechanical detail having time-saving for their object. In toll line calls the unnecesary delays introduced by any cause are of particularly bad effect on revenue, because they consume time in the use of an operating plant whose value is enormously increased over that of a local telephone company by the interest on amounts invested in costly line construction. Such a general statement may stand to represent the positively heartbreaking consumption of time that occurs at the busy periods in the telephone day due to perfectly avoidable, wholly unnecessary inertia or erratic behavior of the public when its members wish to talk over a long wire. An example borrowed from another field of electrical engineering experience in the operation of the Boston Elevated Railway may serve to emphasize the writer's meaning here. In the design of both rolling stock and permanent way by the very capable engineers who have carried into execution that up-to-date piece of work, a far-reaching effort to produce a quick schedule resulted, on the opening of the road to the public and for a long time thereafter, in no more than ordinary "rapid transit" for the tens of thousands of daily passengers; where it would seem that the carefully laid grades and curves, the powerful, quickly accelerated trains and the elaborate block-signal system ought surely to result in real rapid transit. Why is such consummate engineering skill made of on effect? Because the public do not "step lively" so as to make a schedule of getting on and off the trains that is in the same class with the schedule of moving the trains. Of what use, the officials of the road might ask, are the unparalleled acceleration and braking of the trains and the high speeds between stations, with a "practice train," making a five-mile run in 18 minutes, since the same trip takes all of half an hour, when the public increase the length of stops at stations so far beyond a reasonable time? It may be objected that modern American civilization asks us too insistently to "step lively." But that is another matter. The contention of the writer is that, given an engineering plant that is correctly designed either for rapid transit or rapid inter-communication for a public that demands rapid transit and inter-communication, is it not fair that the essential public co-operation should not be overlooked, and should not the securing of such co-operation by education of the public in any way be regarded as just as much a part of the broad engineering problem, as, for example, the proper distribution of block signals?

While it will no doubt be the good fortune of the Boston Elevated Railway management to be able after a while to give something like the quick service that their constructing engineer had planned, simply because railroad trains have a well-known way everywhere of leaving by the clock without waiting for belated individuals, yet the example cited may serve to illustrate the serious effect of lack of public co-operation. And in the case of telephone communication we are without the salutary corrective tendency of direct and positive reaction upon the offending individuals. For example, if a man does not use the plain co-operative faculty of being on time for his train to New York, he is left behind. The punishment is his alone, and the train, serving faithfully the hundreds who meet the simple co-operative requirement, makes the schedule time, along its disciplined course, which engineering skill provides. The transportation is there, if he can avail himself of it. His slowness or stupdiity does not affect the system at all as far as the public service provided by that train is concerned. But how is it in the case of his telephone message, where he does not, in the vast majority of cases, co-operate with the service and is not positively required to by the system of operation, and where his failure does profoundly affect the public service, a factor of loss militating against the benefits that ought to be expected from the costly plant of lines and apparatus and skilled labor just as any other fault in the system would do?

Take the case of a party in Boston calling New York. To begin with, he approaches the telephone in a spirit—conscious or sub-conscious—differing from that in which he would approach the railroad ticket window; in the respect that, while he knows he must there

comply with a very quick dispatch of his business of buying a ticket to New York, here he knows that the operaor will take his call—must take his call—in any way that he chooses to give it. He feels quite at liberty to tell her what he thinks she has to know in order to transact this business, in the order and with the emphasis on detail that the importance of the call to him suggests. He does not like delays on the telephone, and the seemingly arbitrary questions by several different operators coming in on the line in succession. He does not realize that when he has started the machinery of a toll line call by signaling his operator, he had far better allow the telephone company to run their business, which in this case is his business, and co-operate gracefully and intelligently by answering the questions put to him and preserving at least as good an attitude of patience as he would at the window of a bank-teller or of any ticket agent; and that, while he is devoting his sole attention and interest to getting this call, the telephone machinery with which he is dealing finds his call simply one of many; to give the best attention to all of which means of seemingly obvious necessity, an elaborate system of division of labor among operators and the divided attention of each operator. He does not realize that the operator with whom he argues has neither the time in her narrow round in a mass of the same work over and over again, nor the temper and brains that go with a larger salary than she gets as a wheel in the machinery, for anything whatever that takes her attention or vitality away from her own clearly defined duties. He fails to realize that the art of telephony as practiced for years by the telephone company may mean an application of the rule of "the greatest good to the greatest number"; that may not be fitted to always give him just what he wants in the time his fancy pictures ought to be sufficient. He does not remember that, though the telephone and switchboard are machines, the operator is not, but is human and quite likely very busy. Finally, to close my list with a reference to an absurd but very common error—he does not realize that in giving in his toll line call (for a party in New York) he is not talking with an operator located in that city.

All this friction—the lack of co-operation of the individual with the operator, just cited—means that the "recording" of a toll line call for transmission to the distant point, may take minutes where seconds suffice when the party calling is simply business-like. All that is needed for quick recording of any call is a prompt, clear and consise answer to the recording operator's question. The minimum time is attained, of course, when the party calling is accustomed to the use of his telephone on toll lines, and is putting in a frequently recurring call. In such a case, both the operator and the party calling understand an abbreviated formula soon pronounced. The long delays in recording come when the operator has to deal with a party who volunteers a copious flow of information from which she has to select the small kernel of essential matter, or with a party who cannot or will not understand the brief, simple questions put to him. Oftener than not, these two "cases" are combined in the same individual.

Delays in recording have been referred to for the purpose of general example of lack of co-operation by public users of the telephone; but, apart from the frittering away of operators' time and tying up switchboard apparatus, such delays are of secondary importance compared to those that take place when connection has been made to the toll line. The same kind of vexatious waste of precious seconds here and there, in delays by substitution of office boys for principals at either end of the line, in failures to ring off when through talking, in refusal to "talk up" when loud transmission is required to reach the end of a long line, but they are vastly more expensive. In the aggregate, on a single call, they may mean many minutes out of the total "elapsed time," shown on the ticket, that cannot be charged for, but that should have carried their revenue. Here it is not a loss of operators' wages plus interest on the switchboard. It is loss of use of toll lines when revenue calls are clamoring for the lines at busy periods; it is the interest on the cost of a 500-mile pole line built over an expensive right of way with the best lake copper and chestnut poles, with some costly and short-lined cables figured in. It is to be borne in mind that toll line telephoning is radically different from telegraphing in the fact that it is the bringing of two particular parties together at the ends of a wire, and not merely the transfer of a message in one direction, and later, perhaps, a reply message in the opposite direction. The telegraph engineer's problem in heavy traffic is to handle a ruck of outward messages at a given office and another ruck of inward messages, and, moreover, he has some opportunity to "distribute the load," in both cases, to relieve busy periods. But the case of toll line telephoning is different and far more difficult, in that the revenue is derived from a message-and-reply communication as a unit, in a minimum of time from the receipt of the call at the outgoing point, and at any time of the day or night that service is called for, at which time the said message-and-reply communication completely monopolizes an electrically continuous pair of wires between the two telephones without the feature of step by step repetition that is often of such economic service in handling telegraph traffic.

The writer has had no thought of merely railing at a "necessary evil," but has desired instead to call attention to a contrast between highly organized apparatus and a widespread incompetence on the part of the users of that apparatus. The system of telephony that has been built up in this country of its birth is one that permits the careless public user to affect its efficiency by his lack of it, to the detriment of the service. Surely any gross imperfection in the working of an engineering plant ought not to remain a necessary evil. The telephone has been with us long enough, has reached a sufficiently high state of perfection and universality, to command a public co-operation at least on a par with the public confidence in its use. Is it not time to give some of the attention that has been so wonderfully exercised in the past in the saving of fractions of a second in switchboard operations to the systematic education of the public? Is it not time to train that other and vaster body of "telephone operators," the public? Has not the time come for standard and common-sense procedure everywhere? In this article it has been sought to point out the need of such standards and of common sense, the complete understanding and practice of which ought not to wait for monopoly of toll and local lines over the country.

Heat Distribution in the Electric Furnace.

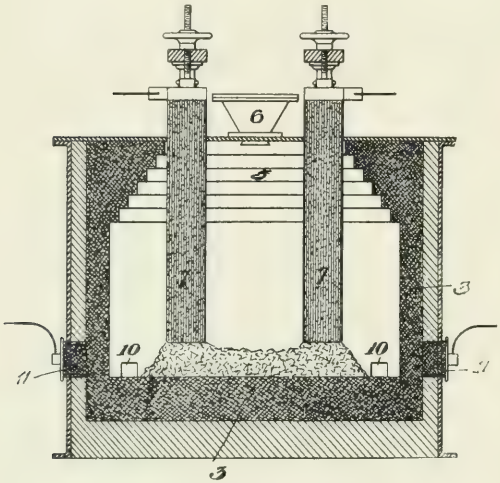
The expression, "the chemistry of high temperatures," has been a favorite one with investigators as indicating the field covered by the electric furnace—the whole classes of reactions, whether of reduction or synthesis, which lie beyond the range of temperatures attainable by the combustion of carbon. It is only recently that it has been fully realized by chemists that the reactions so indicated occur at temperatures which are considerably below the utmost attainable limit of the electric furnace, and that the effects of excessive heat must be as carefully guarded against as in the more familiar metallurgical processes. Calcium carbide is prone to dissociation with most troublesome results, both as regards the grade of the product and the clouds of dust which follow the combustion of the volatilized metal. Carborundum, at a somewhat higher temperature than that which suffices for its formation, breaks down, leaving a residue of graphite, and it is becoming more and more common to state, of any given reaction, not that it can be accomplished in the electric furnace, but that it may be effected by the heat developed by a given current under specific conditions. It has been found, in short, that the element of temperature control is exceedingly important, and that the intense and localized heat of the arc is not the most favorable for the accomplishment of quantitative results on a commercial scale.

The resistance furnace is more readily governable, and has grown correspondingly in favor. If, however, the heat be developed by the passage of the current through a mixture of carbon with the ore to be smelted as in the Cowles furnace, there are violent fluctuations due to the changing conductivity of the charge as the smelting operation proceeds. When the product of the furnace is alone relied upon to carry the current, the field of operations is necessarily greatly restricted, for it is essential to such work that the product be capable of being tapped off to maintain a conductor of constant cross-section, and also that it afford sufficient resistance to the current to develop the necessary temperature. Clearly but few furnace products possess both of these essential properties. If, as in a third class of resistance furnaces, the current be carried by conductors, either of carbon or a suitable refractory metal, which are independent of the charge, the ideal conditions as regards control are approached, but such furnaces are relatively expensive to construct and maintain, for the resistance is an additional and perishable element.

De Laval, of Stockholm, about 1892, invented a type of resistance

furnace differing from all of these and offering many points of advantage, a type which might appropriately be termed the "electrolytic furnace." In this construction a fused electrolyte is traversed by an alternating current, and the heat thereby developed is employed for the reduction of a suitably prepared charge. This furnace was designed chiefly for the reduction of iron ores, and as an electrolytic resistance a body of fused magnetite was interposed between separated lateral masses of molten iron constituting the terminals. Iron ores, mixed with carbon, and introduced into this electrolyte become reduced, the metal accumulating in the lateral pockets which contain the terminals and being tapped therefrom to maintain a constant volume.

A patent issued Aug. 27 to Mr. Hugh Alexander Irvine, of Niagara Falls, N. Y., represents an extension of the De Laval method to the production of volatile elements, and particularly to the manufacture of phosphorus. The furnace, as shown in the accompanying figure, consists of a hearth and side walls 3 of packed carbon, surmounted by an arch 5 and feed-hopper 6. Carbon electrodes 7, connected to opposite terminals of the source of electricity project through the cover of the furnace and into proximity with the hearth, the circuit being at first closed through a mass of granular coke, as shown, but in further operation by a layer of conductive slag, derived from



IRVINE ELECTRIC FURNACE.

the charge itself and maintained constant in volume by tapping the excess through the top-holes 10.

In operation a charge consisting of a mixture of phosphate rock and carbon, with an added flux to form the conductive slag, is fed into the furnace and the circuit closed. The flux may be basic, acid or neutral, according to the character of the phosphate treated, the essential point being that it shall determine the accumulation of a fused electrolyte in quantity sufficient to cover the furnace hearth and to provide a path for the current between the carbons. Upon this molten bath of slag the remainder of the charge rests, and is progressively smelted by the uniform and moderate heat developed by the resistance of the electrolyte. Terminals 11 in electrical connection with the hearth are provided in case it should become necessary to change the path of the current for any purpose.

These electrolytic furnaces are essentially continuous in operation, for the slag and charge are non-conductors when cold, and if the furnace were allowed to cool difficulty would be experienced in again starting it. An obstacle inherent in the type of furnace, and one which will probably prevent any extended application of the principle, is the difficulty of securing a lining material for the hearth which shall be infusible, neither fluxed nor oxidized by the supernatant slag, and at he same time so highly resistant as to carry no appreciable proportion of the current. It would seem doubtful whether "packed carbon" is fully capable of meeting these conditions.

The Control of High-Potential Systems of Large Power.*

By E. W. Rice, Jr.

The enormous increase in the use of electricity for lighting, traction and power has necessitated important changes in our generating stations. As the areas to be served have rapidly increased, corresponding increases have been made in the size of these stations and in the electrical potentials employed. The change has been due, not only to the great natural growth but to the consolidation of generating machinery into fewer stations. Instead of a number of separate stations, containing relatively small units producing electricity at comparatively low voltage with relatively large transmission losses, we now frequently find one large central station, containing generating units of great size delivering electricity at a high potential. Dynamos of 2000 to 5000 kilowatts capacity are displacing those of 200 to 500 kilowatts, and pressures of 5000 to 15,000 volts those of 1000 to 2000 volts. The design and manufacture of large generating units of this character have called for engineering skill of a high order, and it can now be fairly claimed that the production of such machines has been reduced to an exact science.

The rapid evolution and present perfection in dynamo design have been due to the skill with which the various problems have been solved by the designing engineers and to the ease with which the data based upon machines of relatively small size were applied to those of larger size.

It is evident, however, that great advances in the capacity and voltage of generators would be useless, if not positively dangerous, unless adequate means for controlling and switching the electrical current were at hand. The evolution of the dynamo was for a time more rapid than that of the devices for controlling and switching currents of large volume and potential. As a result, a number of machines of large size were placed in operation with comparatively inadequate methods of switching and controlling. The energy and power which can be safely concentrated in a single central station is obviously limited by the amount of current and voltage which switching devices can safely handle. This fact was especially forced upon the attention of the writer at the time when the company with which he is connected took the contract for the equipment of the generating station of the Metropolitan Traction Company, of New York. This station was to contain 11 three-phase dynamos, each of 3500 kilowatts output at 6600 volts. In order to realize the full economy of such a station, it was, of course, necessary that all the generators should supply current to a common bus-bar, and that from these bus-bars the current should be distributed through feeders to a number of sub-stations. The sub-stations were to contain rotary converters, frequently working in multiple with large storage batteries on the direct-current side. The characteristics of such a load prevented any reliance being placed upon the opening of the exciting circuit of the generators in case of the necessity of a general shut down, as the rotary converters would, under certain conditions, supply sufficient magnetizing current to excite the generators, even with the field windings of the generators unexcited. It became, therefore, essential to produce a switching mechanism which would enable the generators to be connected and disconnected from the bus-bars with certainty and safety under all conditions of load, even up to a short circuit, and also that the various feeders supplying the sub-stations should be capable of the same treatment. Three types of switching devices were available for this work and were carefully considered:

1. Switches breaking the circuit in the open air.
2. Switches arranged to break the circuit in an enclosed air space.
3. Switches arranged to break the circuit under oil.

Switches of the first type (open air) were impracticable, because the space demanded to make such switches operative could not be provided.

Switches of the second type (enclosed air) had no such limitation, but oil break switches were found to meet the conditions more perfectly. Tests conducted showed that energy up to 2000 to 3000 kilowatts could be controlled in a single oil switch at potentials as high as 15,000 volts, which was the limit of the apparatus at our disposal at the time. Switches of this type, however, as large as was considered necessary, required an amount of oil per switch so great as to be objectionable, in view of the large number of switches required

*A paper read at the Buffalo Convention of the American Institute of Electrical Engineers.

for generators and feeders. The problem then was to produce a switch which would retain all the advantages of the usual oil switch and at the same time minimize the quantity of oil.

The type which was finally evolved and employed in the Metropolitan installation has shown itself in practice to be remarkably successful. It is known as the Form "H" Oil Switch by the manufacturers, and was designed by the writer, with the assistance of Mr. E. M. Hewlett. It was described by Mr. J. E. Woodbridge in the Electrical World and Engineer of April 14, 1900. Reference to this article will give the details, which I need not here repeat. I shall simply outline the principal features.

The switch, as designed for three-phase circuits, consists of three double-pole, single-phase switches, or elements. Each single-phase switch is contained in a fireproof cell, but all three switches are designed to be operated simultaneously. Each single-phase element consists of two brass cylinders or cans, one can for each pole. The in-coming lead is attached to one of the cans and the out-going lead of the same phase to the other. Each cylinder is nearly filled with oil and is covered by a metal cap which carries a long insulating sleeve. Two copper rods joined by a metallic cross-head and forming together a U-shaped conductor, slide through the insulating sleeve and fit into tubular contacts at the bottom of the cans when closing the circuit. The cross-head of each U-shaped conductor is atached to a wooden rod, which extends through the top of the cell or casing which encloses the switch, and is in turn attached to a metal cross-head operated by an air motor or an electric motor, as the case may be. The three-phases are seen, therefore, to be broken or close simultaneously. When the three sets of U-shaped conductors are lifted, the circuit is broken under the oil at two points in each phase, or six points in each complete three-phase switch. The range of movement of the cross-head varies with the potential to be controlled; it is 12 inches in the switches in the Metropolitan station for 6000 volts, and 17 inches in the switches for the Manhattan station for 12,000 volts. The brass cans are lined internally with fiber to prevent the arc from jumping from the rod to the metal of the can when it is drawn up through the oil. Each switch unit stands alone on its own foundation, with the three phases in three separate cells or spaces separated by brick walls. These brick partitions act as barriers and prevents any possible burn-out in one cell from spreading to the others. As an opening of two legs breaks a three-phase line, an arc in one cell will not incapacitate the switch. The circuit breaker or switch differs radically from older forms in the separation of the phases as indicated, and also in the separation of the contacts for each phase, in two separate oil pots. This separation of the terminals of each phase gives two separate arcs, each enclosed in a space well removed from the others, so that the possibility of an arc communicating from one pole to another is obviated. It will be seen that in breaking a three-phase circuit, the arc is produced in six independent oil pots. This method of construction, together with the separation of the phases in separate fireproof compartments, accounts for the unusual effectiveness of the switch in practical operation. The general construction of the switch is clearly shown in the accompanying illustration.

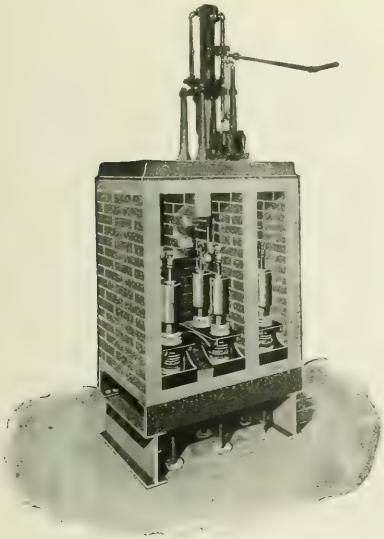


FIG. 1.—PNEUMATICALLY OPERATED SWITCH.

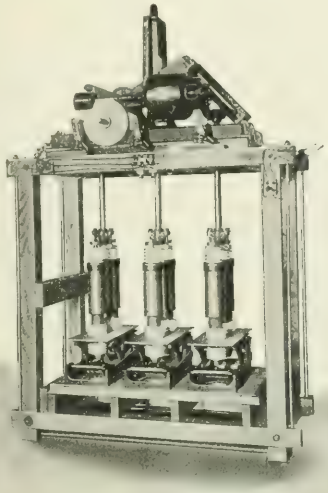


FIG. 2.—ELECTRICALLY OPERATED SWITCH.

Fig. 1 shows the switch used in the installation of the Metropolitan Traction Company, New York. It is designed for 6600 volts and 300 to 800 amperes.

Fig. 2 shows the same switch as modified to suit the conditions of the Manhattan electric installation. On account of the higher voltage the oil pots are larger and a larger opening of the circuit is provided. The 12 covers for the oil pots are replaced by porcelain. It is designed for 12,000 volts and 300-800 amperes.

Fig. 3 illustrates the enclosed air tube type of switch already mentioned. This switch has given most excellent results on high potential work.

Fig. 4 shows a form of tank oil switch, without the tank for containing oil.

Fig. 5 is a reproduction from a photo taken at Kalamazoo of a special form of open-air switch. The switch was opening a circuit of 25,000 volts and 60 amperes at the time when the photograph was taken.

It was at first thought that the use of oil switches for the control of high potential circuits would possibly result in reasonance effects, particularly in circuits containing considerable capacity, such as underground cables or long overhead lines. A number of experiments have been conducted and the weight of evidence seems to be in favor of the oil switch as avoiding these effects. It has been found as an interesting fact that under the conditions described considerable disturbance due to resonance may occur upon the *closing* of a circuit. This is naturally independent of the character of the switch employed; it may occur equally well with an oil, an enclosed air, or an open air switch.

Upon the rupture of the circuit, however, the results obtained from many tests indicate that open air switches are liable to produce heavy resonance effects while the enclosed air and the oil switch are practically free from such effects. Extensive experiments to determine this point were conducted prior to the production of the switches for the Metropolitan and Manhattan stations. Very recently experiments of a more severe character have been conducted at Kalamazoo, Mich. These tests were made at from 25,000 to 40,000 volts, with from 1200 to 1300 k. v. a. of highly inductive load, the

power factor being 40 to 60 per cent. The switches tested were the cylindrical oil switch, already described (Metropolitan type); an oil switch in which all the terminals were enclosed in a single tank of oil, called the tank oil switch; a switch of the expulsion air tube type; and an open air switch in which the terminals were simply separated long distances in free air. In making these tests an oscillograph was used to determine the time of break and other interesting effects, and a camera to photograph any particular instructive phenomena.

The long break open air switch, which operates upon the principle of drawing a long arc in the open air, opened the circuit at 25,000 volts, but required several seconds of time and drew such a long arc as to be impracticable. At 40,000 volts the arc held and flared to a total distance of over 30 ft. until it struck the line and short circuited the system, producing at the same time high voltage oscillations equal to two or three times the normal potential of the system. It would therefore seem that the open air switch was generally unsuitable for the control of high voltage systems of large power, as even where sufficient room is available for their use, the production of high resonance effects tends to endanger the system. These tests also show that wherever a short circuiting arc occurred in the open air, electric oscillations of high voltage resulted. These were probably due to the rapid alternate extinguishment and formation of the arc during its period of interruption, the arc acting somewhat in the manner of a Wehnelt interrupting device. The dangerous character of short circuiting arcs emphasizes the need of the precautions which I shall mention in this paper, having in mind the avoidance, as far as possible, of such accidental short circuits.

The expulsion tube air switch operated up to 25,000 volts, but failed at 40,000.

The tank oil switch operated satisfactorily on 1200 to 1300 k. v. a. up to 25,000 volts, but at 40,000 volts it spat fire and occasionally emitted black smoke, thus seeming to be working at the limit of its capacity. No attempt was made to open short circuits with the tank oil switch.

The cellular oil switch never failed to open 1200 to 1300 k. v. a. at any voltage up to the maximum employed, 40,000; the circuit opening noiselessly and without the appearance of fire or emission of smoke

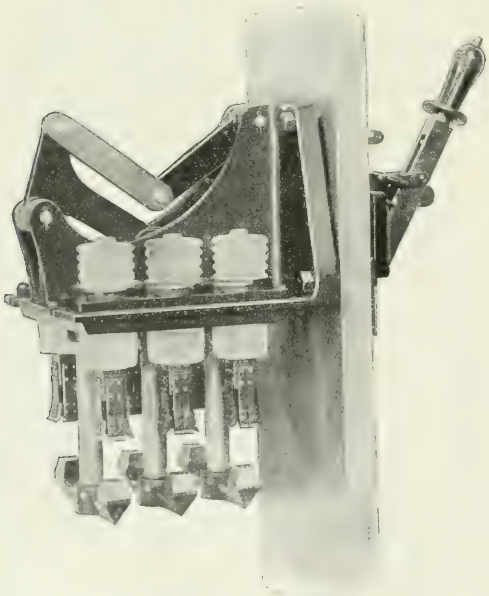


FIG. 3.—OIL BREAK SWITCH.

at the switch. It was used as an emergency switch in all the tests to open *short circuits* on 25,000 to to 40,000 volts. The results of these and other tests, and the continued effective operation of the cellular type switch in the Metropolitan station indicate that this type of oil switch will safely control circuits of practically unlimited power at potentials considerably above 40,000 volts, probably as high as 100,000 volts.

The character of the break when operating properly was the same

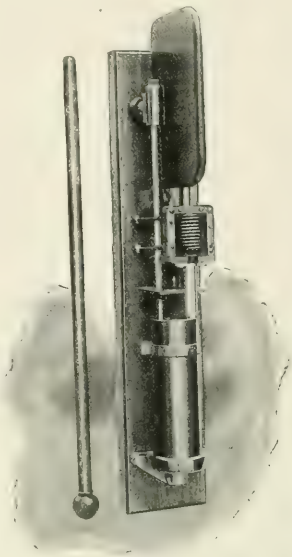


FIG. 4.—EXPULSION TYPE SWITCH.

in all the switches except the open air type. In opening, the arc held for a number of half waves from 6 to 18 and then broke at zero value without disturbance of the system. With the oil switches no traces of oscillation were noticed before the break, and no traces of rise of voltage. With the expulsion air switch, traces of oscillation were seen for a number of half waves before the final break and in consequence a slight voltage rise occurred.

I will not attempt to describe the numerous observations made at the Kalamazoo tests, as these will undoubtedly be given to you by our president, who supervised these tests and to whom I am indebted for the information which I have given regarding them.

In addition, however, to the production and use of a switch which will be as safe and reliable as engineering skill can make it, there are certain other factors which should be considered in connection with the control of current for high potential stations which should be taken into consideration by the electrical engineer. It should be constantly kept in mind that no apparatus can be absolutely free from accident, no matter how carefully designs are constructed. The engineer should, therefore, carefully consider the possible effect of any accident with particular reference to the possibility of an accident to one element involving other apparatus. The layout should be such that an accident to one element could not of itself, or in consequence of a chain of accidents, result in a breakdown of the entire generating station, even for a short time.

The mechanical engineer has considered this point and met it with a fair degree of success in the large modern central station with the fireproof boiler house and the frequent sub-division of this boiler house into two or more portions by suitable fire walls, as in the case of those of more than one story.

The general employment of a duplicate system of steam piping, or its equivalent, also provides a reasonable safeguard against failure of supply from accidental disarrangement of a steam system. The steam engines in well arranged stations, being important units, are placed a sufficient distance apart, and so disposed, generally, that an accident to one will not easily involve other units. This is also true of the dynamos which are directly coupled to the engines.

The switchboard with its switches for controlling and appliances for measuring the output of the generating station, the cables leading from the generator to the switchboard, the location of the busbars, and the disposition and arrangement of the feeder cables for distributing the current, have not, as a rule, been given that serious

attention which their importance deserves; in fact, the consideration of the electrical controlling devices and the wiring of the station has been apparently left to the last, and it is frequently the case that a generating station containing apparatus of great value has been jeopardized by the lack of careful design of the switching appliances. Stations designed to deliver a normal output of from 5000 to 10,000 kilowatts, at relatively high pressure, say, 5000 volts or upwards, frequently contain switches for controlling the generators and the feeders mounted upon the face of a long continuous panel, and so crowded together that in case of failure to open the circuits the resulting arc would be almost certain to involve adjacent switches and even possibly cripple the station for a time. The bus-bars are also often so disposed that an arc may easily start thereat or at least so that an arc, if started for any cause, would be liable to seriously damage the switchboard.

The same methods frequently obtain in regard to the manner of installing the conductors; high tension and low tension conductors being often mixed together and the conductors so arranged that in case of any injury to one, other of the conductors leading from the generators or from the switchboard out of the station are in danger of being involved.

These methods have probably arisen from the fact that up to a comparatively recent period the service of a city for lighting and for power has been separated among a number of different stations, each of a relatively limited amount of power. In case of the failure of any individual unit in such case, as of the generator, switchboard, or other apparatus, the damage was small, owing to the limited energy available. A shut down, even of the whole station, was comparatively unimportant. However, the case is quite different with the large modern station with output of from 10,000 to 100,000 horsepower, which is designed to supply electrical energy for a large portion of a city's needs, combining frequently electric power for traction purposes, for lighting, etc. The economies expected of such stations—lower cost of operation, smaller investment and greater economy in coal and in steam—due to the better load curve obtained by the concentration of loads of large area and of various character in one station, as well as to the higher efficiency of the large units, are familiar to all electrical engineers. I am inclined to think, however, that the possible dangers of such a concentration of energy have not been fully realized. The failure of such a station, even for a brief period, would be a disaster which, with proper design, need not occur.

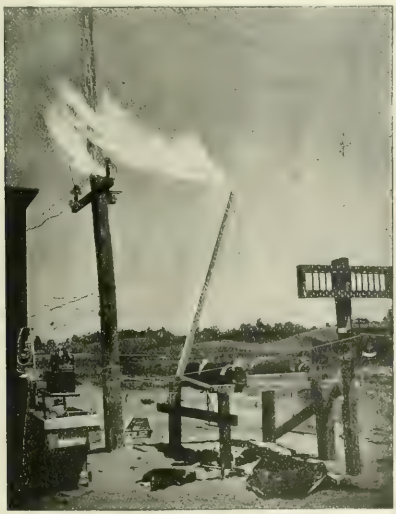


FIG. 5.—EXPERIMENT WITH AIR BREAK SWITCH AT KALAMAZOO.

I will briefly outline the principles which I believe should govern in the layout of such a central station, the details of which may naturally be varied considerably to suit local conditions. It should be kept in mind that I am discussing stations of normally large output, say, 5000 kilowatts and over, although many of the principles mentioned could probably be applied with advantage to stations of smaller size. Broadly speaking, I would carry the principle of subdivision into units as far as practicable; the units to be chosen with respect to the size of the station, character of load curve, etc. The boiler house, as already stated, should be sub-divided into two or more distinct portions, so that injury to one will not involve the entire steam system. Fortunately, the foundations, masonry and mounting of boilers are so essential and of such a nature that damage to one unit is not liable to involve another. At the same time, it is important that the boiler house should be divided into two or three sections, separated from each other by brick partitions. The steam piping should be in duplicate or a substantial equivalent, and so arranged that the bursting of a steam main cannot flood all the boiler rooms with steam or stop the entire flow of steam to the engine room. The engines, with the dynamos coupled thereto, may be placed in one large room, provided this room is of sufficient size to enable the units to be placed at proper distances apart. The switchboard should preferably be placed in a separate room, so that any accident to the engine or to the steam piping will not injure the switchboard operator or the switchboard mechanism. The electrical conductors from each dynamo should be led to the switchboard as far apart as possible from those of other units. Each set of conductors should be led to its own switch. Each switch should be of ample capacity to interrupt the entire output of the generator at full voltage and even take care of the concentration of the entire load of the station, as in a short circuit. This switch should be placed in a cell of fireproof material and preferably electrically controlled from a central point. If so disposed, these switches may be placed reasonably close together, but the partitions should be such that any one of the switches could arc to destruction without involving the switch of a neighboring generator. Switches should be in duplicate, so that in case of failure of one, another switch will be in readiness. Especial care should be taken, in leading the conductors from the switches to the bus-bar, to keep the conductors as far as possible from those of neighboring units.

The bus-bar or bars should preferably be in duplicate, or some equivalent arrangement such as sectional sub-division, should be adopted. Bus-bars should be carefully protected in fireproof compartments so arranged that it would be impossible for any arc to short circuit from one conductor to another or for it to be injured by an arc caused by the destruction of any of the generator or feeder switches. The same care should be taken to isolate the conductors leading from the bus-bars to the feeder switches. The feeder switches should also be in duplicate; that is, two separate sets of switches on each feeder in series with each other when feasible, or the conductors leading to a group of feeders may be joined together by a switch placed in series therewith controlling a group of feeders. Each group switch and each of the feeder switches should be mounted in its own separate fierproof compartment and preferably controlled electro-magnetically from a distance. The conductors leading from the feeders out of the staion should not be massed together in one conducting trench or well, but should be sub-divided into as many groups as circumstances will permit.

The constant aim throughout the entire station should be to limit the normal flow of energy in a given space to a predetermined amount, preferably for example, to that of the generator unit which has been selected, or in the case of the feeders leading outside the station the normal flow of a group may be limited to that delivered to any one sub-station.

It is obvious that the arrangement of switchboard, as described will occupy more space than the ordinary panel type. The total space occupied, however, is but a small portion of the total space required for the generating plant, and it is believed that the precautions recommended are essential to the continued success and reliability of large generating plants. Such separation of the switches, etc., makes some method of control from a distance very desirable. The motors used for operating the switches may be either pneumatic or electric. The control of these motors should preferably be electric in all cases. By adopting electric control from a distance, it is possible to combine all the switches required for the generator, feeders, etc., upon a small keyboard under the observation and control of a single operator. It is also possible to place this operator in such a position that he will have a comprehensive survey of all the measuring and controlling devices needed for the station, and at the same time be free from danger in case any of the apparatus should fail to perform its work. Under such circumstances the operator is much less liable to make a mistake, and it is believed that having taken

such precautions accidents even of a trivial character will be more unlikely to occur. In laying out the electrical devices for such a station the utmost simplicity should be aimed at; not a single instrument, conductor or switch being placed in the station that has not been carefully considered and felt to be essential. It is better to err on the side of simplicity than of complexity.

Power Factor Indicators.

THE Institute paper of Professor William Hand Browne, Jr., on the above subject, opens with an examination of the principles involved in power factor instruments for use on circuits where it is desirable to balance wholly or partly the wattless component of current due to induction motors, by the use of synchronous motors or converters. It is shown that measurements for determining the phase angle are unsatisfactory when involving the cosine, if the cosine approaches unity. We must measure either the phase angle directly or indirectly, or what in most cases would be equally satisfactory, the wattless volt amperes; that quantity Mr. Steinmetz has called the "wattless power."

Unfortunately, few of the methods suggested for measuring these quantities are more than laboratory methods, and the instruments used are unsuitable for practical work. The split dynamometer of Blakesley, the three-voltmeter method of Fleming, and the three-ammeter method of Sumpner are too familiar to need description, and are hardly applicable under the usual operating conditions. There are, however, two or three instruments which give satisfactory service under proper conditions.

Power factor indicators are classified in the paper under four heads:

1. Phase meters, by which the phase angle is determined directly.
2. Power factor meters, measuring a function of the phase angle.
3. Wattless power meters, measuring $E\ I \sin \phi$.
4. Wattless current meters, measuring $I \sin \phi$.

In the first class there may be included, in addition to types to be described below, all forms of oscillographs and curve tracers. The second class may include all instruments measuring $\sin \phi$ and $\tan \phi$ as well as $\cos \phi$.

These classes may be further sub-divided, according to the means employed to obtain an indication, into four types:

(*a*) Electromagnetic, using the force of attraction of electromagnets.

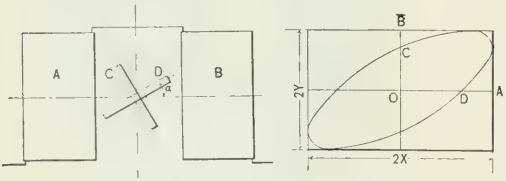
(*b*) Electro-dynamic, utilizing the reaction between coils carrying currents.

(*c*) Induction, a rotating magnetic field is set up and used to deflect a disk.

(*d*) Electrolytic, depending upon electrolysis to secure a record.

Phase Meters.—The various types of oscillographs and curve tracers are too well known to need description. In general they are laboratory instruments and not applicable to commercial working

Tuma's Phase Meter (1*b*).—Let the pair of coils A B (Fig. 1)



FIGS. 1 AND 2.—POWER FACTOR INDICATORS.

carry the current whose phase angle, referred to the e. m. f., is desired.

Within the space between the two, suspended freely, is the movable system C D, consisting of two independent windings connected together mechanically at right angles. Let *a* be the angle which D makes with the axis of A B.

The paper then proceeds to show mathematically that *a* is the phase angle.

Induction Phase Meters (1*c*).—If we pass through two coils, concentric but set at an angle with each other, currents which set up equal fluxes differing, however, in phase, a rotating magnetic field of elliptical form will in general be created. If the two coils are inclined at an angle which is the supplement of the phase angle, the resulting field will have a constant value. An armature suitably placed in such a field will cause a ray of light reflected from an attached mirror to travel in a circle. In applying this method it is necessary to have the fluxes of equal value and to change the angle between the coils until the ellipse becomes a circle when the phase angle is read off directly. The instruments of Angelmeyer, Korda, Hess, Rossi and one of Arno, make use of this principle.

Electrolytic Phase Indicator (1*d*).—A very simple device, due to Janet, consists of a metallic drum upon which rest two styli of iron. One of these is connected so as to have a difference of potential between it and the drum which is in phase with the current, the other one being in phase with the e. m. f. On the drum is stretched a sheet of paper which has been soaked in potassium ferrocyanide and ammonium acetate.

When the difference of potential between either stylus and the drum reaches a certain positive value, electrolysis begins and the paper under that stylus turns blue. Now, if the drum be turned, each stylus traces a broken blue line on the paper, each blue mark representing part of a positive half wave. The angular distance from the center of one of these short lines and that of the corresponding mark made by the other stylus, expressed in electrical degrees, is the phase angle. This is true only when the two waves have the same form.

Powr Factor Meters (2).—Two harmonic motions acting at right angles and having the same frequency and amplitude, but a difference in phase of 90 degs., will produce, if acting at the same time, a uniform circular motion. If the amplitudes are not the same, the result is an ellipse, the major and minor axes of which are the respective paths of the two harmonic motions.

If the phase difference is not 90 degs. the two axes of the resulting ellipse do not coincide in direction with the two harmonic motions.

Puluj's Power Factor Meter (2*a*).—The principle just described has been made use of by Puluj. Two electromagnets, through the winding of each of which, one of the currents, the phase difference of which is desired, is passed, act upon two armatures causing them to vibrate in planes normal to each other. A ray of light falling upon a mirror attached to one of these and reflected to a second mirror on the other, and thence to a screen, will describe an ellipse, the shape and position of which is determined by the values of the two currents and the phase difference. Referring to Fig. 2, it is shown in the paper that $\sin \phi = OC/OB = O\eta/OA$.

Morland's Power Factor Meter.—In an apparatus described by Mr. Morland, the two conductors carrying the two currents pass between the poles of a permanent magnet. Each of these causes a small mirror to vibrate, producing the result just described.

Claude's Power Factor Meter.—Claude places the two electromagnets in direct opposition and causes them to actuate the same armature. Let the maximum flux set up by each coil be N. The ray of light reflected from the mirror will, under the influence of the flux N, oscillate along a path in length $K\ N$, K being a constant. If both coils were acting and if the currents were in phase, the length of this path would be $2\ K\ N$. Call this d_1 and the path of the ray d_2. Then it is shown that

$$\frac{d_2}{d_1} = \cos \frac{\phi}{2}.$$

It is evident from what has been said above that this method will not be accurate when ϕ approaches zero.

Rayleigh's Power Factor Meter (2*a*).—Lord Rayleigh's apparatus for measuring phase angles is somewhat similar to the above. The movable loop is replaced by a soft iron needle and the two coils are placed on opposite sides of this.

The deflections are measured as in a reflecting galvanometer. Mr. Edwin Place gives the results of a great number of experiments made with an instrument of this type. He shows that the angle found in this way is that between the equivalent sine waves. The cosine of this angle, however, is not given by the ratio of true watts to volt amperes, the true power factor.

Tuma describes an instrument similar to the above, but with the coils at right angles. One of these lies in the magnetic meridian.

He shows that, with specially wound coils, if ϕ is the phase angle and ϕ the angle between the needle and that coil which lies in the magnetic meridian, then $\cos \phi = \tan 2\ \psi$

Dynamometer Types.—A Siemens electro-dynamometer having two fixed coils may be used for phase angle measurements if the movable system be replaced by a coil closed upon itself and suspended in the plane of the other two. Suppose that with one current flowing in one of the coils the angle of torsion to keep the movable coil in its zero position is d_1, and with the other current flowing in the other

coil it is d_2, and with both currents flowing at the same time the angle is d_3. Then $d_1 + d_2 - 2\sqrt{d_1 d_2} \cos \phi = d_3$, from which the phase angle can be deduced.

Arno's "Tangent Phase Meter" (2b).—A second power meter of Arno's consists of a Siemens electro-dynamometer with an additional pair of coils closed upon themselves and fastened together at right angles. The pair, as a whole, is suspended within the two other coils and may be held in any position by a torsion spring. In Fig. 3 let A

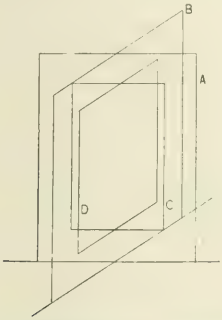


FIG. 3.—POWER FACTOR INDICATORS.

and B be the two coils of the dynamometer and C and D the pair of short-circuited loops.

Passing the two currents through A and B, respectively, the instrument becomes a wattmeter, and d_1 is the angle of torsion required to keep the movable coil in position.

Now, fix B and pass one current through A, and the other through B. Let d_2 be the angle corresponding to the couple between A and B; then $\tan \phi = K \frac{d_1}{d_2}$.

Breitfield's Method (2b).—Mr. C. Breitfield has suggested an application of an ordinary wattmeter for measuring the power factor of a three-phase system. The current coil is placed in one line and one end of the pressure coil also connected to this line. The other end is first connected to the second line and then to the third. In the first case we have the deflection of d_1, and in the second a deflection of d_2. Then $\tan \phi = \sqrt{3} \left[\frac{d_1 - d_2}{d_1 + d_2}\right]$.

General Electric Company's Instrument (2b).—The well-known fact that the ratio of the readings of the two wattmeters used to measure the power of a three-phase system changes with the power factor and is unity when the power factor is unity, has been made use of by the General Electric Company to indicate the power factor. The instrument is simply two wattmeters of the dynamometer type, the movable coils of which are attached to the same spindle. The instrument deflects to the right or left, according as the current lags or leads, and stands at zero when the system is balanced and the power factor unity.

Ferraris' Power Factor Meter (2c).—Ferraris combines two harmonic fields, producing a rotating field of elliptical form. Within this field is suspended a short-circuited coil which can be held in any position, by a torsion spring, as is the movable coil of a Siemens dynamometer. The force required and therefore the angle through which the spring must be turned, to hold the coil in any position is proportional to the square of the intensity of the flux in that direction. Points can thus be determined and the ellipse plotted and the sine of the phase angle deduced as above. (See Puluj's method.)

Power Factor Indicators (3).—In the methods described above, the object sought was the determination of the phase angle. But few of these are applicable under the usual operating conditions. We might mention as useful forms, those of Tuma and the General Electric Company. In most cases, however, we are more concerned with the magnitude of the wattless component of current than with the power factor. We care less about the decrease in the total output than about the poor regulation caused by inductive loads. Instruments which will indicate the wattless current, or rather the wattless volt amperes, are easily made in commercial form.

"Wattless Wattmeters." Dynamometer Type (3b).—A Siemens dynamometer becomes a wattmeter indicating $E\ I \cos \phi$ when the current is passed through one coil and a current proportional to and in phase with the e. m. f. through the other.

If the current in the pressure coil be in quadrature with the e. m. f. the instrument indicates $E\ I \sin \phi$, the wattless volt amperes.

This is easily done with a two-phase system. With a single-phase system it is necessary to place a proper condenser or inductive reactance in series with the pressure coil.

"Wattless Wattmeters." Induction Type (3c). *Dobrowolski's Power Factor Indicator.*—In a fully compensated induction meter the shunt flux is in quadrature with the series flux, the result of the two being a rotating or shifting field. If the shunt flux be brought into phase with the series flux an alternating field only will be set up as long as the current and e. m. f. are in phase. If, however, the current lags, the field will rotate in one direction. If it leads, the field will rotate in the opposite direction. The torque developed on a disk placed in this field is, in either case proportional to $E\ I \sin \phi$, the wattless volt amperes. This is the principle of Dobrowolski's apparatus.

The movable disk is held in its zero position by a spring when the wattless volt amperes are zero, but deflects one way or the other, when the current is out of phase, an amount proportional to $E\ I \sin \phi$.

Any induction wattmeter can be used in this way provided the flux through the pressure coil be brought into phase with the e. m. f.

Wattless Current Meters (4).—The Allegemeine Electricitats Gesellschaft make an instrument which indicates the wattless current. This is really an induction wattmeter having the shunt flux in phase with the e. m. f. and indicates therefore only when there is a phase difference. As an instrument of this type indicates $E\ I \sin \phi$, it is presumed that this meter is graduated to read $I \sin \phi$ at normal voltage, and should properly come under "wattless wattmeters" (3c).

The Siemens Electro-dynamometer.—The paper gives a set of curves which were taken with a Siemens dynamometer, the movable coil of which was in series with a capacity of 3.5 microfads. The values of $\cos \phi$, $\sin \phi$ and $E\ I \sin \phi$ plotted have been computed from ammeter, voltmeter and wattmeter readings given in Table I.

$E\ I \sin \phi$ is a straight line and is plotted above and below the axis to indicate lagging and leading currents, respectively. The base is the deflection in degrees. These curves were taken for a constant power delivered, of 500 true watts. The displacement of current was obtained by means of a phasing transformer. For comparison between $E\ I \sin \phi$ and $\cos \phi$ the axis of abscissæ was taken as unity for the latter, and the decreasing values plotted above and below this.

TABLE I.

SIEMENS DYNAMOMETER AS POWER FACTOR INDICATOR.

Amp. I	Volts E	Watts $E I \cos \phi$	Deflection. ϕ	Direction.	Phase	Apparent watts $E I$	Power factors $\cos \phi$	Inductance factors $\sin \phi$	$E I \sin \phi$
10.15	108	500	213	Right	Lead	1096	.456	.889	975
8.4	108	500	158	"	"	907	.552	.834	755
7.58	107.9	500	141	"	"	818	.611	.791	647
6.51	108	500	106	"	"	703	.711	.703	494
5.63	107.8	500	78	"	"	607	.823	.568	294
5.25	107.8	500	53	"	"	516	.884	.467	241
4.78	105.5	500	13	Left	Lag	504	.992	.126	63
5.05	105.7	500	44	"	"	533	.938	.346	185
5.67	106.1	500	79	"	"	602	.831	.555	334
8.17	106	500	155	"	"	869	.577	.817	707
9.61	105.9	500	197	"	"	1017	.497	.867	875

NOTE. Pressure coil in series with 3.5 microfarads capacity.

It is shown that these lines do not pass through the origin. The resistance of the pressure coil is not negligible, as the instrument shows a slight deflection at unity power factor. The curves show very clearly that a slight change in the power factor when near unity caused a comparatively large change in the value of $E\ I \sin \phi$.

This fact is very striking when working with the instrument. It may be made to deflect considerably to the right or left without producing any appreciable change in the reading of the Weston wattmeter, the current and voltage remaining constant the while.

Power factors for larger power delivered, lie below the one just considered and hence are still flatter when approaching unity. One for 1000 true watts has been plotted from calculated values only. It shows that it would be practically impossible to say from ammeter, voltmeter and wattmeter readings alone, when the current was in phase with the e. m. f. With the power factor indicator, however, there would be no difficulty in getting an almost exact adjustment.

Weston Wattmeter as Power Factor Indicator.—The characteristic of a Weston wattmeter of 150 volts, 50 amperes capacity, used on a two-phase system in the manner described above, is given. The characteristic is a straight line, but does not pass through the origin.

This may be due either to the slight inductance of the pressure coil, or to a slight change in the phase angle between the impressed e. m. f.'s, or to both.

The method of calibrating consisted in connecting the pressure coils of the power factor indicator and wattmeter, respectively, to the two primary windings of a two-phase induction motor, used as a phasing transformer. The current coils of the meters were in series and connected to the movable secondary. As the secondary is shifted, the load is partially shifted from one phase of the primary winding to the other. This doubtless caused a slight change in the phase angle between the e. m. f.'s at the motor terminals. The motor used was rated at 2 horse-power. The supply was drawn from two 4-kw transformers, both partially loaded in addition with lights.

TABLE II.

WESTON WATTMETERS AS POWER FACTOR INDICATOR.

True Watts.	Voltage.	Amperes.	W'tless volt amperes observed.	Phase relation.	Volt-amperes.	Power factor.	Inductance factor computed.	W'tless volt-amperes computed.
1970	111.5	44.4	4530	Lag	4950	.398	.917	4540
1970	111.5	29.8	2690	"	3340	.590	.807	2690
1970	111.5	20.1	1050	"	2240	.879	.477	1070
1970	111.5	17.7	180	"	1975	.997	.071	140
1970	111.5	17.65	0	—	1970	1.0	.0	0
1970	111.5	20.1	1130	Lead	2240	.879	.477	1070
1970	111.5	29.8	2785	"	3340	.590	.807	269
1970	111.5	44.4	4610	"	4950	.398	.917	4540

The agreement between observed and calculated values of $E\ I$ sin ϕ is good. Table II. gives observed and computed values for this instrument.

NInduction Motors.—The paper shows a set of curves obtained from a Shallenberger integrating wattmeter used as a power factor indicator. The instrument is a 500-volt, 10-ampere meter of the older type (1898). The reactive coil was replaced by a non-inductive resistance of 2000 ohms. In series with this was a capacity of 3 mf., this being found to balance the inductance of the shunt coil at a frequency of 60 cycles. In this case the instrument was used as a recording meter. The curves plotted are $E\ I$ sin ϕ, cos ϕ and ϕ, all on a revolutions-per-minute base, for a delivered power of 500 true watts. Table III. gives the instrumental readings and computed values for these curves.

Table IV. gives results from the same meter under somewhat different conditions. Here the recording train was removed to lessen the friction, and a light steel spring attached to the spindle of the revolving disk. A pointer attached to the disk passed over a scale marked in degrees. The curves plotted are, as before, $E\ I$ sin ϕ, cos ϕ and ϕ, for a delivered power of 500 true watts. The base is degress deflection. It is shown that from 20 degs. lag to 20 degs. lead the deflection is almost directly proportional to the phase angle. The flattening of the curve for cos ϕ is very marked. This instrument was even more sensitive than the dynamometer and besides was dead beat, as the damping magnets were left in. Table IV. gives the instrumental readings and computed values for the curves.

TABLE III.

SHALLENBERGER WATTMETER AS POWER FACTOR INDICATOR.
10 AMPERES, 400 VOLTS.

Amp.	Volts.	Watts	r.p.m.	Direction.	Phase.	Apparent watts $E\ I$	Power factor cos ϕ	Phase Angle	Inductance. factor sin ϕ	$E\ I$ sin ϕ
10.03	111.3	505	30.8	Left	Lagging	1114	.449	630—10′	.898	996
6	111.5	505	13.45	"	"	669	.756	40—53	.655	438
4.78	110.3	505	4.68	"	"	527	.954	17—26	.300	158
4.5	111.0	505	0	"	—	504	1.00	0	0	0
4.58	114.5	505	5.29	Right	Leading	525	.962	15—50	.273	143
6.09	112.2	505	14.6	"	"	684	.738	42—26	.675	462
10.0	111.2	505	30.6	"	"	1112	.454	63—00	.891	992

NOTE.—Impedance coil cut out and shunt coil in series three microfarads and 2,000 ohms.

Application of Power Factor Indicator.—To illustrate the application of a power factor indicator, the Weston wattmeter mentioned above was used to measure the wattless volt amperes taken by a General Electric 7½-kw, 125-volt, four-pole synchronous converter for different values of field current. The converter was run on a two-phase system at constant input. The supply was drawn from two Westinghouse 7½-kw transformers, both fitted with a Hartford regulator. The output was absorbed by a lamp bank and water rheostat.

Curves were plotted with armature current and wattless volt-amperes as ordinates, the base being field current. The imput was 3½ kilowatts per phase. The flatness of the current curve alluded to above was quite noticeable here. The characteristic for wattless volt amperes was plotted above and below the axis of abscissæ to indicate lagging and leading currents, respectively.

The instruments were quite steady, a condition indicating but little hunting of the armature, although there were no devices on the machine to prevent this phenomenon. The power factor indicator, although exactly like the wattmeter, was even steadier than the latter. There was no difficulty in setting the indicator to read any desired value by adjusting the field current.

It was stated at a recent meeting of the National Electric Light Association, during the discussion of a paper on synchronous converters, that it was practically impossible to operate a synchronous motor or converter at unity power factor. The reasons given were

TABLE IV.

SHALLENBERGER WATTMETER AS POWER FACTOR INDICATOR.

Amperes.	Volts.	True watts	Degrees deflection.	Direction.	Phase.	Apparent watts.	cos ϕ	ϕ	sin ϕ	$E\ I$ sin ϕ
8.29	110.	500	75°	Left	Lag	911	.549	56°—42′	.836	761
6.54	109.	500	50	"	"	712	.702	45—35	.712	507
5.41	109.2	500	30	"	"	590	.848	32—00	.530	313
4.94	109.9	500	20	"	"	543	.921	22—56	.390	212
4.57	111.1	500	10	"	"	507	.987	9—04	.158	80
4.59	108.4	500	0	—	—	498	1.	0	0	0
4.67	109.	500	10	Right	Lead	509	.982	10—53	.189	96
5.35	108.	500	30	"	"	578	.865	30—07	.502	290
6.45	109.7	500	50	"	"	707	.708	45—05	.706	498
8.16	108.7	500	70	"	"	886	.564	55—40	.826	732

NOTE.—Impedance coal removed and shunt coil in series with three microfarads and 2000 ohms non-inductive resistance. Recording gear removed and light torsion spring attached to disk.

hunting of the armature and dissimilar e. m. f. waves of motor and generator. In the above experiment it was found that the power factor indicator could be set at zero and under these conditions the true watts and the volt amperes were equal. This condition would seem to be that of practically unity power factor.

A number of power factor curves of synchronous converters have been published recently, in which the current passes from lag to lead without the power factor passing through unity. Even if it were impossible to hold the power factor at unity, it must pass through this value as it swings across the line.

In Table V. are given the data which were obtained in a test, power factor being from wattmeter readings and inductance factor from the "wattless wattmeter" readings. In addition there were plotted two curves obtained by assuming these values to be cosines and sines of phase angles and the corresponding values of sines and cosines taken from tables and plotted on the same base. These deduced values do not agree at all with the observed ones. The discrepancy is greater for leading than lagging currents. This discrepancy, as has been pointed out by Mr. Steinmetz, is due to the distortion of the e. m. f. and current waves.

Conclusions.—It would seem from the above that there is a decided need of an accurate power factor indicator in all large installations,

TABLE V.

GENERAL ELECTRIC SYNCHRONOUS CONVERTER. 7½-KW, 125-VOLT, FOUR-POLE, 60 ~, TWO-PHASE. INPUT 3.5 KILOWATTS PER PHASE.

Wattless kilo-volt amperes.	Amperes armature current	Voltage at brushes	Amperes field current	Phase relation.	Kilo-volt amperes.	Power factor	Inductance factor	sin computed from power factor.	cos computed from inductance factor.
5.55	61.6	109.9	0.57	Lag	0.76	.518	.822	.855	.569
2.62	40.9	109.9	1.03	"	4.5	.778	.583	.628	.812
0.45	32.0	109.8	1.36	"	3.51	.997	.128	.077	.992
—0.05	31.9	109.8	1.47	Lead	3.50	1.0	.014	.0	.999
—0.45	32.1	110.0	1.55	"	3.53	.992	.128	.126	.992
—1.20	35.7	110.4	1.69	"	3.94	.888	.306	.460	.952
—3.65	51.3	110.0	2.22	"	5.64	.621	.648	.784	.762
—6.65	71.9	100.8	2.75	"	7.89	.444	.844	.896	.536

but especially in those in which induction and synchronous motors are used together. This method of operation has been adopted by the Deering Harvester Company, where adjustment of the exciting current of the synchronous machine is made by means of a wattmeter, and at Butte, Mont., where adjustment is made from ammeter readings. The advisability of adopting this composite system is not in question here. We are considering merely the best method of attaining the end sought. For accurate adjusting of the system the indications of the instrument should depend upon the values of ϕ or sin ϕ and not upon cos ϕ.

Instruments of the dynamometer or the induction type seem more

suitable for operating conditions. If the meter be of the dynamometer type the resistance of the pressure coil must be negligible if it is to be used on a single-phase system, as the current in this coil must be in quadrature with the e. m. f.

If the meter is to be used on a two or three-phase system, the inductance of the pressure coil must be negligibly small, and meter connected in one of the methods described above. In this case care must be taken that the loads on the different phases be kept equal. In a two-phase system, unbalancing the phases will shift the e. m. f.'s relatively to each other. In a three-phase system, since the meters used are really wattmeters, unbalancing the phases will vitiate the indications of the instrument.

If the meter be of the induction type the inductance of the pressure coil must be negligible, since not only is it undesirable to use condensers to compensate for this, both from their bulkiness and expense, but the presence of any reactance makes the deflection dependent upon the frequency. An attempt was made to improve upon the induction meter described above by removing the three-legged stampings of iron upon which the pressure coil was wound. The inductance was still too large for satisfactory working, and as the condensers in the laboratory were not sufficient to compensate for this, it was necessary, to make up for this lack of capacity and to avoid the use of iron, to add an auxiliary inductance wound on a wooden bobbin. The instrument thus modified was found to be so sensitive to slight changes in frequency that it was impossible to use it with any degree of satisfaction in the laboratory. Any change of load on the prime mover would so change the reading of the instrument as to make its indications extremely unreliable.

Dobrowolski shows, in the reference given above, the application of his instrument for automatically adjusting the excitation of the synchronous machine so as to keep the power factor at unity at all times.

The use of an instrument of this kind emphasizes the fact that, when induction motors are used alone, the inductance factor is always a large percentage of the power factor. For instance, when the power factor is .85 the inductance factor, assuming sinusoidal waves, is nearly 62 per cent of this. That is, for every 1000 watts used by the motor, 620 "wattless watts" are, so to speak, borrowed. It would seem but fair that those who used induction motors should at least pay rental for the wattless volt amperes required. It is true this does not represent energy consumed, but it does, in a sense, represent energy borrowed and returned and the station must have sufficient capacity in generators to meet all such calls for loans.

The additional charge could be taken care of by over-compensating integrating wattmeters of the induction type, as suggested by Mr. Benischke. They would then read high on lagging reactive loads and low on leading reactive loads. This would put a premium on the use of synchronous motors as they, if not too greatly over-excited, help out in the regulation of the plant. The induction motor has so many points in its favor it can well afford to pay for what it needs—a large wattless component of current.

A Note on English Methods.

By E. Kilburn Scott.

One result of the recent visit to Germany of the British Institution of Electrical Engineers is that it makes the younger English engineers more and more dissatisfied with the state of the electrical industry at home. A grave fault with all British electrical engineering is that it has throughout been of too tinkering a character, and this is partly traceable to the training of the men who have until recently, at any rate, taken leading positions in the electrical profession in England. The telegraphic and telephone men, inventors (or royalty mongers), wiring contractors, etc., are very good in their place, but as engineers in the broad sense they are undoubtedly not a success, and this is well known on the continent. However friendly on the surface, there is no doubt that the highly technical German expert looks upon the partly trained telegraphist or commercial man posing as an electrical engineer as the fraud he really is.

One thing is very evident, and that is that the purely English manufacturer must knock off making dynamo machinery, etc., and let some one else do it for him. This, as a matter of fact, is what is happening, in that various firms from abroad are establishing works in England to do that which the home firms should have done long ago. The average tinkering, tinpot, copper alternator and two-pole dynamo makers, especially those employing as dynamo designers students who hardly know a pump from a mangle, are going to get badly left, and they deserve it. Another individual who will have to go is the one-horse template pattern consulting engineer, the man who for lighting a town advises and lays down a 60-kw generator or some equally absurd small unit. Then there is the man can't advise his client to run a works by polyphase motors because such motors "are so inefficient," when any one can see that the real reason is because he knows absolutely nothing about the subject. Finally, there is the funky-monkey commercial man, who figures, so largely on the directorates of English limited companies—he also won't be missed.

Some few years ago a well-known Glasgow gentleman made a semi-official visit of inspection round the leading iron and steel works of the States. On his return he stated very impartially the position of affairs, but the British ironmasters were critical and said money was not being made in actual manufacturing, etc. Yet it came out later in the lawsuit between Carnegie and Frick that the former had been taking millions a year out of the business in manufacturing profits alone.

As it was with the steel trade, so it is with the electrical industry. When the pottering English manufacurer sees or is told of the fine works abroad, he promptly says that they are not working at a profit. He states in so many words that the money is being supplied by banks for the pure love of squandering it, totally ignoring the fact that banks abroad are conducted on practically the same commercial lines as in England, and they don't carry on business purely for the love of it any more than Carnegie or his partners.

The writer thinks he can detect a tendency in the English manufacturer to pat himself on the back and say, "T. G., we are not as other men (the Germans and Americans) are. We may be behind in our design and methods of manufactures, but, at any rate, our finance is all right." But such as are of this way of thinking will make a grand mistake if they carry on their stick-in-the-mud policy any longer. Although they may be busy for the time being, there is no doubt about it that the continental firms are preparing to rush plants into England at prices which the badly equipped English works cannot reach by 15 or 30 per cent; and, further, English buyers are every day getting more and more confidence in machinery designed or made abroad as has been shown recently in a most striking manner.

At present it is the fashion to blame the English working man, his unions, the growth of the municipal idea—in fact, anything but the main reason, which is the woeful ignorance or supineness of those who are supposed to lead in the English electrical profession. The American firms got into the English market in the first instance by supplying alternating-current machinery which could be depended on to work continuously without break-down. When traction work came along, what was easier than that some established English firm should take an American traction motor and build some like it. One or two did essay the task, but they made such an awful mess of it, that it was not until an American firm was established in the country that reliable home-made car motors could be bought.

Foreign firms are now taking the cream of the orders—that is to say, all the big contracts—simply because no home firm has designers or the plant to execute such work. Eighteen firms quoted to Manchester the other day for a £140,000 order, and of these 15 were foreign, and it was given to a Berlin firm. A Frankfort firm, Lahmeyer & Co., got the two Charing Cross & Strand orders, totaling £350,000, and the many contracts secured by American firms are too well known to need recital.

It might be thought that these strictures are too severe, but those who have a thorough inside knowledge will recognize their truth. If there were anything to applaud the English manufacturers for, the writer would be the first to do it. At present, however, they only want a whipping for being such incompetent messers.

The Gender of "Automobile."

This question of gender is a vexing problem to French grammarians. Many writers make it feminine. Emile Faguet is among them. But the *Auto-Velo* reproached him for defying the academy, which is said to have voted for the masculine. Faguet then wanted to know why the Academy made "automobile" masculine, at the same time that it made "locomobile" feminine. "Why," was the reply, "an automobile is clearly too ugly to be feminine."

Magnesium Carbide.

The recent announcement of a method for the production of carbide of magnesium by direct reduction recalls the interesting part which this body played in the early history of the carbide art. The existence of a compound having the formula MgC_2 was known, and it was readily calculated from considerations of atomic weights, that a carbide of the above composition should, by reduction with water, yield an amount of acetylene gas large exceeding, per unit weight of carbide, the quantity obtainable from the calcium compound. Thus 1 lb. of calcium carbide liberates, according to theory, .406 lb. of acetylene, or at 60 degs. F. and 30 inches barometric pressure, 5.93 cubic feet, whereas the reaction—

$$MgC_2 + 2H_2O = Mg(OH)_2 + C_2H_2$$

indicates .591 lb., or 8.63 cubic feet of acetylene for each pound of magnesium carbide, an excess of nearly 50 per cent. It seemed a fair assumption that methods capable of yielding calcium carbide would prove effective for the magnesium compound, and indeed Borchers had announced with all the emphasis of spaced type that given a sufficient temperature every metallic oxide was reducible by carbon. Accordingly, we find that Willson in his early foreign patents specified dolomite (the double carbonate of calcium and magnesium), as a raw material of peculiar value for carbide manufacture, and Dr. Cabell Whitehead, of Washington, even obtained a patent in 1896 describing and claiming as a new chemical compound a crystalline double carbide of these metals, obtained, it was said, by electric furnace reduction of calcined dolomite. At this time the prediction was freely offered that the development of the future would occur in the line of the magnesium compounds rather than with those of calcium.

Just at this juncture, however, Moissan, in steady pursuit of his splendid researches upon the properties of the carbides, published the simple statement that magnesia is irreducible by carbon even at its temperatue of fusion. This conclusion was quickly confirmed by Morehead and De Chalmot. The refractory character of this single oxide was entirely unexpected in view of its near group affiliation to metals readily reducible, and the discovery effectually disposed of the claims which had been put forward by Borchers to priority of the discovery of calcium carbide upon the narrow basis of a generic statement, now proved to be inaccurate. The fact as now known, is that the presence of magnesia even in small amount is peculiarly detrimental to the manufacture of calcium carbide, and dolomitic limestones are unsuitable for this purpose. If magnesia be present, even to the extent of 2 per cent in the mixture, the diminution of yield is marked, the falling off being apparently due to the physical effect of the inert oxide becoming interposed between the carbon and the lime and thereby preventing their reaction.

In this inertness to carbon at all temperatures magnesium oxide seems to be unique, but the property has proved of value in electric furnace construction since it permits of the reaction chamber being formed with walls in which bricks of magnesia and carbon alternate. Moissan seems to have at first attributed this peculiar property of magnesia to the fact, long ago noted by Ditte and confirmed by Moissan for the hightest temperatures, that the oxide polymerizes rapidly with rise of temperature, the specific gravity increasing regularly from 3.19 in the case of oxide, which has been heated to 350 C., to 3.65 for magnesia solidified from full fusion. Later, however, he found the simple explanation in the fact that magnesium carbide is quite unstable even at temperatures now considered moderate. It is completely decomposed by the heat developed by a current of 600 amperes at 60 volts, and at the temperature of fusion of magnesia is entirely incapable of existence.

It follows, of course, that any process for the production of magnesium carbide must operate at relatively low temperature. The new method, which is due to Mr. Henry Spencer Blackmore, and forms the subject of a patent issued Aug. 20, secures a low reaction temperature by the use of a flux of haloid compounds of the alkali metals, and utilizes as a reducing agent, calcium carbides. In carrying out the invention, sodium and potassium fluorides in proportion to yield a readily fusible bath are melted, and magnesium fluoride and calcium carbide are introduced; the reaction whereby magnesium carbide and calcium fluoride are formed is as follows:

$$MgF_2 + CaC_2 = MgC_2 + CaF_2$$

Of course, commercially considered, this reaction is a costly one, and even though magnesium carbide were produced to the full extent indicated by theory, the cost of acetylene would hardly thereby be cheapened. As to the actual efficiency of the method and the form in which the carbide separates, we are as yet, unfortunately, entirely in the dark.

Danger to Firemen from Electrical Wires.

Mr. Morris M. Mead presented a paper this week before the meeting of the International Association of Fire Chiefs at Indianapolis on the danger to life attending firemen when at work fighting fires by electric light and trolley wires, and the remedy. After an interesting and intelligent discussion of the subject, Mr. Mead said:

In enumerating and closing, I would place, first, a thorough municipal control—under one head—of all municipal electrical matters, backed up by a legislative power to compel compliance to reasonable suggestions in a reasonable way.

Secondly, I would compel all overhead wires to be placed underground, especially electrical light and power wires, carrying 300 volts and over, in the business parts of all cities and towns and along all main avenues leading to the outlying districts of the city. I would compel all feed wires to be placed underground for railroad purposes, and wherever the local conditions warrant, to place the underground system in use.

Next, I would compel an overhead construction (where the wires were not underground), and all circuits be run parallel or side by side, at intervals of every 2000 or 3000 ft., lead off to properly protected and covered double pole, switch cut-outs. That the voltage of every circuit be marked upon each circuit and located at regular intervals. Next, that these locations, as well as the location of every circuit on each pole, be carefully mapped and blue printed, and copies left at the fire chief's headquarters and at the headquarters of the municipal electrician. That the men be carefully drilled as to the location of these cut-outs and circuits, and in the proper methods of handling the same. That one or two men, competent electricians, be detailed to go to all fires; that the companies, both lighting and railroad companies, be compelled to have special wagons and outfits controlled by competent men placed at regular intervals, through the business parts and built-up sections of the city, that they have gong attachments and all necessary communication features with the Fire Department proper; that they answer every alarm, and that the men be compelled to sleep at these several locations, or that a duplicate force of competent men should be employed.

Next, that reasonable precautions to safety be furnished each fireman, by way of ruber boots and rubber gloves, and insulated temporary tools to handle himself with, to be used in all cases of necessity.

Independent Telephone Development.

The Consolidated Telephone Company and the Inter-Ocean Telephone Company, recently formed in Cleveland, Ohio, to build lines and exchanges in New York State, have opened a fine suite of offices occupying half the second floor of the Electric Building, in that city. The officers of the new companies have already been referred to in these columns. The accounting department of the companies has opened for business under the management of Mr. R. E. Glass, who is recognized as one of the most expert accountants in Ohio. Last week the Consolidated Company took over the independent plant at Ithaca, N. Y. The Ithaca plant will be equipped with a new board and central energy system, and proposes to furnish the best of service at $36 and $24 rates. During the past week the Inter-Ocean Company closed important exclusive toll line contracts in New York State. The Corning exchange of the Consolidated Company has been cut in with 150 subscribers, and 650 three-year contracts waiting to be connected up. The Consolidated Company owns and controls the plants operating at Ithaca, Hornellsville, Corning, Wellsville, and other New York towns, and has in process of construction plants at Elmira, Waverley, Sayre, Athens, Watkins and Bath, with approximately 80 miles of long-distance line connecting Elmira and Wellsville and other intermediate cities. It has important franchises and toll line rights of way and contracts for long-distance service in Allegany, Steuben, Schuyler, Chemung, Tompkins and Tioga counties, New York.

Tesla Patents.

As noted in our issue of last week, two decisions have lately been handed down sustaining the Tesla patents, one from the United States Circuit Court of the Southern District of New York, and another from the United States Circuit Court of Appeals for the Second Circuit.

The first-mentioned decision was by Judge Lacombe. The defendant's device is an alternating-current wattmeter, and it was contended by the complainant that the circuit to which the meter is connected is divided so that part passes through a fine wire coil and another part through a coarse wire coil, and that as a consequence there is a difference in phase between such circuits. The complainant contended that this arrangement is an infringement of two Tesla split-phase patents, both bearing date of Dec. 26, 1893.

The defendant contended that the device does not constitute an infringement for two reasons, that the patents at issue cover motors only, while the device in suit is a meter. In the opinion of the court, this is a mere verbal distinction without apparent merit. The patents contemplate the production of power, though they are wholly silent as to the amount of power. The meter exerts power, its disk rotates against the action of a permanent magnet and turns a spindle which operates the registering devices. Second, the defendant contended that the meter does not operate by virtue of the so-called "Tesla rotating field" of the polyphase patents. The court considers that the preponderance of evidence indicates that in the motor in suit there are independent energizing circuits; that alternating-current from a supply circuit is passed through both, and that by a variation or modification of the relative resistance or self-induction of these energizing circuits they are put into different phase; and that the revolvable disk becomes effectively operative because such arrangement exerts its influence through the development of a rotating field, which is characteristic of Tesla methods.

The conclusion of the court is that the motor involved an infringement of the claims of both the Tesla patents above mentioned.

The second decision is by Judge Shipman, and was on an appeal from the Circuit Court of the District of Connecticut in the suit of the Westinghouse Electric Manufacturing Company against the New England Granite Company. The Circuit Court opinion of Judge Townsend was printed in our issue of Sept. 8, 1900.

The opinion of Judge Shipman is lengthy, and quotes largely from that of Judge Townsend, which it sustains. Taking up the main points of the defense, it is noted that Bailey said that the object of his experiments was to cause a disk to rotate by an intermittent rotation of the field, effected by electromagnets, and this statement is sufficient to show that he neither thought of nor unconsciously aided in solving the problem of transmission of power by electric currents of any kind. Bailey, in his experiments with reversed currents did not attempt to produce, as Tesla did, a continuously rotating field. Reverse currents and alternating currents, though they may be equivalents for some purposes, are not equivalents for transmission of power over a distance. Reverse currents cannot practically be used for that purpose.

Taking up the Bradley defense, it is stated that Bradley's alleged invention was a dynamo "which would generate an alternating or a continuous current as desired." He described two currents obtained from the same machine, and says that they can be employed for any purpose for which alternating currents are applicable, and they may be used separately, one being employed to feed one circuit and the other to feed another circuit, but he apparently did not in his application understand any benefit resulting from the transmission of two currents of different phase.

Judge Townsend is quoted to the effect that Bradley's application is limited in scope, ambiguous and indefinite. It fails to show that he had any conception of the Tesla idea of "the utilization of the motor for the purpose of progressively shifting the magnetic poles of a plurality of alternating-currents by circuits which preserve the independence and differing time relation of the other phases." Even if the idea had been first conceived by Bradley it was not sufficiently described to disclose a principle or method of operation. Bradley does not anticipate or limit this principle, Tesla being the first to reduce it to practice.

As to the Marcel Deprez defense, what Deprez did was to mathematically demonstrate that the polar line of an annular magnet may be shifted the entire circumference of the ring by two magnetizing forces properly related; he showed how a resultant magnetic field could be produced, but he did not describe or suggest apparatus for power. His currents were not the alternating currents of Tesla. Giving the Deprez theorem all the value to which it is entitled, its application by Tesla to the production of a new, original and most beneficial practical result by new and described means and the use of polyphase alternating currents; in brief, by the polyphase system—the apparatus of Tesla nevertheless was an invention of a very high order.

Referring to the Siemens patent of August, 1878, it is stated that the drawings showed direct-current machines and those capable of being both direct and alternating. The part of the specifications upon which the defendants lay stress is as follows: "It is to be understood as stated above that with suitable modifications these apparatus are generally applicable also as rotary transmitting machines, the rotary parts being caused to revolve and give out mechanical power when electricity is applied to them, and thus one of these machines may be driven by any suitable motive power so as to generate electricity, and this electricity may be conducted to a similar machine at a distance, causing it to work and to give out a portion of the power applied in the first instance." The opinion states that no modifications are described, and there is no suggestion that the patentee thought of such connections between the generator and motor, each of two phases, as to preserve the phases of the two and the difference of phase, and that currents should act independently and regularly succeed each other and thereby keep the armature constantly rotated. The hints in the patent respecting the modifications by which the apparatus could be made to give out mechanical power were valueless, as no modifications are described, the kind of apparatus to be modified is uncertain and independence of phase was not in contemplation by the patentee.

As to the claim that the reversibility of the Siemens or Bradley apparatus followed from a principle universally recognized as to the reversibility of electric machines, it is stated that the reversible principle, while true in regard to direct-current machines, was only a matter of theory and not of practice in regard to alternating-current motors for power purposes. Declarations that such machines could be so reversed so as to furnish power were merely theoretical and gave no information to the inventor of the method by which reversibility was to be made useful to accomplish any result.

As to the point that infringement of the patents in suit is limited to synchronous motors and thereby not infringed by the defendant's induction motor, the opinion says that assuming the patents did describe synchronous motors only, their claims did not make and did not intend to make synchronism a part of either patent, but were for the broadly described invention of "a novel system of electric distribution and transmission of power by means of alternating currents."

Electrical Development in Greece.

Mr. F. W. Jackson, United States Consul at Patras, Greece, writes as follows:

The progress of communication within Greece at present is marked, and promises in the near future to bring conveniences of travel to a level with those of any country in Europe. The Greek Electric Company, otherwise known as the Thomson-Houston Company, established in 1898, with a capital stock of 10,000,000 drachmas ($1,250,000), of which 5,000,000 drachmas ($625,000) is paid up, is now completing in Patras the first electric street railway in Greece. The same company operates the gas company of Patras, the electric-light plants of Athens and Piræus, and of four or more other cities, and is now negotiating with the Athens-Piræus Street Railway Company to supply motive power from a central electric station at Phalerum, near Athens. This proposed power station, if constructed, will be on a scale sufficiently large to supply power for manufacturing purposes, as well as for the lighting of Athens, Piræus and Phalerum.

Speaking more particularly of the street railway in Patras, the system will be similar to that found in general use in France and Italy. The motive power will be furnished by gas engines of German construction. The steel rails are from Belgium, while from the United States there will come—from the General Electric Company—the material for the aerial line, insulators and car motors, and—from the Brill Company—the trucks for the cars. The main stem of the road is constructed the length of the city, parallel with the sea, and extends some distance beyond the city limits, to a point suitable for coffee houses and baths.

CURRENT NEWS AND NOTES.

"WIRELESSING" is the word we find in the New York *Herald*, used to describe the act of sending a message by wireless telegraphy.

BRITISH TELEGRAPHS.—The British Postmaster-General has just issued his report for 1900. The telegraph department again shows a big deficit, being this year $3,260,500.

THE NEW YORK CENTRAL has had notice served on it by the New York Board of Health to stop the smoke nuisance in the terminal tunnel. As stated in these pages last week, the company has already placed the matter in competent engineering hands.

RONTGEN SOCIETY.—The second regular meeting of the Röntgen Society of the United States will be held at Buffalo, N. Y., Sept. 10 and 11. A programme of papers has been prepared to cover a great variety of subjects of special interest to the members. Room will be provided for the exhibition of apparatus and accessories, and every possible aid to demonstration will be given.

THE PROPOSED AMERICAN PACIFIC CABLE.—United States Consul General Rublee at Hong Kong reports that the business community in that city is taking a keen interest in the proposed cable between the United States and Manila, and its eventual connection with Hong Kong. The present rates are regarded as excessive, and it is thought that the American cable would afford relief in this respect. The project has been indorsed by the Hong Kong Chamber of Commerce.

FRENCH AUTOMOBILISM.—The Czar of Russia is to visit France to witness the autumn grand manœuvres, and it is stated that automobiles are destined to play a great part in the manœuvres, notably in reconnoitring and in the transmission of orders. General Brugere, generalissimo of the French army, already has at his disposal a swift 24-hp Gardiner-Serpollet automobile, which will be driven by one of his staff officers. This automobile has been sent to La Rochelle to meet General Brugere. Numerous other machines are to be employed by the chief officers.

G. A. R.—The Consolidated Telephone Company, the Inter-Ocean Telephone & Telegraph Company, and the Century Telephone Construction Company, all of Cleveland, Ohio, have issued the following notice: "We wish to extend a very urgent invitation to the members of the Grand Army of the Republic and their friends who may be interested in the telephone business, and who intend to visit Cleveland during the Grand Army encampment on Sept. 9, to make our offices on the second floor of the Electric Building their headquarters. We shall take pleasure in taking care of their mail, furnishing all the information in our power and making their visit agreeable in every way."

ALASKA CABLE.—The steamship "Lakme" sailed from Seattle, Wash., for Skagway, Alaska, on Aug. 15, with the Alaska cable expedition, headed by Mr. G. F. Porter, of the Brixey Kerite Company. The Government cable, which will extend from Skagway to Juneau, is in one section, 126 miles in length. A party of 10 students from the University of Washington accompanied the expedition to assist in the work. One of their number was Miss Pearlita C. Stadelmann, who is taking the course in electrical engineering. The contract price is $75,000, and the actual work of laying the cable should be accomplished in about 26 hours. Major W. A. Glassford represents the signal service of the army in the work.

A. A. A. S.—The American Association for the Advancement of Science, in session in Denver, has installed these new officers: President, Professor Charles S. Minot, of Boston; vice-presidents, Section A (mathematics and astronomy), James McMahon, of Cornell University; Section D (mechanical science and engineering), H. S. Jacoby, of Cornell University; Section G (botany), B. T. Galloway, of the United States Department of Agriculture; Section H (anthropology), J. Walter Fewkes of the Bureau of American Ethnology; Section I (social and economical science), John Hyde, of the United States Department of Agriculture; permanent secretary, L. O. Howard, of the United States Department of Agriculture; general secretary, William Hallock, of Columbia University; secretary of the Council, D. T. MacDougal, of the New York Botanical Gardens; treasurer, R. S. Woodward, of Columbia University.

MOTOR CONDENSERS.—In the course of a discussion at the recent convention of the Ohio Electric Light Association one of the speakers said that the condenser is likely in the future to occupy a prominent place in the field of electrical distribution. The cost of a condenser for use with motors was stated not to exceed at the present time $10 per kilowatt. With motors whose highest power factor is above 90 per cent the condenser capacity required is only about 10 per cent of the capacity of the motor, thus bringing the expense within very reasonable limits. Commenting on this statement another speaker said that if condensers were used with single-phase motors they usually required in addition the introduction of a boosting transformer or compensator, and these two devices will cost about three-fourths as much as the motor. In reply it was stated that a condenser is no more essentially a part of a single-phase motor than of a polyphase motor.

NERNST LAMP HEATER.—A resistance heater for electrolytic incandescent lamps is the subject of a patent granted Aug. 27 to James Swinburne, of Westminster, Eng. Resistance heaters can be made of carbon or metallic conductor mixed with clay, but when the conducting material oxidizes in air at the temperature necessary for a heater, the resistance is greatly altered and can be no longer used as a heater. To overcome this difficulty the patent describes a means of protecting the oxidizable conductor against the action of the air by vitrifying or glazing the insulating material. Graphite is kneaded up with kaolin and squirted into the form of thin rods or spirals, which are then dried and baked at such a high temperature that the kaolin is vitrified. To facilitate vitrification feldspar may be added to the kaolin, or the kind of clay used for china may be employed instead of kaolin and feldspar. Instead of vitrifying the resistance heater it may be glazed by dipping it after it has been fired, into water containing glaze and then firing it in the usual way, such glazes being employed as are soluble in water, such as boracic acid.

PRIMARY BATTERY DIAPHRAGM.—A patent granted Aug. 27 to John Laskey Dobell, of Harlesden, England, relates to the manufacture of diaphragms or porous pots for use in primary batteries in which litharge and caustic soda are maintained in a state of fusion, and acting to produce electricity in conjunction with fused lead and carbonaceous material in which the porous pot is immersed. In practice it is found that a porous pot of the ordinary kind is incapable of resisting the fused oxides, and the objects of the invention is to provide a pot which will effectually resist this deleterious action. Calcined magnesite is moistened with a saturated solution of boracic acid and the mass then kneaded into a stiff paste, after which it is shaped into the form of a porous pot. After being dried and fired the pot is ready for use. As water dissolves a comparatively small quantity of boracic acid, this quantity may be increased by the addition of a suitable amount of the saturated solution of boracic acid in spirits. In cases where it is desired to increase the porosity of the magnesite pot, a quantity of sawdust, bran or other similar material may be mixed with the magnesite.

MUNICIPAL OWNERSHIP IN TOLEDO, OHIO.—After 10 years of experience, Toledo, Ohio, has leased its municipal natural gas plant to a private corporation. This plant has cost the people of Toledo over a million dollars in bonds and half a million dollars more in interest, while it is found now that the rental will be much less than the city will need to keep up the annual interest on the debt incurred when the experiment was undertaken. The Council has leased what was left of the plant to the Toledo Gas Light & Coke Company for a term of 20 years at $6,500 a year. The annual interest account on natural gas bonds outstanding is $47,250. And the city will keep on paying that for many years to come. The cause of the failure is fairly well outlined in this remark by the Toledo *Bee:* "Incidentally, many of the men who shouted loudest for the gas plant got their start in life out of their connection with it, and having become taxpayers, managed to bob up and help urge the Council to lease the plant to a private corporation—so as to save them taxes." Toledo is the home of Mayor Jones, who has been one of the most vociferous advocates of municipal ownership.

ALASKAN CABLE.—The cable between St. Michael, Alaska, and Nome City is broken beyond repair.

MUNICIPAL ELECTRICIANS.—We are informed by Mr. Morris Mead that President McKinley will receive the Municipal Electricians' Association at the International Hotel, Niagara Falls, on Thursday, Sept. 5, and that Friday will be Municipal Electricians' Day at the Pan-American.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION.—The next annual meeting of the Kentucky Independent Telephone Association will be held at Owensboro on Oct. 8 and 9. The Association is composed of about 60 independent companies, and a large meeting is expected.

AUTOMOBILE ENDURANCE TEST.—Up to Tuesday evening there were nearly 80 separate entries for the 500-mile endurance run from New York to Buffalo, of the Automobile Club of America. The start will be made from the clubhouse, the Plaza and West Fifty-eighth Street, at 8 a. m. on Monday, Sept. 9. At present no electric vehicles are entered.

WIRELESS TELEGRAPHY IN CANADA.—It is understood that the Dominion Government will shortly be asked to cause the installation of a wireless telegraph station near Victoria, British Columbia, for the purpose of signaling incoming steamers. The Canadian Pacific officials have made an offer to install the Marconi system on each of their three Empress steamers if the Government will erect a shore station for communication.

AMERICAN FIRE WASTE.—The summary of the fire waste in the United States during 1900, as given in *Chronicle Fire Tables*, shows 109,092 fires in the United States, against 105,342 in 1899 and 94,062 in 1898. Dwellings and boarding houses constituted 46.2 per cent of the property burned. The losses by exposure were 27.6 per cent of the whole. The principal causes of fires in 1900 in the order named (excluding those of unknown origin) were: Incendiarism, defective flues, sparks, spontaneous combustion, electric lights and wires, furnaces, lightning and friction in machinery.

TO ELEVATE THE KING.—The three American electric elevators for Buckingham Palace will have their cabinet work built in England. Of these three elevators one will be for the personal use of His Majesty. A simple press of the button at any floor will bring the lift to that floor, where it will automatically stop and open its doors. By pressing one of a series of numbered buttons inside the car it ascends or descends to the floor corresponding to the number of the button pressed. The elevators are made automatic, so that King Edward, if he wishes, can operate them himself. It is believed that the cost of the three will be about $25,000.

ELECTRICAL ILLUMINATIONS FOR ROYAL VISITORS.—The Dominion Government has decided that the illumination of the Parliament Building, during the visit of the royal party at Ottawa, shall be the finest electrical exhibit, in comparison to the size that has been seen on this continent. Acting in concert with the contractors the Deputy Minister of Marine has secured designs of the Buffalo illuminations, and the plans, now being worked out, are adaptations of these illuminations. The great buildings will be illumined, not from the prominent lines, but from the recesses. The electric light will shine out from the darkest points into the night. All the windows are being picked out in this way, and the cornices over arches, etc., while the big central tower will be framed in electric lights in somewhat the same manner as the great electrical tower at the Pan-American Exhibition. Preparations are also being made to illuminate the new interprovincial bridge in the same manner, the decorations of which will be elaborate and costly. Almost without exception, the larger business buildings, public institutions, railway stations, as well as private residences, will be illuminated with electric light. Already large contracts have been placed with three of the leading electric companies of the city whose capacity will be taxed to the utmost. It is estimated that not less than 100,000 additional incandescent lights will be utilized throughout the city.

MORE LARGE WATER POWER DEVELOPMENT IN SOUTHERN CALIFORNIA.—The increasing production of fuel oil in California does not seem to be preventing the building of more large water power plants for electric transmission purposes, and that, too, right in the midst of the oil-producing region. The Edison Electric Company, of Los Angeles, which has a local distribution at Los Angeles and an 83-mile transmission plant from the Santa Ana Cañon to Los Angeles (see Electrical World and Engineer, June 29, 1901), and which also now controls a number of smaller companies operating in the numerous small towns between San Bernardino and Los Angeles, has now secured sites in the Kern River Cañon over the mountains north from San Bernardino, and is building a 15,000-hp plant. The plant will be just above that of the Power Development Company, which supplies power to Bakersfield and vicinity for irrigation pumping, as described in the Electrical World and Engineer of April 6, 1901. The water will be conducted for 8 miles, and will be at a head of 840 ft. at the power house. To those familiar with the country the daring of the scheme appeals forcibly. Two formidable mountain ranges intervene between the company's territory in the Los Angeles region, and the distance air line is over 100 miles. Fuel oil is now obtainable at very low rates at Los Angeles, and Bakersfield is the most important oil-producing center in the State. It certainly appears as if the financial results from long-distance transmission from water powers in Southern California had been very satisfactory when a company already in the business is carrying out such important new projects.

OPEN VERSUS ENCLOSED-ARC LAMPS.—In a discussion at the recent meeting of the Ohio Electric Light Association on the enclosed-arc lamp, Mr. Alexander Dow, in referring to a criticism of the open arc, said that as a basis of comparison the open-arc lamp had been taken as it had been neglected by the ordinary station, while in considering the enclosed arc the newest device with all the latest improvements had been considered. While admitting that the defective open arc with which comparison was made represents current practice much more accurately than is creditable to the industry, yet he wished to say to those members who feel bound to use their open arcs for some time to come, that if they will use first-class carbon, employ screens to keep out wind, dust and insects from the globes, use alabaster plated globes and keep the feed mechanism of the lamps clean and in adjustment, open arcs will give just as good a light as is possible with the best type of enclosed arcs, and will be under no disadvantage except that it will cost more for carbons and for labor and trimming. Against that extra cost of operation may be set the fact that the station will not have to make an investment in new apparatus and thereby increase its fixed charges. In reply to a question as to what he would advise in a case where the management was considering a change to the enclosed arc system, Mr. Dow said that if money was to be had at a reasonable figure and the transaction showed a profit by reason of the increased economy of operation, he would make the change. On the other hand, if money was not to be had easily and cheaply, he would recommend letting the operating expenses stay at the present figures, or even run them up by using better carbons, etc., holding on in the meantime to the old apparatus. It was merely a question in his opinion of finance, not a question at all of giving good street lighting, as this can be obtained with either system. The speaker against whom Mr. Dow's criticism applied said it was perfectly true that the use of an opal globe with an open arc light will improve distribution of the light; that, in fact, if the regulation does not vary beyond, say, two volts, the distribution will be equally as good as from the enclosed arc. Unfortunately, however, the ordinary open arcs in service vary so greatly in voltage that the rise and fall in the light is very objectionable; and while the use of opal globes improves the distribution, it does not in any case bring the steadiness up to the plane of the enclosed-arc lamp.

Letter to the Editors.

The Pan-American Electrical Hazard.

To the Editors of Electrical World and Engineer:

Sirs.—In the Electrical World and Engineer, of Aug. 24, is an article (page 298) headed "The Electrical Hazard at the Pan-American." This article contains the substance of a report made by the National Board of Fire Underwriters' inspectors, G. D. Bruin, E. A. Fitzgerald and J. C. Forsythe.

The inference which the public in general would make from this report would naturally be that the installation had been poorly made

and that the Exposition would be wiped out by an electrical fire before the article could be printed. The entire impression produced by this report is manifestly unfair. The report makes five principal statements, none of which was true at the date of its writing; and apparently these statements were prompted by a desire to use them as a weapon of defence in a quarrel between the National Board and the Buffalo Board of Underwriters.

In an insurance inspector's line of work, the evident safe position to take, in passing his opinion, is to condemn, for in the event of loss by fire he can state "I told you so." In the event that no fire occurs he is permitted to state that the result was simply due to good fortune.

It would be useless to make an unsupported statement that the electric work at the Pan-American had been done carefully and thoroughly, and in accordance with the best practice, but fortunately, however, opinions can be readily had from the best engineers in the country as to the thoroughness of the work. It is a fact that during the above suggested controversy the work of nearly every electrical manufacturer in the country put in at the installation of their exhibits, was condemned by these same inspectors, as unworkmanlike and hazardous. I do not believe that any of the criticisms which Chairman Bruin sent out in regard to the Exposition's work were proper or even reasonable. Hence I desire to protest against the publication of their findings without the true facts of the case being brought out.

BUFFALO, N. Y. HENRY RUSTIN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Slotted Armatures.—E. DICK.—A theoretical article on the distribution of the lines of force is slotted armatures with highly saturated teeth. It has often been regarded as a rule that the maximum saturation of the teeth should not be over 18,000. He remarks that this rule is not justified, and that higher saturations have no disadvantages. He mentions a first-class machine, in which the saturation of the teeth is 24,000 lines (per square centimeter). High saturation of the losses enables one to reduce the copper losses on the armature. It also enables one to reduce the air-gap to a minimum. This is discussed analytically and illustrated by numerical examples. High saturation of the teeth also reduces the armature reaction. His final conclusions are, first, a dynamo is properly designed, when the air-gap is reduced as much as practical; second, the excitation, required for a larger air-gap, can suitably be used for overcoming the reluctance of the highly saturated teeth, so that more favorable dimensions of teeth and slots can be obtained.—*Elek. Zeit.*, July 25.

Maximum Efficiency of Direct-Current Machines.—FINZI.—A brief theoretical article. The losses in a direct-current machine, running at a given voltage, can be divided into two parts, one the "no-load loss," which is the sum of the losses due to friction of the bearing, air friction, and friction at the brushes, and the losses due to hysteresis and eddy currents at no load and to the Joulean heat in the coils of the magnet poles. The other "loss due to the load," this loss being proportional to the square of the armature current. He shows that the maximum efficiency corresponds to that load for which the "no-load loss" and the "loss due to the load" are equal.—*Elek. Zeit.*, Aug. 8.

Interpolar Induction and Distribution of Copper in the Armature of an Alternator.—WILSON and MARDEN.—The first part of a paper, illustrated by diagrams, in which they give the results of tests made with a Siemens & Halske 12-pole alternator, in order to investigate the following points: First, to find the distribution of induction between the two opposing pole-pieces in a given machine when the air space length is varied and the exciting current kept constant; second, to examine the effect of variations of air-space length upon leakage for a given exciting current, and, third, to find the most economical distribution of copper in an armature bobbin with the given air space and distribution of induction. They describe the method of their experiments and give some curves obtained, but no general conclusions are given in this part.—Lond. *Elec.*, Aug. 16.

New Insulating Material.—A note on a new insulating material which is brought out by a German firm and which is expected to supersede micanite to a large extent for insulating purposes, especially for the construction of commutators and the manufacture of field magnet spools. It is cheaper than micanite, and being made solely of mica and asbestos has the additional advantage that it can stand much higher temperatures without softening. The process of manufacture is briefly as follows: Moistened asbestos will adhere rigidly to mica so as to unite small pieces of the latter material, and the union thus produced remains even after the moisture has been removed. Small, thin plates of mica are, therefore, mixed with asbestos, or laid upon it, and the whole is moistened with water. The mass is then subjected to pressure by means of which the greater proportion of the water is removed and the mica and asbestos are said to be left as rigidly bound together as the individual laminæ is natural mica. Any moisture still remaining is removed by further pressure and simultaneous drying by the application of heat. The material can be made in the form of flat plates or sheets, or can be moulded into any shape required. The results of some tests, made by the German Reichsanstalt, with five samples of different thickness, are given. The plates were placed between two brass electrodes, each with a surface of 20 square cm., the upper electrode being weighted with 2 kilograms. For a plate of 1.3 mm. thickness, the insulation resistance was 27.3 megohms at 500 volts and 21.5 megohms at 1000 volts; the "sparking-through pressure" was 8000 volts with direct current and 7800 volts effective with alternating current. For another plate of 3.7 mm. thickness, the insulation resistance was 82 megohms at 500 volts and 72 megohms at 1000 volts; the "sparking-through pressure" with alternating current was about 16,000 volts effective, while it did not spark through with direct current up to 11,000 volts.—Lond. *Elec.*, Aug. 16.

REFERENCES.

Induction Motor with Power Factor Equal to Unity.—HEYLAND.—An English translation in full of his German article which was abstracted in the Digest last week.—Lond. *Elec.*, Aug. 16.

Construction of Alternators.—LASCHE.—A continuation of his very well illustrated serial on the construction and systematic manufacture of alternators. He deals with the size and arrangement of the centrifugal masses and gives formulas for the flying masses, which must be fulfilled to insure the desired degree of uniformity. He then describes in detail the mechanical construction of the inductor for very high speed.—Lond. *Eng'ing*, Aug. 16.

Traction Generator.—An illustrated description of a 500-kw, 550-volt traction generator of the Internat. Elec. Eng. Co., of Clun House, W. C., coupled direct to a Belliss high-speed engine.—Lond. *Elec. Rev.*, Aug. 16.

Self-Starting Single-Phase Motor Without Brushes.—An illustrated article on the motor of Fischer-Hinnen, described in the ELECTRICAL WORLD AND ENGINEER, June 22. It is said that a similar arrangement has previously been suggested by Sahulka, in 1891, for a two-phase motor.—*Zeit. f. Elek.*, July 28.

Manufacture of Alternators.—LASCHE.—The first part of a well illustrated serial in which he discusses the conditions underlying the construction and systematic manufacture of alternators of various types. In the first section he deals with the manifold conditions for standard types and the types hitherto produced.—Lond. *Eng'ing*, Aug. 9.

Rotary Field.—BERGMANN.—A mathematical article on the rotary field of a bipolar three-phase winding.—*Zeit. f. Elek.*, July 21.

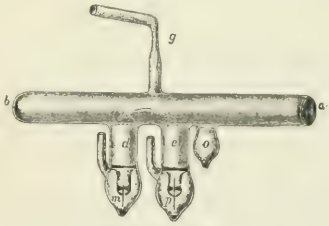
LIGHTS AND LIGHTING.

Mechanism of the Electric Arc.—HERTHA AYRTON.—A long abstract of an interesting (Brit.) Royal Soc'y paper in which she shows that the assumptions of a large back e. m. f. in the arc or of a "negative resistance" or of any other unusual attribute are entirely unnecessary, as all the principal phenomena of the arc may be accounted

for by applying the ordinary laws of resistance, of heating and cooling and of burning to the arc, considered as a gap in a circuit furnishing its own conductor by the votalization of its own material. When the carbons are once separated, all the material in the gap cannot retain its high temperature. The air must cool some of it into carbon mist or fog. The positive pole only volatilizes. She therefore considers that the arc consists of three essentially different parts: First, a thin layer of carbon vapor issuing from the end of the positive carbon; second, a bulb of carbon mist joining this to the negative carbon, and, third, a sheath of burning gases, formed by the burning of the mist and the hot ends of the carbons, and surrounding both. The vapor appears to be indicated in images of the arc by a sort of gap between the arc and the positive carbon, the mist by a purple bulb, and the gases by a green flame. The flame is found to be practically insulating, so that nearly the whole of the current flows through the vapor and mist alone. It is suggested that the vapor has a high specific resistance compared with that of the mist, and that it is to the great resistance of this vapor film that the high temperature of the crater is due, and not to any large back e. m. f. of which it is the seat. Volatilization can only take place at the surface of contact between the vapor film and the positive carbon. When that surface is smaller than the cross-section of the end of the carbon, it must dig down into the solid carbon and make a pit. The peculiar shaping of the negative carbon is due to its tip being protected from the air by the mist, and its sides being burned away under the double action of radiation from the vapor film and conduction from the mist. As nearly all the current flows through the vapor and mist, the surrounding flame being practically an insulator, the resistance of a solid carbon arc, apart from that of the vapor, must depend entirely upon the cross-section of the mist. To see how this varies with the current, images of an arc of 2 mm. were drawn, with the purple part—the mist—very carefully defined, for currents between 4 and 14 amperes. The mean cross-section of the mist was found to increase more rapidly than the current, consequently its resistance diminishes more rapidly than the current increases. As the resistance of the vapor film also diminishes faster than the current increases, it follows that the whole resistance of the arc does the same, and that therefore the p. d. must diminish as the current increases. The exact formulas are given. She then discusses under what conditions the partial differential quotient of the p. d. to the current measures the true resistance of the arc. Finally, she discusses in detail the changes introduced into the resistance of the arc by the use of cored carbons. The way in which the core acts in each case is traced, and the alterations in the specific resistance and cross-sections due to the core are shown to bring about changes in the p. d. exactly similar to those found by actual measurements.—Lond. *Elec., Elec. Rev.,* Aug. 16.

Bremer Arc Lamp.—LAPORTE.—A paper read before the Internat. Soc'y of Elec. in Paris, giving the results of tests of the Bremer arc lamp, made in the Central Laboratory of Electricity in Paris during the last Exposition. (The Bremer arc lamp has been described at some length in the Digest, July 28, and Sept. 8, 1900). As is known the characteristic features of the lamp are the arrangement of the carbons, which are nearly vertical, but form an acute angle; the regulation of the arc under the influence of a magnetic field, the regulation being made automatically by the intensity of the current, and the use of a special positive carbon, the composition of which is still kept secret. For a 43 to 45-volt and 9-ampere lamp the special positive carbon has a diameter of 7 mm., while for the negative carbon, a Siemens carbon of 6 mm. diameter is used. The special positive carbon has a considerably higher specific resistance, 12,300 microhms centimeter, that of the Siemens carbon being between 8300 and 9400. The positive carbon contains a certain number of metallic salts, and during combustion rather large quantities of deposits are formed, magnesia being the principal constituent. This magnesia is deposited on a screen above the arc which then acts as a reflector and produces a favorable distribution of the light. The color of the light is peculiar, it is between the color of the light of incandescent lamps and that of ordinary arc lamps without globe. The results of photometric tests and the comparison with an ordinary arc lamp are given in a table. The consumption of watts per candle for the ordinary arc lamp is about twice that for the Bremer arc lamp, the exact ratio, taken from the table, being 200 ÷ 117. He says about the results of his tests: "It cannot be denied that these figures are favorable to the Bremer lamp. The only point which still needs to be cleared up is whether the price of the special carbon may not offset the advantage put in evidence by the photometric tests."—*L'Ind. Elec.,* July 25; *L'Eclairage Elec.,* July 20.

Mercury Lamp.—LUMMER.—The Arons mercury arc lamp (which is a forerunner of the Cooper-Hewitt lamp) is well adapted for polarimetric work, but has the disadvantage of being liable to burst, and its light is easily obscured by the condensation of mercury vapor. The present author obviates these defects by cooling the lamp in running water and giving it the shape shown in the adjoining diagram. Only the mercury bulbs *d, c* and *o* are submerged, the tube



MERCURY LAMP.

a b being free. The latter, therefore, remains at a higher temperature than the mercury and does not condense the vapor. The arc plays in the direction of the arrow, and is seen end-on. The tube is ground, except over a circular area at the end *a,* through which the light is viewed. He gives detailed instructions concerning the construction and mounting of the lamp. He made one pattern for magnetic work in which the tube is enclosed in a narrow box which can be introduced between the poles of a magnet.—*Zeit. f. Instrum.,* July; abstracted in Lond. *Elec.,* Aug. 16.

Incandescent Lamp Efficiencies and Lamp Renewals.—An editorial referring to Willcox's recent paper read before the Nat. Elec. Light Ass'n in which he recommended the general use of incandescent lamps having an efficiency of 3.1 watts per candle, and the adoption of free renewals for consumers by the central station authorities. In advocating the high-efficiency lamp Willcox is said to look at the question from the lamp manufacturer's point of view rather than from that of the central station engineer. A general increase in the efficiency of the lamps connected to the mains is simply a decrease in load, the revenue being diminished at the same time as the expenditure, and, of course, the reduction of standing charges would be in a smaller proportion than the reduction of load. The use of high efficiency lamps should be encouraged only as long as the net result is increased cheapness of light. Theoretically, it would be easy in every individual supply system to work out the best grade of lamp to use, but practically it is a very difficult problem. The custom of charging for current on the maximum demand system makes it still more complicated. Here it would theoretically appear to be better to install lower efficiency lamps for those burning long hours than for the others which are only alight for short periods, more especially if this is during the peak of the load. A system of free renewals of lamps in the form suggested by Willcox, "would be impossible in Great Britain, where every man's house is his castle. It is almost a grievance that the meter man should have entry, and the new-lamps-for-old man would hardly be more welcome." It is said that a free lamp system should either be based on the Bradford principle, where the lamps are delivered to the consumer at the works in number according to the amount of energy he has used, or on the still simpler system, suitable for smaller turns, of giving the consumer a new lamp if he brings a sufficiently old one in exchange for it.—Lond. *Elec.,* Aug. 16.

REFERENCE.

Bardon Arc Lamp.—MONTPELLIER.—An illustrated description of a new closed arc lamp made by Bardon.—*L'Elec.,* Aug. 10.

POWER.

Bulgarian Power Transmission.—PERKINS.—An illustrated description of the Isker-Sophia power transmission. The transmission line is 20 kilometers long. The capacity of the plant is 2000 horsepower. The voltage of the three-phase currents on the line is 7200. —*Jour. of Elec.,* July.

California Power Transmission Plant.—LOW.—The first of a series of articles on the transmission system of the Bay Counties Power Company. This article gives a nicely illustrated popular description of the transmission.—*Jour. of Elec.,* July.

Electric Power in Slate Quarries.—BRUNSWICK.—Continuations and conclusion of his well illustrated article (Digest, Aug. 3), on the electric power plant of a French company operating slate quarries. All the machines used are described in detail, among them Boucherot's compound alternator with its special exciter (see Digest, Oct. 27, 1900). The work in the quarries is also described.—*L'Elec.*, July 21, Aug. 3, 10.

Electric Elevators.—A long and well illustrated description of the new electric elevator of the Washington Monument.—*Eng. News*, Aug. 22.

TRACTION.

Automobile.—An illustrated article on an automobile which recently made a run of over 187 miles in Chicago on one charge. For this run it had two batteries of Porter cells of together 383 ampere-hours capacity and 600 lbs. weight. The carriage and motor weighed 600 lbs., so that the total weight of the rig was 1200 lbs. Some particulars are given on the construction of the automobile.—*West Elec.*, Aug. 17.

REFERENCE.

Baltimore.—A long illustrated article on the street railway system of Baltimore.—*St. R'y Rev.*, Aug.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated description of the Holyake and West Kirby electric generating station. There are three steam alternators, each giving 33 amperes at 2300 volts, the frequency being 50, and a motor-generator which is used either for charging the batteries or for converting the current supplied from the batteries into alternating current to supply the network. There are two batteries, each of 60 cells of a normal capacity of 500 ampere-hours.—Lond. *Elec. Eng.*, Aug. 16.

REFERENCES.

High-Tension Switches.—A full report on the discussion held at the recent meeting of the Pac. Coast Elec. Transm. Ass'n on high-tension switching and fusing practices. A number of papers on the same subject, presented at the same meeting, were recently noticed in the Digest.—*Jour. of Elec.*, July.

Communication in Generating Stations.—An article in which the methods of communication in electric generating stations, by signals or telephones, are discussed.—Lond. *Elec. Rev.*, Aug. 16.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Wooden Fittings.—JOHNSON.—An illustrated article on "Wooden fittings for electrical uses," dealing with the manufacture of poles, cross-arms, pins and brackets, etc.—*West. Elec.*, Aug. 24.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effect of Electric Convection.—CREMIEU.—A reply to Wilson's criticism recently noticed in the Digest. He denies Wilson's objections to his experiments, because his apparatus was not of the construction supposed by Wilson. He remarks in general about his experiments: "In taking my experiments one by one, it is possible to point out in each some defect which might account for the negative result of that one experiment. But the general conclusions which I have stated are based on the ensemble of four widely different experiments, and are confirmed by a fifth, a very conclusive one, regarding the existence of open currents. Each of these experiments has, besides, been subjected to numerous criticisms. Up to the present, I have always met a criticism by an experiment, and this latter has always confirmed my conclusions." He therefore maintains that electric convection produces no magnetic effect, and that there is no electrostatic effect on a charged conductor due to a variable magnetic field.—*Phil. Mag.*, Aug. In a communication on another subject in the same number, Oliver Lodge congratulates Wilson "on his successfully destructive criticism of the over-emphasized experiments of Cremieu, and of the revolutionary deductions too readily promulgated on the strength of them."

Theorem in Rotary Fields.—CAMPBELL.—An illustrated "Note on a theorem in rotary fields." He has recently proven by analysis the following theorem: "If two alternating fields, A and B, of equal effective values and any wave forms be inclined to one another at an angle equal to the supplement of the 'power-lag' between A and B, then the resultant rotary field will have a constant effective value in all directions perpendicular to an axis of rotaion." (By "power-lag" he means the angle whose cosine is the power factor.) In this note he illustrates the theorem graphically.—Lond. *Elec. Rev.*, Aug. 16.

Dielectric Cohesion.—BOUTZ.—A gaseous mass placed in a uniform electric field allows the passage of an electric discharge as soon as the e. m. f. surpasses a critical value, below which the gas is a perfect insulator. He has tested whether the wall of the vessel in which the gas is contained has any effect upon the critical e. m. f. He found that no such effect exists.—*Comptes Rendus*, July 22; abstracted in Lond. *Elec.*, Aug. 16.

Current Through Conducting Cases.—RUTHERFORD.—An account of an experimental investigation. In the conduction of gases under the influence of Röntgen and Becquerel rays, it has generally been considered that the magnitude of the current between the electrodes is independent of the direction of the electric field, except in the case of potential differences of the order of one volt, when the contact differences of potential between the electrodes may cause inequalities in the currents. In the general case of gas conduction, however, the author has found that there is, in most cases, a difference between the values of the current with the reversal of the electric field. This difference is due to the inequality of the velocities of the positive and negative ions. It is only in certain special cases that the current is independent of the electric field.—*Phil. Mag.*, Aug.

Uranium Radiation at Very Low Temperatures.—BECQUEREL.—He has studied the radio-activity of uranium compounds at the temperature of liquid air. At that temperature the radiation is substantially the same as at ordinary temperatures. This supplements the fact that no variation is shown between the temperatures of —20 degs. and + 100 degs. Uranium nitrate, when plunged into liquid air, or liquid hydrogen, becomes luminous. This is an electric phenomenon due to molecular contraction. The luminosity only lasts while the crystal is cooling down, but it can be renewed by allowing it to regain the ordinary temperature, as the luminosity is seen both in heating and cooling. The phenomenon is intermittent.—*Comptes Rendus*, July 22; abstracted in Lond. *Elec.*, Aug 16.

Magnetization of Wires by Intermittent Current.—HONDA and SHIMIZU.—An illustrated account of an experimental investigation of the magnetization of iron, steel and nickel wires by intermittent current. For these wires, the magnetization in weak fields decreases as the frequency of the intermittent current is increased. On the contrary, the magnetization in stronger fields increases with the frequency. The diminution of magnetization by a definite frequency of the intermittent current becomes greater as the field is increased, till it reaches a maximum in a field near that of the maximum permeability. It then gradually goes on decreasing and continues in that state till there is increase in the stronger intermittent field. The field, in which the change of magnetization vanishes, increases with the frequency. The area of the hysteresis curve for the maximum field of 27.7 c. g. s. units increases with the frequency. It reaches a maximum and then gradually decreases. "As regards the explanation of these facts, it only suffices to assume with Wien that the magnetization has inertia."—*Phys. Rev.*, Aug.

REFERENCES.

Visible Radiation from Carbon.—E. L. NICHOLS.—The first part of a paper, read before the Am. Ass'n Adv. Sc., in which he gives an account of experiments in which he measured the temperature of carbon rods rendered incandescent by the passage of an electric current, and made spectrophotometric comparisons of the visible radiation from their surfaces with the corresponding wave length in the spectrum of an acetylene flame. In the present part his apparatus and method are described.—*Phys. Rev.*, Aug.

Electric Oscillations and Electric Waves.—J. A. FLEMING.—An illustrated reprint in full of his series of Cantor lectures, held at the end of last year. Abstracts of the same were mentioned before in the Digest. The first lecture on electric oscillations is in Lond. *Elec.*, Jan. 25, Feb. 1, 8; the second lecture, on electric resonance, in Lond. *Elec.*, Feb. 22, March 8; the third lecture, on the electromagnetic medium, in Lond. *Elec.*, May 3, 24, 31; the fourth lecture on electric waves, in Lond. *Elec.*, June 28, July 5, 12, 19, 26.

Dielectrics.—FLEMING and ASHTON.—Reprints in full of two British Phys. Soc'y papers, abstracts of which have been noticed before in the Digest. Fleming and Ashton, on a model which imitates the behavior of dielectrics, Ashton on the electrification of dielectrics by mechanical means.—*Phil. Mag.*, Aug.

Velocity of Becquerel Rays.—KAUFMANN.—A preliminary account of experiments in which he attempts to arrive at an accurate estimation of the ratio e/m for Becquerel rays. His results point to very

high velocities.—*Phys. Zeit.*, July 13; abstracted in Lond. *Elec.*, Aug. 16.

Ether.—LORD KELVIN.—A reprint, with additions and critical notes, of an old paper (1884) "On the possible density of the luminiferous medium, and on the mechanical value of a cubic mile of sunlight." The new title is "On ether and gravitational matter through infinite space."—*Phil. Mag.*, Aug.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Printing.—DARLING.—An abstract of an interesting lecture on the Friese-Greene process of electrolytic printing, the object of which is the supersession of printing ink with its accompanying complications. The same presses and type can be used as heretofore, but instead of inking the type, the latter is connected to the negative pole of some source of electricity. The paper used is impregnated with suitable chemicals, while the pressure rollers are connected to the positive pole. A current accordingly traverses the paper as it passes through the poles, and the chemicals being decomposed thereby, a sharp impression of the type appears on the surface of the paper. The amount of chemicals needed to give a good impression is small. Thus in one experiment with a silver nitrate paper the coulombs were measured and the amount of silver liberated was therefrom calculated. It was found that an eight-page newspaper can be printed with the liberation of 0.134 grains of silver. Silver nitrate is, however, only convenient for experimental work and unsuitable for practical use, as a paper impregnated with this salt turns black on exposure to light. The chemical originally suggested for the practice was a mixture of manganese sulphate and nitrate of soda, both of which are very cheap. By suitable chemicals prints of any color may be obtained. The rate of production is very great, and it is possible to print on both sides of the paper. It has further been suggested that the method might be applicable to the typewriter, the inking ribbon being done away with and the prepared paper used in conjunction with metallic type connected to the negative main of an electric lighting circuit.—*Eng'ing*, Aug. 16.

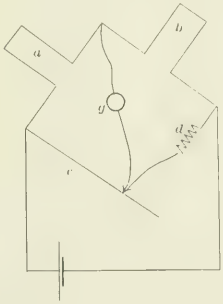
REFERENCES.

Polarization and Internal Resistance of Electrolytic Cells.—ATKINS.—The first part of a paper in which, after an introductory note, by Guthe, on the polarization capacity of electrolytic cells, and on a constant-current method for determining it, the author gives an account of an experimental investigation made to examine Wiedeburg's theory of electrolysis. A brief review of this theory is given and the apparatus and method used in the experiments are described. An account is given with tables and diagrams of the results obtained with copper sulphate between copper electrodes, silver nitrate between silver electrodes; platinum electrodes in sulphuric acid, zinc sulphate between amalgamated and algamated zinc electrodes. So far as there are no disturbing influences the results appear to be in agreement with the theory.—*Phys. Rev.*, Aug.

Handling Storage Batteries.—LEES.—An illustrated article, giving elementary rules how to treat a storage battery. The article is intended for attendants in small private installations.—Lond. *Elec. Eng.*, Aug. 16.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct Reading Conductivity Bridge.—APPLEYARD.—When it is required to check the conductivity of several tons of copper wire, of the same nominal diameter the method generally used resolves itself into making a careful test of the conductivity of the wire of a selected bank, and afterwards balancing a length of this on a slide-bridge against successive equal lengths of the remaining banks of wire of that diameter. If an ordinary slide-bridge is used, the scale readings corresponding to the balance position of the sliding contact are not directly proportional to the successive conductivities, but some calculation is required to find them. If, however, the slide bridge is arranged somewhat differently, the readings of the slider can be made to be directly proportional to conductivities. In the adjoining diagram *a* represents the resistance of the selected wire of known conductivity *A* and *b* the resistance of any of the remaining wire whose conductivity *B* is to be determined. The third arm of the bridge is a fixed resistance *d* and the fourth arm is the slide-wire *c*, the resistance of which can be adjusted to balance *d* by moving the slider. He shows that then the conductivity *B* to be determined, is equal to *c* multiplied with the constant ratio of *A* to *d*; the required conductivity *B* is therefore given in terms of the slide-wire reading. It is necessary that the contact between *c* and *d* should be invariable. He found that the best contact is obtained by a device resembling a drill-bow. The slider carries a small brass bow strung with one or more platinum wires, each of which passes once round the slide-wire. Vertical stops fixed to the slider prevent the platinum wires from lagging behind the bow as it is moved to right or left. Some remarks are added how to calibrate the instrument.—*Phil. Mag.*, Aug.



CONDUCTIVITY BRIDGE.

REFERENCES.

Magnetic Measurements.—MONTPFLLIER and ALIAMET.—Continuations and conclusion of their illustrated serial on magnetic measurements with the ballistic method.—*L'Elec.*, July 20, 27.

Oscillographs.—BLONDEL.—The second part of his article on instruments for directly recording variable current waves. He deals with the applications of the oscillographs to the study of the electric arc.—*Rev. Gen. des Sc.*, July 30.

Volt and Ammeters.—An illustrated description of "column type indicating and recording meters." The principle on which the operation of this type of volt and ammeter is based "consists in causing the variations in the current to be measured to control the variation in pressure of a body of air in a closed vessel, this variation being in turn indicated or recorded by the rise and fall of a column of non-volatile liquid in a glass tube." The construction is described in detail.—Lond. *Elec. Rev.*, Aug. 16.

Meters for Variable Tariff.—GOISOT.—An article giving illustrated descriptions, mainly taken from patent specifications, of the following meters for variable tariff: Rasch, Aron, Union Elec. Co., Loubery, Francois, and Kunkelmann.—*L'Eclairage Elec.*, July 6.

Localizing Faults in Cables.—BETTS.—An article, illustrated by diagrams, in which he describes a new method of localizing a fault in a single cable. It is claimed to approach the loop test method in accuracy and simplicity. No second cable is required.—Lond. *Elec. Rev.*, Aug. 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telephone Line.—An article on the steps that are being taken to establish telephonic communication between England and Belgium. Up to the present time there are only two submarine telephone connections of any appreciable length, viz., between Buenos Ayres and Monte Video, and London and Paris. The cables have a length of 45 km. and 40 km., respectively, while the total length of line is 302 km. and 515 km. Between London and Brussels the distance is 400 km., the submarine part between Dover and La Panne being 90 km. long. Arrangements are being made so that Birmingham, Manchester, Liverpool, Antwerp and Liege can make use of the line as well as the two capitals. Tests were originally made to see if it would be possible to establish communication between England and Belgium, via Lille and the Calais-Dover cable; but later further experiments were made on the three Anglo-French telephone cables in series, which showed that it was quite possible to talk through 120 km. of submarine cable. It was deemed advisable to make the overhead part of the line of copper weighing 800 lbs. per mile. (This corresponds to a diameter of about 5.7 mm.). The cable is a four-conductor one, i. e., with two telephone circuits, and each of the conductors is seven-strand, weighing 39.12 kg. per kilometer, and is covered with gutta-percha weighing 73.35 kg. per kilometer. It is expected that the maximum capacity of the core will not be greater than 0.1483 microfarads per kilometer. A brass tape is in-

terposed between the armoring and the core. The armoring consists of 16 galvanized iron wires. This is claimed to be not only the longest telephone cable which will have been laid, but the overhead parts will be the heaviest that have been used up to the present, for hitherto the maximum diameter of telephone conductors has been 5 mm. It is hoped that telephonic communication will be open before the end of the year.—*Trans. Soc. Belge d'Elec.;* abstracted in Lond. *Elec.*, Aug. 16.

Humming Telephone.—GILL.—A paper, illustrated by diagrams, in which he gives some notes on a humming telephone. Hibbard's experiment is referred to in which a telephone is held against or near to the diaphragm of the microphone and a hum or whistle is set up and continues. The microphone is in series with the battery, and with the primary of the induction coil. The telephone is in series with the secondary of the induction coil. The latter circuit also contains a reversing switch. A novel feature observed by him is that if the wires leading to the telephone are reversed by the latter switch while the instrument is humming, the note at once changes in a striking manner, and if the hum is stopped it will recommence again high or low, according to the side the switch is on. Several other observations are also noticed.—*Tel. Mag.*, Aug.

REFERENCES.

Telephonic Newspaper.—An article on the telephonic newspaper of Budapest which transmits by telephone important news, reports from the Bourse, etc., and puts the subscriber into communication with the opera, concerts, etc. When the number of subscribers became 1200, difficulties were experienced in the operation which, however, have been surmounted so that it is claimed that 20,000 subscribers can now be connected to the paper. Some details of the installation are given and illustrated.—*La Nature,* July 20.

Telephony for Power Transmission Plants.—THEBERATH.—A paper read before the Pacific Coast Elec. Transm. Ass'n on "Telephone service in connection with long-distance power transmission."—*Jour. of Elec.*, July.

Multiple Telegraphy.—An illustrated article on the Mercadier multiple telegraph system.—*Sc. Am. Sup.*, Aug. 24.

New York.—An illustrated description of the Eighteenth Street central office of the New York Telephone Company, "a complete model installation on the common battery system."—*Elec. Rev.*, Aug. 24.

Poles for Line Construction.—An article giving practical formulas for calculating the sizes of poles for line wire construction.—*Tel. Mag.*, Aug.

MISCELLANEOUS

REFERENCES.

Treatment of Lupus by Arc Light.—An illustrated article in the Lortet-Gounod method of treatment of lupus by arc light. The arc lamp used by them, is described in detail and illustrated.—Lond. *Elec. Rev.*, Aug. 16.

Glasgow Exhibition.—A continuation of the illustrated serial giving brief descriptions of several direct-current machines of British make.—Lond. *Elec. Rev.*, Aug. 16.

An illustrated article on electrical features of the Glasgow exhibition.—*West. Elec.*, Aug. 17.

A continuation of the illustrated serial giving brief descriptions of several three-phase machines of British make.—Lond. *Elec.*, Aug. 16.

New Books.

SHOP AND ROAD TESTING OF DYNAMOS AND MOTORS. A Practical Manual for the Testing Floor, the Car Barn and the Road. By Eugene C. Parham, M. E., and John C. Shedd, Ph.D. New York: Electrical World and Engineer. 627 pages, 211 illustrations. Price, $2.50.

The second edition of this excellent work contains 627 pages and 211 illustrations as compared with 538 pages and 163 illustrations of the edition which it supersedes. From the preface we learn that aside from corrections and minor changes, the new matter consists of two chapters on installation tests of car equipments. The first of these chapters takes up all of the various devices comprised in the equipment of a car in the order in which the current passes through them on the way from the trolley wire to the wheel, and a description in detail is given of the trolley, overhead switches, fuse box, lightning arrester, controller, starting coil and motor. The various forms in common use are in each case described, their practical points brought out and information given as to their application and use. As an example of the practical nature of the treatment, in the case of the controller the undesirability of running on resistance is dwelt upon, and other abuses referred to which may occur through careless manipulation. The second chapter gives instructions in full detail for testing a motor and equipment, the subject being treated under the heads of the testing circuit; testing the starting coil and the controller; motor tests; testing for motor polarity; setting the gear; mounting the motors; testing the gears; starting the car; grounds and short circuits.

To those who wish to obtain a thorough knowledge of the principles involved in the dynamo and motor, and in electrical measurement, this work should prove very useful in that respect alone, since the first seven chapters deal with the principles of the dynamo and motor, Ohm's law, the measurement of current, e. m. f., resistance and insulation; while to those desiring information on the practical testing of electrical machinery the work should prove invaluable—the second portion of the work treating of this subject under the heads of testing series, shunt and compound-wound machines; compounding tests; core-loss; testing for eddy current and saturation; brush and efficiency tests; tests for grounds on the line; motor testing. In addition, the new chapters, as above stated, cover street car equipment testing.

In reading the book one is impressed with its thoroughly practical character; indeed, the criticism may be offered that in endeavoring to cover every practical bearing of a subject, lucidity of development is at times sacrificed. This, however, will doubtless not be considered an objection by those who use the book in connection with practical work, and it merely involves a closer reading on the part of the beginner.

Directory of Electrical Societies, Etc.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Buffalo, N. Y., Sept. 10, 11 and 12, 1901.

ILLINOIS STATE ELECTRIC ASSOCIATION. Next meeting, Rock Island, Ill., Sept. 24 and 25, 1901.

RÖNTGEN SOCIETY OF THE UNITED STATES. Next meeting, Buffalo, N. Y., Sept. 10 and 11, 1901.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Owensboro, Ky., Oct. 8 and 9, 1901.

The Cable Works of the Allgemeine Electricitats Gesellschaft.

BY E. KILBURN SCOTT.

QUITE the finest factory which the members of the Institution of Electrical Engineers saw in Germany was the new cable works of the Allgemeine Electricitats Gesellschaft, situated at Oberspree, about 5 miles from Berlin. It was built so recently as 1897, and the area already covered by buildings is about 75,000 sq. ft. It is not quite correct to call them cable works, because the establishment includes a rolling mill for copper, brass, bronze and aluminum, and also for commutator and bus-bars; a factory for the manufacture of all kinds of insulation material, and rubber goods, such as india rubber hose, valves for pumps, washers for bottles, etc.; a department for the manufacture of mica insulators used for high-tension work, etc., and a factory where all kinds of Röntgen ray and wireless telegraphy apparatus are made. There are also machine and repairing shops for producing tools, molds, etc., and a joinery for making drums and packing cases.

The works are very favorably situated for the supply of raw materials, such as copper, lead, iron, coal, etc., either by water or rail, and for the delivery of finished products—cables, wire, etc.

Entering the works from the wharf we arrive first at the metal foundry. Here 15 furnaces are at work, 10 provided with a side blast of special construction and five furnished with a winding arrangement by which the furnace can be raised and the metal poured direct into a ladle for casting. In the machine shop are the ma-

chines for pressing commutator segments for dynamos, these being finished off with the greatest accuracy.

In the rolling mills raw copper, aluminum, bronze, etc., is rolled and drawn into wire. The heated copper bars pass successively through 21 different rolls from the bar to the finished wire, which is 6 mm. diameter (300 yards in length, weight 70 kg.), the whole operation taking 40 seconds. Both sets of rolls are electrically driven, the heavy rolls by means of a 200-hp, 500-volt, three-phase motor, and the finishing rolls by means of a 600-hp, three-phase motor at a tension of 1000 volts. There is also a smaller tin plate rolling press of 40 horse-power. The output of the rolling mills in 10 hours is 30 tons of 6 mm. wire and 10 tons of bars of various metal.

Next to the rolling mills is the cleaning room, where the wire is placed in baths containing diluted sulphuric acid in order to remove all oxide or other impurities. There are also five annealing furnaces for softening the copper wire after drawing, in order to render it soft enough to be drawn again.

The wire drawing mills have, besides the middle and fine wire drawing machines, 21 heavy machines and 10 multiple machines, These latter have each seven dies and represent the most advanced and improved construction which has been reached up to the present. The series of seven dies are arranged side by side, and after passing through the first die the wire is gripped by a power roller from which it passes again to the front of the machine and so through the next die. Again it is gripped by a power roller and so on through all the separate dies. The fine drawing machines are also multiple machines, the dies of which are fitted with diamonds in order to obtain the greatest accuracy in the finished wire. These machines draw wire down to .05 mm. or .002 inch diameter.

The main cable factory has six large lapping machines used for lapping either rubber or paper cables for high tension. There are also the usual wire winding machines, and the cable machines in which the wire is stranded and insulated with either jute, paper or a combination of jute and paper. After being coiled into baskets the insulated cables are put into large vacuum drying ovens heated by steam coils, the time being adjusted according to the quantity of material to be dried. The cable is next laid in a vacuum compound tank where it is impregnated and is then passed to the lead press. The lead presses are on the well-known Huber system, in which the lead is melted down from the pig as it is used. They work at a pressure of 200 to 350 atmospheres. The lead-covered cables are put under water for the usual 24 hours, and are then tested for insulation resistance and capacity. When for high-tension they are tested with double the working pressure, there being at disposal a pressure of 50,000 volts alternating from a transformer of 50 kilowatts. When a high-tension test is being taken that part of the laboratory that is dangerous is lighted automatically by red signal lamps.

In the armoring machines the test cables are passed from the drum at the back of the machine, first through compound and then successively served with paper, compound, jute, compound, two layers of steel tape, compound, jute, then two compounds and whitewash, and finally wound direct on to a drum for delivery.

The braiding room has no less than 350 small machines at work braiding flexible cords and insulated wires. The machine for insulating fine copper and resistance wires as small as 0.4 mm. with pure Milan silk were especially interesting. There are 88 such machines, each with from 20 to 40 heads running at a speed of 4000 r. p. m. In this same room there are also 200 braiding machines, which are exclusively used for braiding flexible cord with colored silk and cotton in various combinations of color.

The telephone machines, of which there are about 100, each with eight heads, are used for covering the telephone wire on the air-space system. The paper can be lapped spirally or longitudinally. In this latter case the telephone cables are paper-covered in rather a special way, the paper being folded lengthwise round the wire and kept in position by being bound round with two threads. When a number of wires are bundled up together these threads form the necessary air spaces. When covered the wires are laid up in the usual manner in twos and then stranded in layers in opposite directions in the large stranding machines up to 306 pairs.

In the rubber factory are to be seen the operations of masticating, cleaning and pressing gutta percha, and also the machinery for cleaning raw rubber. When mixed with the necessary pigments the rubber is kneaded in mixing rolls, and after being compounded are rolled into sheets by means of callenders. Part is used for moulded goods, and part for pure Para rubber tape 0.2 mm. thick. The pure rubber tape is vulcanized by means of chloride of sulphur.

In the micanite factory are produced sheets and moulded goods of various shapes, tubes, rings, disks, spools, etc. The mica plates are put together by means of shellac, and are afterwards pressed into moulds and dried.

The boiler house is equipped with six multitubular boilers by Babcock & Skinmüller, the steam generator being used for drying the cables, heating compound and for warming the buildings.

In the pumping station a Riedler express pump delivers 1.5 cubic millimeters of water per minute when running at 180 r. p. m., and driven by a 15-hp three-phase motor. In case of fire a pressure of 6 atmospheres can be obtained. Three other plunger pumps are in reserve.

The generating station, or transformer room, contains four revolving three-phase continuous-current transformers of a capacity of 110 kilowatts at 200 volts. These deliver current for the cranes, locomotives and the arc lamps. There is also an accumulator battery. Along the wall are 16 three-phase transformers, which transform down from 6000 to 1000, 500, 200 volts, as required for the various circuits. The total capacity is 2600 kilowatts, and current is obtained from the Oberspree station of the Berliner Elektricitats Werke.

All the running machinery is exclusively driven by three-phase motors, either singly or in groups, so that transmission by shafting is nowhere made use of. This enables the electric lighting to be carried out throughout by inverted arcs. There is no shadow, and so the workmen's eyes are not strained.

An electric locomotive is employed for shunting railway trucks, and there are also two electric locomotive cranes. These cranes have a jib of 5 metres and a lifting capacity of 4½ tons.

The dangerous nature of manufacture renders it necessary to have an extensive volunteer fire brigade, which consists of 40 workmen under the direction of an inspector of the Berlin Fire Brigade.

In front of the works there is the Casino, which has four halls with sufficient space for accommodating 1600 persons. In the principal hall weekly lectures of a scientific and instructive character are given. The ground floor contains bathrooms, also a surgeon's room in order to have speedy help at disposal in case of accident.

Everything possible is done as regards care for the workmen's welfare. A special invalid fund has been provided and provision is also made for material assistance in cases of protracted illness. There is also a convalescent home favorably situated, which will accommodate 200 inmates.

By wireless telegraphy on the Slaby-Arco system messages can be sent to the Central Depot in Berlin, over a distance of 10 miles. The wires hanging from the main shafts serve for sending and receiving the electric waves. It may be mentioned that the firm has supplied a large number of instruments to the warships of the German Navy, and they have also recently installed instruments on the imperial yacht "Hohenzollern."

Electric Automobile Tests in Cleveland and Chicago.

By Frederick Carrington Phillips.

The readers of the Electrical World and Engineer will doubtless be interested to learn of two record tests made recently on an electric automobile in Cleveland and in Chicago, as already noted briefly in these pages. The tests were made to demonstrate the possibilities of long distance travel with an electric automobile on one charge of its battery, and at the ordinary speed such as is now, or will be, the general practice in cities, namely, about 10 to 11½ miles per hour. The common objection that is raised to an electric motor vehicle is that it will not cover enough miles in town service. I think that we have completely demonstrated that there can be constructed a perfectly practical electric vehicle that will run long distances in city use and also comparatively long distances over fairly good country roads, and yet such vehicle will not be of special weight or be otherwise other than perfectly practical. The two tests that I describe below amply demonstrate this proposition.

Test 1 was made from the late evening of July 12 to midday of July 13 in Cleveland, on clean, first-class streets and boulevards that are paved with stone, brick and asphalt, and that are more or less up and down grade, but not very much so.

The second test was made in Chicago on the south side avenues and boulevards, for the most part excellent macadam pavements, from the evening of Aug. 5 to about midnight of Aug. 6.

In the first test we covered on a practically continuous run with

one charge of the battery, a distance of 151 miles at an average speed of 10.91 miles per hour, with a consumption of 4275 watt-hours. The weight of the vehicle with its passenger was just under 1100 lbs. (1090 lbs., to be exact). This works out, as will be seen, at practically 52 watts per ton mile.

In test 2, made in Chicago, as described above, we covered 187½ miles on one charge, and at a speed that was a trifle over 9 miles per hour. In this case, however, we had on board a larger battery that weighed 600 lbs., and the total weight of the vehicle with passenger was 1400 lbs. The consumption of power in this case was substantially 55 watts per ton mile. The weight of the battery in test No. 1 was 350 lbs.

The vehicle itself is a Baker-Stanhope, the body being of our own design. The motor is of special Elwell-Parker design and manufacture, such as we are regularly furnishing to the Baker Motor Vehicle Company, of Cleveland. The battery in both cases was that furnished to us by the Porter Battery Company, of Chicago.

The vehicle with its electric equipment and battery are of the regular type that are on the market, and are in no way specially designed for the particular tests that we made, since we were desirous of demonstrating, not what could be done with a specially constructed rig, but what could be done in regular practice by a commercial electric vehicle. I think that the above results, especially in the direction of the efficiency, as indicated by the watts per ton mile, are quite unequaled, by a large margin, by any results that have been obtained heretofore in an electric motor vehicle.

ELECTRIC AUTOMOBILE.

These efficiency results are due primarily to the high efficiency of the motor and running gear of this vehicle, a large part of the good results being due to the fine design and construction of the latter part, although, of course, the high efficiency of the motor on the various currents that are required in driving at the various speeds in a practical run, cuts a large figure in obtaining these satisfactory results. In addition, of course, due credit should be given to the battery for its comparatively large storage capacity with the minimum of weight.

I may remark, in passing, that these runs were practically continuous, excepting for intervals necessary for the chauffeur's rest and refreshments, and once in the case of the Cleveland test, and again in the case of the Chicago test, for replacing tires that were punctured or that otherwise came to grief.

The above tests have demonstrated the electrical and mechanical efficiency that are attainable in electric automobiles, and show that whereas the speeds obtained in these trials were not very high, it is quite feasible to secure as high if not higher efficiencies on higher speeds, as, for instance, at 15 miles an hour or more. This presumption is justified, as it is well known that moderately increased speeds are obtainable with a well-made vehicle with far less additional power consumption than is the case with a very rapidly moving object through the air, or, in the case of a vessel moving through the water.

New Equipment for Ottawa, Canada.

The Ottawa Electric Company, whose plant was destroyed in the great fire in that city some time ago, has recently contracted with the Westinghouse Electric & Manufacturing Company for a new equipment, of which we illustrate herewith one of the three 700-kw generators, to be equipped for waterwheel connection, one of two 700-kw belted generators, and one of three 250-hp induction motors. In addition there will be supplied one 300-kw rotary, with two 165-kw transformers, one motor-generator outfit of 22½ kilowatts capacity, one 37½-kw slow-speed multipolar generator and a special 56½-kw multipolar type generator.

Each of the 700-kw turbine-driven generators is a two-phase machine, and is to be of the two-bearing type, with a coupling on the shaft for direct connection to the end of a waterwheel shaft, revolving at a speed of 180 r. p. m. At 60 cycles each machine will have an output of 159 amperes per terminal at 2200 volts under a non-inductive load. The external frame will be divided in a vertical plane and movable from the shaft to permit easy access to windings. In all, there will be 40 poles upon this frame. The winding of the field coils is to be of strap on edge. The armature of the slotted drum type, will be built up of laminated steel of the highest magnetic quality. Its wire-wound coils will be continuous and retained in position by fiber wedges. The two-phase current will be collected by special brass rings of the open ventilated type employed by the Westinghouse Company. The temperature conditions and regulation will be excellent.

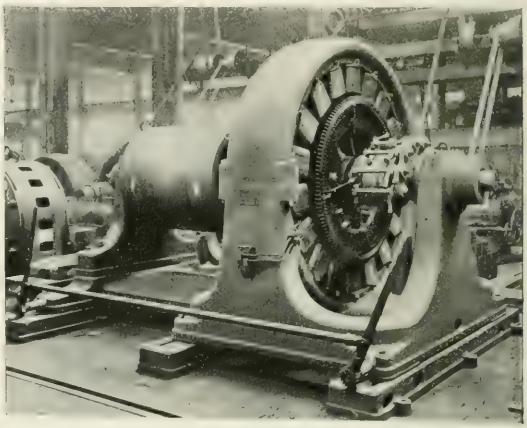


FIG. 1. 700-KW, TWO-PHASE, BELT-DRIVEN GENERATOR.

The requirements of the Ottawa Electric Company were that the generator should under a non-inductive load have an efficiency of not less than 83 per cent at one-quarter load; 90.5 per cent at one-half load; 93 per cent at three-quarters load, and 94½ per cent at full load.

The machine will operate for 24 hours at 2200 volts, and at 159 amperes per terminal, at from 90 per cent to 100 per cent power factor with a rise in temperature not to exceed 40 degs. C.; at 25 per cent greater current with the same power factor for 24 hours the rise in temperature will not exceed 50 degs. C.; at 50 per cent greater current the rise in temperature will not exceed 60 dgs. C.

The 700-kw belted generators are of the three-bearing type with rotating armature. Each will generate two-phase currents at 2200 volts, 159 amperes per terminal under a non-inductive load. The journals will be self-oiling and self-aligning, while the shaft will carry a pulley 58 inches in diameter and 72 inches in face. The frame of the horizontally divided type will contain 22 poles, and at a speed of 327 r. p. m. the frequency of the machine will be 60 cycles. The regulation will be very close. In the case of this machine the Ottawa Electric Company requires that, on a non-inductive load, the efficiency should be less than 84 per cent at one-quarter load; 90½ per cent at half load; 93 per cent at three-quarters load, and at full load 94 per cent.

The field coils will be wound with strap on edge and are to be placed on pole pieces so designed as to reduce the armature reaction and the self-induction to a minimum. The armatue coils are to be

continuous, wound from strap copper and retained in place by wedges of hard fiber.

The 250-hp induction motors are to be two-phase, Type "C," Westinghouse constant-speed C motors, with self-oiling and self-aligning bearings. They are intended to operate directly on the 2200-volt circuit at a speed of 580 r. p. m. under full load. Each is a 12-

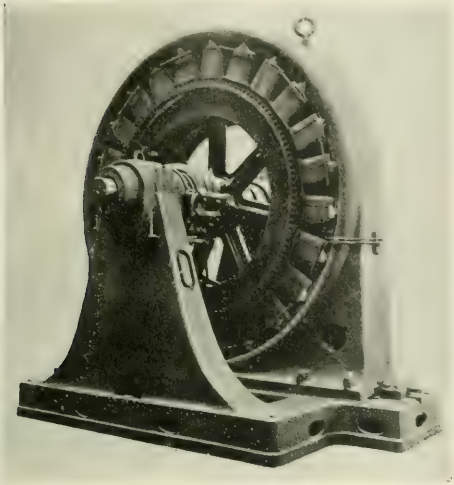


FIG. 2.—700-KW, TWO-PHASE REVOLVING ARMATURE GENERATOR.

pole motor weighing approximately 11,000 lbs. The parts are a cylindrical yoke carrying the primary windings, and to which will be bolted circular end brackets to carry the bearings, and a rotating squirrel-cage secondary. The motor will have an efficiency of not less than 90 per cent under its full load of 250 horse-power, and a power factor of not less than 91.5 per cent. The temperature conditions are a normal load for 24 hours, with a rise not to exceed 40 degs. C.; a 25 per cent overload for 24 hours with a rise not to exceed 50 degs. C., and a 50 per cent overload for one hour with a temperature rise not to exceed 60 degs. C. It is intended to place a 125-light Brush arc machine on each end of each motor and to make direct connections by suitably flanged couplings.

The 56½-kw generator is of the special multipolar type, compound wound for 125 volts, and is intended to operate at 475 r. p. m.

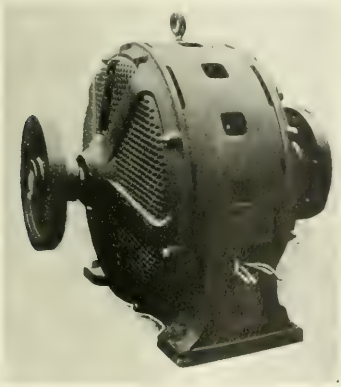


FIG. 3.—250-HP INDUCTION MOTOR.

Its shaft is to be extended that the coupling may be placed outside of its pulley, and each machine is to be equipped with belt-tightener, base plate, flange coupling and pulley. Each of the 37½-kw direct-current generators is to be of the slow-speed multipolar type, compound-wound at 125 volts. The motor-generator outfit is to consist of one 22½-kw direct-current generator compound-wound for 250 volts, and one 30-hp, slow-speed direct-current motor shunt-wound for 500 volts.

A Southern Power Plant.

The Fries Manufacturing & Power Company's power house is located on the Yadkin River, about 14.5 miles from Winston-Salem, N. C. The enterprise was undertaken by the Fries Manufacturing & Power Company in 1898, and has been in successful operation ever since. The dam is 10 ft. high and 500 ft. wide, and will furnish from

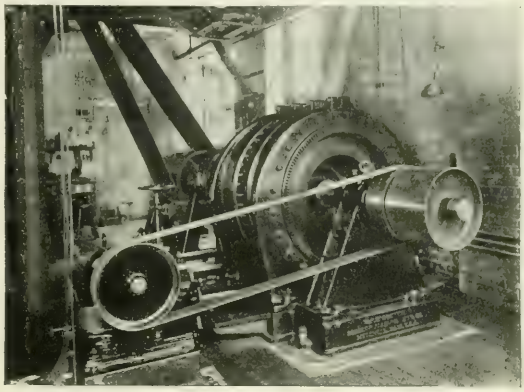


FIG. 1.—COTTON MILL GENERATOR PLANT.

2500 to 3000 horse-power. All the buildings at the river are of rubble masonry, and go to bedrock for their foundation. The power house is built into and constitutes one end of the dam, and is divided into eight compartments, each containing two 54-inch McCormick turbines. The wheels are in vertical position, and eight of them are connected to a horizontal shaft which is connected direct to the generator shaft by means of flexible coupling driving a 750-kw, three-phase S. K. C. generator wound for 12,000 volts, 66 cycles at a speed of 166 r. p. m. The other eight turbine wheels are connected in the same way to a second generator of the same size and make, the two generators running in parallel.

The current is carried from the power house to the sub-station at Salem, N. C., on three No. 1 bare copper wires, where, by using

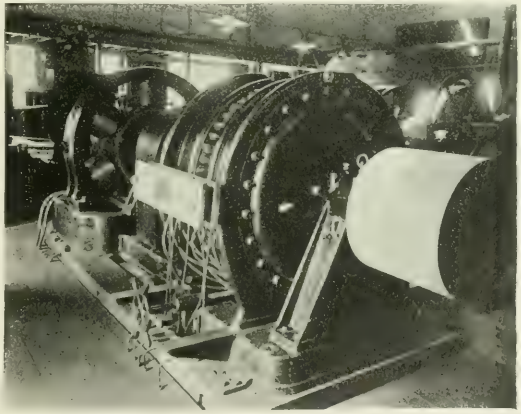


FIG. 2.—RAILWAY POWER HOUSE.

step-down transformers, a portion of the current is reduced to 1200 and 2300 volts. One high-tension circuit is run to South Side Cotton Mills, 11,500 volts, where it is transformed to 600 volts, operating two 300-hp S. K. C. synchronous motors, also driving a large motor for the Salem water works. One circuit runs to the Southern Chem-

ical Company, driving a large number of motors of various sizes, from 20 to 80 horse-power.

The remaining high-tension circuits enter the railway and electric light power house at Winston, N. C. Current is reduced to 1200 and 2400 volts by step-down transformers, which are furnishing power to two 300-hp S. K. C. synchronous motors driving two 200-kw, direct-connected dynamos, furnishing power for street cars; also current for 200 arc lights and about 4000 incandescent lights. Power is also supplied to Fries woolen mill, 80-hp S. K. C. motor, and Fries cotton mill, 300-hp S. K. C. motor. Many other enterprises, furniture factories, knitting mills, tobacco factories, etc., are furnished exclusively with power.

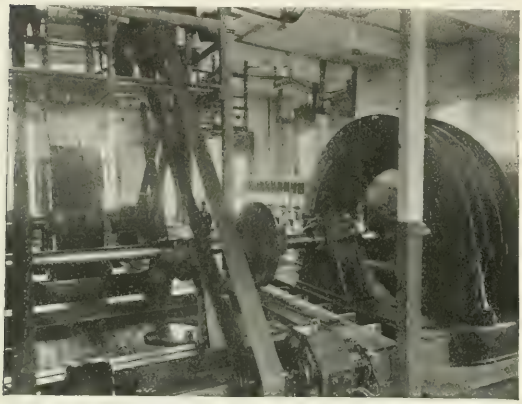


FIG. 3 —THE RIVER PLANT.

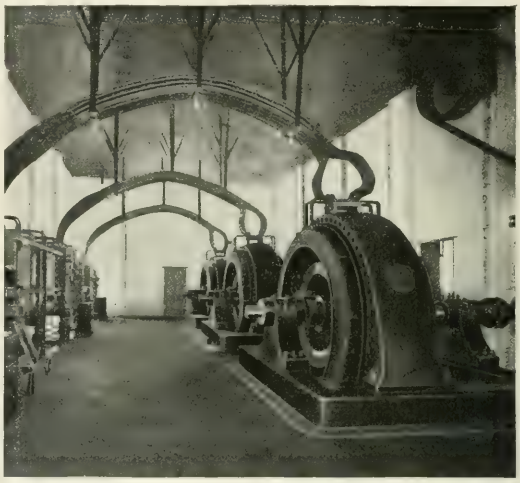
The railway power house also has a steam plant as reserve, consisting of four boilers and three engines of the Armington-Sims and Ball types in case of dry season. The generators, motors and transformers are all of the well-known S. K. C. system, and the lines are protected by S. K. C. lightning arresters, manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

Electric Reduction Plant in West Virginia.

At the falls of the Great Kanawha, some 36 miles above Charleston, W. Va., is a great industrial enterprise that has in it far more of interest than attaches to the manufacturing of ordinary articles of commerce. It is the Willson Aluminum Works, which are employed in the reduction of chrome ore and the manufacture of ferro-chromium, which is utilized in the hardening of the steel of which armor plates for war vessels are made. When the Willson Company entered the ferro-chromium business they had to deal with ore so refractory that only electric heat was practicable for its reduction. It became necessary, therefore, to obtain a site for their plant where current could be generated at a minimum of cost. For this reason Kanawha Falls was chosen. Here New River, which is joined by the Gauley about two miles above, rushes over a precipice some 26 ft. high, and is thereafter known as the Great Kanawha. The fall makes one of the finest water powers in that region, careful estimates showing that at the lowest stage 8000 ehp can be developed. Across the river, on the top of the solid rock forming the falls, the Willson Company has built a dam, and on the north side an electric plant of 3000-hp Bullock alternating-current generators of the revolving field type has been installed, and is now at work. The remainder of the power will be developed by machinery soon to be put in on the south side of the river.

In the heat kindled by this 3000 horse-power current the chrome ore is reduced to ferro-chromium, or as it is usually called, ferro-chrome. The ore reduced to pure metal is not picked up on the wooded mountain within easy reach of the company's works. Chrome ore is found in a number of places on the globe, but there are many qualities of it, and this company requires what is best suited to the special purpose for which it is intended—that is, which contains the highest ratio of chrome and the smallest proportion of iron. The ore used is from Australia and Asia Minor, most of it being from the latter country. It is taken from the mines and carried many miles on the backs of camels to a port on the Black Sea, where it is put on shipboard and sent to this country, coming from the seaside to Kanawha Falls by rail. The metal produced from this ore is 70 per cent chromium.

The entire output of the plant is contracted to the Carnegie Steel Company and the Bethlehem Steel Company to be used as alloy in hardening the steel for the armor plates which those companies are making for the United States Navy. To supply this demand the Willson Works will be run to their full capacity during the life of the Carnegie and Bethlehem contracts with the Government. Ferro-chrome is also used in making the projectiles used in modern warfare, thus appearing on both the offensive and defensive sides of the conflict.



THREE 600-KW, THREE-PHASE GENERATORS.

A Feature of Three Wire Secondary Distribution.

The past two or three years have witnessed the very general introduction of the 110-220-volt alternating-current, three-wire system. The advantages of this method of secondary distribution, using large transformers situated at suitable points, are so well known as to require no further explanation. Attention has been called, however, to the disturbing effect such a method of distribution exerts upon the core-type transformer when wound in the ordinary manner; with a primary and a secondary on each leg of the core, there being thus two primary coils and two secondary coils. When connected to a three-wire system it will be observed that one of the secondary coils is thus connected across each branch of the circuit. If one side of the system is loaded and the other side unloaded, the transformer therefore is supplying current from one of its secondary coils, and no current from the other secondary coil.

The effect which this has upon the regulation of the transformer has been stated to be so pronounced as to prohibit practically the use of such a transformer for this service. Taking the extreme case where the one side is fully loaded and the other side unloaded, it has been observed that the voltage on the loaded side dropped from 100 volts down to 80 or 85 volts, while the potential on the loaded side rose from 100 up to 115 or 120 volts. This, of course, is the extreme effect, and as the regulation becomes normal when both branches carry the same loads, the regulation will vary from normal to the prohibitive condition mentioned.

The Pittsburgh Transformer Company observed this peculiarity of the usual core type transformer, and at once sought a remedy for the trouble. It was recognized that the effect was caused by the excess of current in the one coil over the other, this apparently causing a leakage of the magnetic lines of force. The lines of force being forced out of the heavily loaded coil, caused an excessive drop in voltage in that coil and, to make matters worse, the lines thus forced out of one coil appear to have been crowded into the other coil, thus raising its voltage as far above the normal as the first coil

is below normal. The solution evidently was to wind the several coils of the transformer in such a manner that the disturbing effect of the excess current in one side should have absolutely no effect upon the distribution of the magnetic lines which thread the assembled coils.

In experiments attacking this problem, some curious effects were brought out, one of which may be of general interest. It was observed with a 1-kw transformer, which was wound for 100-200 volts with the common style of winding mentioned, that no unbalancing effect was to be detected. This transformer was not mounted in the cast iron case. Another transformer wound in precisely the same manner, but which was mounted in the case, showed the effect most markedly. This second transformer was then removed from the casting and again tested. It was observed that this also failed to show the unbalanced effect looked for. It was then evident that the casting surrounding the transformer was responsible for at least a portion of the magnetic leakage which produces the above described distortion upon the voltage.

The winding which was adopted by the Pittsburgh Transformer Company was carefully tested under various conditions, and it was demonstrated that normal regulation, that is, the regulation which is obtained upon the common two-wire system, was exhibited under all variations in the load. With one side of the system fully loaded, and the other side entirely unloaded, the difference in voltage between the two sides was that due simply to the ohmic drop, and was equal in amount to the normal regulation. This method of winding the core type transformer is said to be broadly covered by U. S. patent No. 680,421, issued to Frederick C. Sutter and Robert V. Bingay, and controlled by the Pittsburgh Transformer Company, which in its Bulletin No. 7 discusses the three-wire system of distribution using large transformers with 110-220-volt secondaries. The advantages of this system are pointed out and the methods of construction used in a type of transformer adapting it to this peculiar service are also shown and illustrated.

A New Lumen Meter.

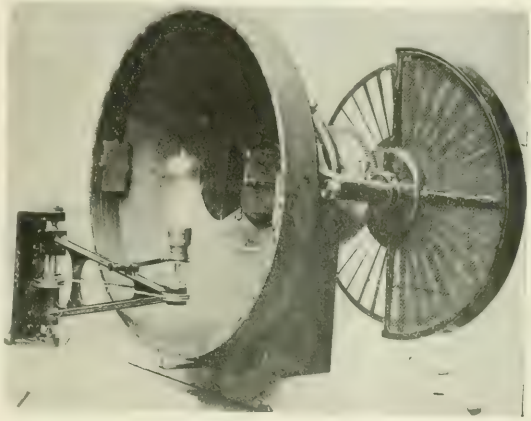
Messrs. Queen & Co., of Philadelphia, have just completed and put on the market a new form of lumen-meter, designed for the rapid measurement of the mean spherical candle-power of incandescent lamps. This instrument is manufactured under the patents of Messrs. Houston & Kennelly, and is a modified design of the arc light lumen-meter described in an article by Professor R. A. Fessenden in the pages of this journal some time ago.

Employing this instrument it is possible to measure accurately with one setting of the sight box, the mean spherical candle-power of any incandescent lamp, regardless of the shape of the bulb or filament. Persons accustomed to taking the large number of settings heretofore necessary in obtaining the mean spherical candle-power, and even then only arriving at an approximate result, will greatly appreciate this instrument as it is now possible to make measurements in as many minutes as heretofore required hours to complete.

As will be seen from the illustration the instrument consists of a funnel-shaped hood carrying a small mirror in the rim. This hood is mounted in ball bearings on a substantial iron base and arranged so that it can be rotated at any desired speed by means of a belt and suitable power. At the bottom of this funnel and rotating with it, is mounted another mirror, the mechanical construction being such that the beam of light from the incandescent lamps falls on the mirror in the rim of the hood and is reflected to the center mirror, whence it passes through an opening in the axis of the apparatus and down the photometer track to the screen. At the far end of the axial opening is arranged a circular metallic disk which revolves at twice the speed of the mirrors. This disk is perforated with different size slots which consecutively pass through and intersect the beam of light and at regular intervals cut off more or less of it. For example, when the mirror has the position shown in the illustration, the slot in the disk is a maximum and allows all the light given by the lamp to pass through. When the mirror is rotated 90 degs. from this position, consequently directly over the top or under the base of the lamp, the disk has revolved to a point where there is no opening so that no light falls on the photometer screen. The various intermediate openings are cut accurately so that at various intermediate positions of the mirrors a correct proportion of light is intercepted.

It will be noted that it is also possible to measure the candle-power of the lamp at any inclination to its axis by merely removing the disk and not rotating the lamp, making the setting at which it is desired to measure the candle-power by means of the scale on the edge of the hood and pointer beneath the lamp.

To make a measurement for mean spherical candle-power the lamp to be tested is placed on the adjustable bracket and rotated about its vertical axis at its usual speed for mean horizontal measurements.

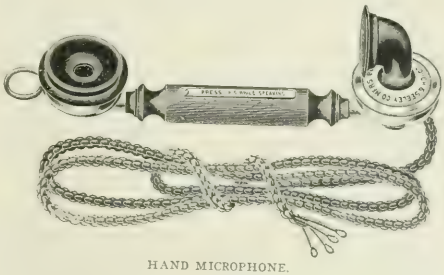


LUMEN METER.

The hood is set so that the mirrors occupy the same position as in the illustration, and the potential at the lamp terminals so adjusted that the rated candle-power is produced. The hood is then rotated at a suitable speed, between 200 and 300 r. p. m., and another measurement made. This reading will indicate the mean spherical intensity at the same voltage at which the lamp gave the mean horizontal candle-power of 16. The apparatus shown is built for testing incandescent lamps in large numbers for their mean spherical intensity.

Hand Microphone.

The accompanying illustration shows a hand-microphone put on the market by the Couch & Seeley Company, Boston, Mass. The specially distinctive feature in this article is that it is adjustable as regards the distance between the receiver and the mouthpiece of the microphone. This is accomplished by loosening a screw in the handle and drawing out or closing up the appliance as one does with a telescope. There is no change in the outward appearance or finish. The microphone is their standard long-distance coal grain type, with

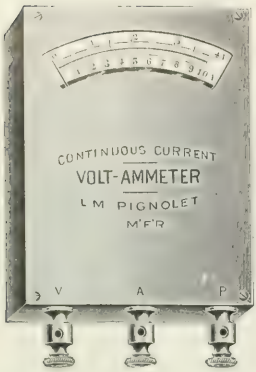


HAND MICROPHONE.

gold electrode and bipolar receiver. The mouthpiece is aluminum, highly finished, and the handle is of polished hard rubber. The switch lever in the handle is fitted with double contacts (unless specially ordered with single), thus requiring no automatic hook when used with either a magneto bell, push button or common battery system.

This type of instrument is used in all of the Couch & Seeley portable sets and iron box telephones for the talking circuit, and is claimed to possess many advantages. It is also convenient for desk use, as it can be placed in a drawer, hung up on a dummy hook or laid down in any position, and the instant the lever in the handle is released, the talking circuit is broken and the ringing circuit completed.

Pocket Measuring Instruments.



The accompanying cut represents a combination volt-ammeter, one of a line of small measuring instruments made by Louis M. Pignolet, of 78 Cortlandt Street, New York City, of sufficient size to secure accuracy and a fair range, but at the same time small enough to fit in the pocket or tool bag, the size being twice that of the illustration.

These instruments are of the permanent magnet type, with magnets of special imported steel, and carefully treated to insure permanency. The construction is thorough; the pivots of the moving parts are hard and sharp, and rest in jewels. The scale divisions are made by hand and are of practically equal width.

The line of instruments comprises voltmeters, ammeters, volt-ammeters and mil-ammeters in various readings for special purposes, among which are low-reading voltmeters for testing storage batteries, ammeters for testing dry batteries, mil-ammeters for medical and other uses; but the volt-ammeters which can be used either as a voltmeter or as an ammeter are particularly useful to those having the care of batteries and telephone, annunciator, fire alarm or other battery circuits.

The condition of the battery can be ascertained as well as that of the circuit. The current flowing through the circuit can be measured to ascertain if it is normal. Grounds, short circuits, etc., can be detected by the drop in voltage on the line and located by testing the line from place to place.

American Electrical Apparatus for Japan.

Takata & Co., of Tokio, Japan, and of New York City, have recently placed contracts for a large plant to go in the Shiramine Dockyard, Japan, where the apparatus therefor will be largely, if not wholly, of American make. The orders include two 150-kw Westinghouse 250-volt direct-current engine type generators, which are to be direct connected to Westinghouse engines, to operate in multiple and to over-compound from 220-volt, no-load, to 250-volt, full load. There will also be a Westinghouse switchboard and one Westinghouse 50-hp slow-speed multiploar shunt-wound motor, 220 volts, running at a speed of 550 r. p. m., together with the usual accessories, such as field rheostat, single-pole starting rheostat, switches, etc. The concern have also ordered one Westinghouse 76-hp, 220-volt, direct-current shunt-wound motor, which operates at a speed of about 300 r. p. m., to be direct connected to two centrifugal pumps manufactured by Gwynne & Co., of London; and a 9-hp, 220-volt, shunt-wound, direct-current motor, operating at about 715 r. p. m., to be direct connected to a centrifugal pump of the same make and mounted on a common base with this pump.

The steam plant furnished by Westinghouse, Church, Kerr & Co. comprises two Westinghouse vertical cross compound automatic condensing engines, size 16 by 27 by 16, running at a speed of 225 r. p. m. These engines will develop 275 ihp, running at the above speed with 125 lbs. pressure at the throttle and 26-inch vacuum, and will be furnished with the necessary extended bed plate, crank shaft and outboard bearing, said shaft arranged to receive the armature of the generator. For furnishing steam the Heine Safety Boiler Company will supply two water tube boilers, each rated at 176 horse-power. These boilers are designed to carry a safe working pressure of 160 lbs., but it is the intention to operate them at 125 lbs. pressure at the throttle.

The steam plant will also include a Knowles patent horizontal air pump and jet condenser, size 12 by 18 by 18, with a capacity of about 10,800 lbs. steam per hour to be used in the main engines, and two Knowles special duplex feed pumps, pressure pattern, size 4½ by 2¾ by 4. The capaciy of both cylinders of each pump in gallons per minute is from 20 to 40.

The Taunton Locomotive Works will furnish for use in connection with this plant two Wainwright even-flow water tube heaters, 250 horse-power capacity each.

Takata & Co. have also placed with the Westinghouse Electric & Manufacturing Company another order for a 125-volt standard speed compound-wound generator, together with switchboard, etc., this outfit being intended to be used to furnish power to operate ventilating apparatus in the House of Commons. The concern is also about to ship a complete hoisting outfit, which consists of a Lidgerwood hoist having a friction drum of 30-inch diameter and 24-inch face. This drum is geared to give a rope speed of about 100 ft. per minute, and to be connected to a Westinghouse direct-current 15-hp, 500-volt motor. There is mounted on the hoist a Westinghouse controller, the necessary resistance being placed under the frame in a convenient place. This hoist is intended for the Ashio Mine, one of the largest copper mines in Japan.

FLEXIBLE PENDANT.

Flexible Steel Armored Conductors.

In the accompaning illustration is shown a section of flexible cord with rosette and terminal bushings, which constitute part of the interior wiring system of the Sprague Electric Company, New York. This cord is particularly useful for lamp pendants and portables under conditions requiring extraordinary service, such as in machine shops, theaters, mills, show windows, factories, engine and boiler rooms, etc.

The success of these products is largely due to the high grade of insulation surrounding the conductors, the perfect mechanical protection afforded by the steel armor, and the lower first cost when compared with metal conduits, plus conductors.

The Coal Handling Installation of the Boston Elevated.

The Lincoln's wharf power station of the Boston Elevated Railway, as already noted in these pages, is an excellent example of the most modern engineering practice. The building is 155 by 145 ft. in area. The pumps, condensers and all piping are placed below the level of the engine-room floor. The boiler room is at a slight elevation above the ground, and the coal is carried above this in steel pockets. The capacity of these pockets is 3500 tons of coal and room for 6500 tons more is reserved on the company's wharf adjacent to the building.

The total nominal horse-power of the boilers is 6000, there being six batteries, each consisting of two 500-hp water tube Babcock & Wilcox boilers. The 12 boilers are equipped with mechanical stokers and fuel economizers. The continuous operation of the generating machinery depends upon the continuous supply of coal to the boilers. The authorities of the Boston Elevated Railway made a thorough investigation, and decided to install an equipment of coal conveying apparatus manufactured by the C. W. Hunt Company, of West New Brighton, Staten Island, N. Y.

The power house equipment of coal-handling machinery consists of two complete systems of Hunt standard noiseless gravity bucket conveyors, each about 500 ft. long, and with a maximum lift of about 100 ft. This conveyor differs from the ordinary chain conveyors in many particulars. While it is usually called a conveyor and classed with this machinery, it is, in fact, a series of cars linked together, each having a body hung on pivots, gravity keeping them in an upright position, no matter whether the track is horizontal,

vertical or inclined. It is carried on wheels fitted with self-closing oil cups and oil reservoir, is electrically driven and is noiseless in operation. All shafting is ground on dead centers, and runs in removable bronze bushings. All gears are machine cut and pressed on taper shafts. Careful provision is made for thorough oiling, and all parts are made to gigs, tools and templets on the interchangeable system.

The motion of the conveyor is obtained by pawls pushing the chain along. The pawls give a steadier motion and permit the power to be applied at any point in the conveyor chain. The wear on the pawls is an insignificant amount, as all the working bearings are of ample area and can be thoroughly oiled.

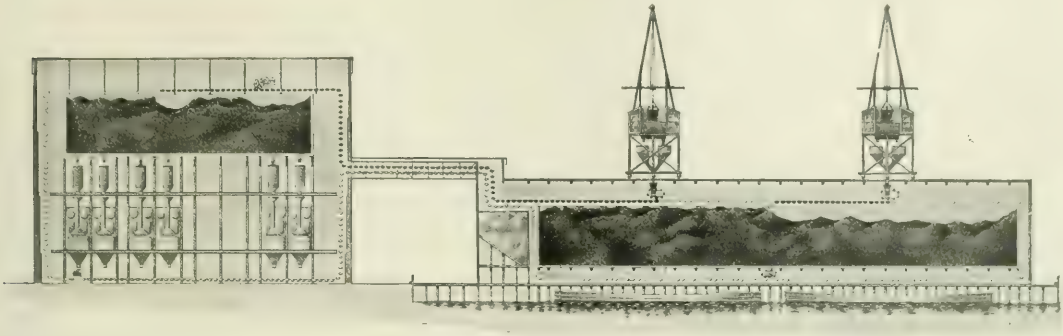


Fig. 1.—Longitudinal Section of Coal-Handling Installation.

Fig. 2.—Lincoln Wharf Power Station.

A Hunt rotary filler is used on the lower line for feeding the coal and ashes into the conveyor buckets. This filler measures a predetermined amount of material and deposits it in each passing bucket. The ashes are carried to a pocket on the wharf. The entire conveyor system is installed in duplicate, and is located in and extends the full length of the power house.

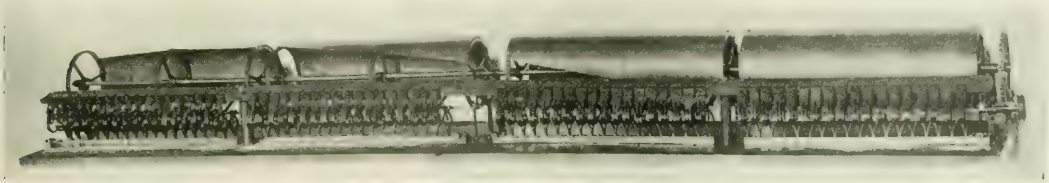
A New Departure in Electric Sign Flashers.

The Reynolds Electric Company, of Chicago, has recently built what appears to be the largest flasher (current controller or automatic switch) of the jack-knife pattern which has yet been constructed. This device is used to flash a very large electric sign erected by a prominent clothing firm in Boston. The letters in the sign are made in script style, containing 360 8-cp lamps. The lamps are wired in circuits of five lamps to a circuit, thus making 72 circuits, and are flashed or lighted so as to give the sign the appearance of being written out by an invisible hand, beginning with the first five lamps and continuing lighting each consecutive circuit of five lamps. This requires about 12 seconds, until the entire sign is illuminated. It remains a few seconds, then is extinguished. This operation is repeated about three times every minute, producing a most attractive effect.

The base of the flasher is 74 inches long by 12 inches wide. Instead of having one wheel or disk for each circuit as in the regular Reynolds flasher, a drum or cylinder of heavy brass is used, which is cut out diagonally, as shown, so that when revolving the various blades are forced one after the other into forks on the base. The lead wires from each circuit from each five lamps being attached to the bracket to which the blade is fastened, the illumination of the successive circuits in the sign is made perfectly uniform without the least interruption or break.

The drum of this device is entirely mechanical, and is not charged with electric current, the current passing only from the bar holding forks through the blade and blade-holder when contact is made, which makes it absolutely safe against burning. The device is driven with a one-tenth horse-power motor.

This is a departure from the former style of flashers for this type of signs, with a charged drum, as it was not considered advisable to construct an automatic rotary jack-knife switch on so large a scale. But all the difficulties have been overcome. We are informed that this firm is now making an estimate for a similar flasher, which is to be three times as large as this one. The company is equipped for manufacturing, besides the original Reynolds flasher of which there are thousands in use, anything in the line of flashing devices from the smallest to the largest, and makes a specialty of very large devices of this class.

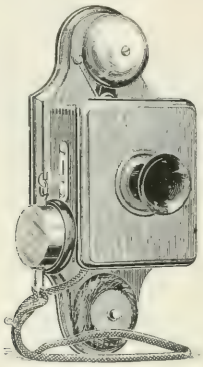


Electric Sign Flasher.

Telephone Station.

The accompanying cuts show a type of telephone station made by the West Electric Company, of Mount Vernon, N. Y., which has been designed to withstand the hard usage likely to occur at the hands of careless or incompetent persons. It will be seen by reference to the cut that the transmitter does not depend for its adjustment upon any part of the wood box, which is something that will be readily appreciated by those who understand the necessity of rigid construction in transmitter work.

The transmitters used are the finest obtainable, and in connection with specially treated granular carbon give the most gratifying results. The watch case receiver is double pole, of a type which is practically unaffected by expansion or contraction by reason of its construction, which embodies a steel ring-shaped casting having a thread cut on its outer end, by means of which the diaphragm is clamped



TELEPHONE STATION.

thereto. At the other end are arranged inner projecting lugs, on which are mounted soft Norway iron pole pieces. This construction gives a rigid, permanent adjustment.

The push button is the regular strap key, with the exception of being double; there are two sets of springs making contact in multiple, which reduces the possibility of leaving open circuits, as is so common when the old type of button is employed. It will also be noticed that there is an entire absence of binding posts on the instrument, contact washers being used for connection. This is a feature of decided merit, as it entirely obviates the possibility of loose contacts at binding posts which are more or less likely to give trouble. The hook switch is amply proportioned, and has German silver contact springs, which are kept bright by rubbing contact. The case is a polished oak box, making a very attractive appearance. A diagram of connections with directions is placed on the back of each instrument.

Electric Circuit Automatic Time Switch.

The automatic time switch shown in the accompanying illustration, known as the "Acme time switch," and manufactured by the Acme Switch Company, 84 Trumbull Street, Hartford, Conn., marks a distinct advance in switches of this type, and it is claimed that its practical success has been thoroughly demonstrated by service tests on central station circuits.

The mechanism of the switch is extremely simple, an ordinary clock movement being employed in connection with a few attachments which add a minimum of complication. On each side of the striking spring and on the same arbor are secured two disks, the one toward the face corresponding to the usual clock striking disk, and the one toward the back controlling the switch. The time mechanism has otherwise been changed merely so that the usual finger arbor shall make a complete revolution in 24 instead of 12 hours. On this arbor is mounted a disk on which are stamped the figures corresponding to the 24 hours of the day. Concentric with this disk are two pivoted arms, one of which is clamped at the hour when current is to be turned on the electric circuit and the other at the hour when current is to be cut off. As the disk revolves, at the time fixed a projection on one of these arms engages with an arm connected to the usual striking arrangement of a clock. The striking arrangement is then released, when the switch disk shown in Fig. 2, is instantly thrown over by the striking spring and the switch circuit closed. When the disengaging arm makes a similar contact with the striking release arm the disk is instantaneously thrown in the opposite direction and the circuit is opened.

Much mechanical skill is shown in the various details of the device. For example, instead of depending upon a clamping device to set the time tripping arrangement, a pin on the time arm enters a small hole at the periphery of the disk. The arm is of spring brass,

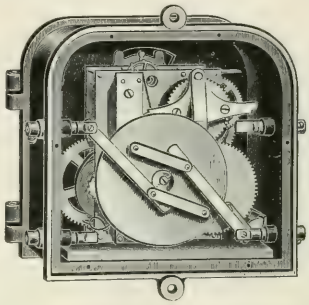


FIG. 1.—MECHANISM OF TIME SWITCH.

which enables it to be drawn back from the face of the disk sufficiently for the insertion of the pin in the selected hole. By this means it is obviously rendered impossible for the time device to become disengaged. The switch device at the rear has also been worked out along the most skillful mechanical lines, and is a model of simplicity. It gives an instantaneous break which is almost 2 inches long in the smaller sizes. The mechanism requires winding but once in seven days.

As will be seen from Fig. 1, all the mechanism is wholly enclosed when the case is locked, thus insuring against careless or incompetent employes, and at the same time making the case dust-proof. The switch may be inserted at any convenient point in the circuit,

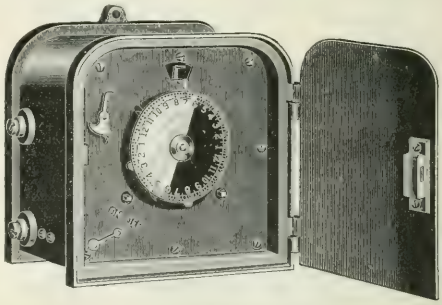


FIG. 2.—SWITCH DISK.

and is intended particularly for the control of interior arc and incandescent lamps and street arc lamps. The switch, which is made in sizes for a current of 15 to 50 amperes, has in the past few months been adopted by several large central stations for use on their circuits.

The Thompson Electric Automobile.

Andrew C. Thompson, of Plainfield, N. J., is manufacturing a light and high-powered electric automobile, illustrated herewith, which is claimed to have absolutely no parts that can get out of order. The running gear is of a special design, with solid axles. The motor and differential gear are mounted together in a strong steel frame, and gear direct to the hubs of the rear wheels. Extra strong 28-inch wire wheels and a ball-bearing steering apparatus are provided. The steering handle is fastened to the carriage body in such a manner as to do away with the vibration experienced in carriages having the steering handle fastened to the front axle.

The equipments are a combination volt-ammeter, electric light, a six-inch electric gong operated from a push button in the end of the

controller handle; an electric brake, and a powerful leather-lined band brake, which is operated by a foot lever and will bring the carriage to a standstill in a few feet when it is running at full speed. On applying the foot brake the power is disconnected, thereby obviating mistakes. Owing to the light weight, the vehicle is claimed to take but half the power to run it required by the average automobile, and also the cost of maintenance is reduced fully one half.

ELECTRIC AUTOMOBILE.

Runabouts equipped with 20 cells of Porter battery weigh complete 550 lbs., and will run a carriage 25 miles on one charge at a maximum speed of 12 miles per hour. A Stanhope, when equipped with 40 cells of Porter battery, will run 75 miles on one charge, and weighs complete 900 lbs. The maximum speed is 20 miles per hour. The motor is of 2½ horse-power, capable of an overload of three times its rated power.

Coal Handling at Tacony, Pa.

FIG. 1.—COAL HANDLING ON DOCK.

At the coal handling station erected for the Pennsylvania Manufacturing, Light & Power Company at Tacony, Philadelphia, coal is delivered either from Delaware River boats or railroad cars to the pocket of 1000 tons storage capacity. The horizontal conveyor over the pocket is reversible and distributes coal delivered either by an inclined conveyor from the dock or by a vertical elevator from railroad cars. The capacity of the plant is 40 tons per hour from railroad cars and 25 tons per hour from river boats. Facilities are provided for crushing the coal at each end, and the entire plant is motor driven. This equipment was furnished by the Link-Belt Engineering Company, of Nicetown, Philadelphia. The local lighting company using it is the consolidation of the various companies of Philadelphia, on the same lines as in New York and Chicago, aiming at a massing together of generating capacity and a consequent economical production of current. In the illustrations herewith, Fig. 1 shows the tub hoist unloading coal from boats and delivering it to the inclined conveyor. Fig. 2 is a sectional view of the whole equipment. Fig. 3 shows the reversible suspended flight conveyor receiving at either end and delivering to such a point in the pocket below, as may be determined. Fig. 4 is a general view of the pocket seen in section in Fig. 2, which are so clear as to need virtually no explanation.

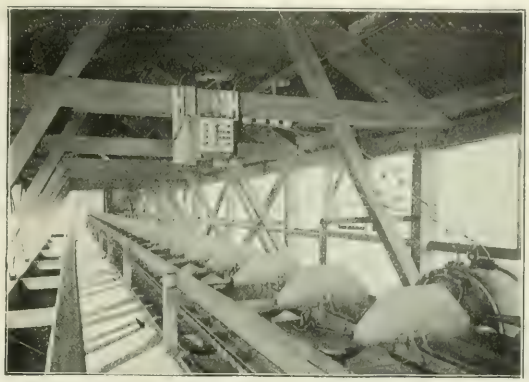


FIG. 3.—REVERSIBLE SUSPENDED FLIGHT CONVEYOR.

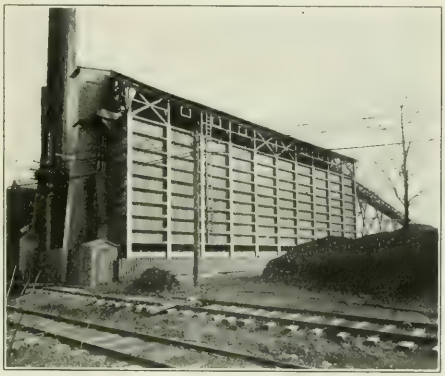


FIG. 4.—GENERAL VIEW OF POCKET.

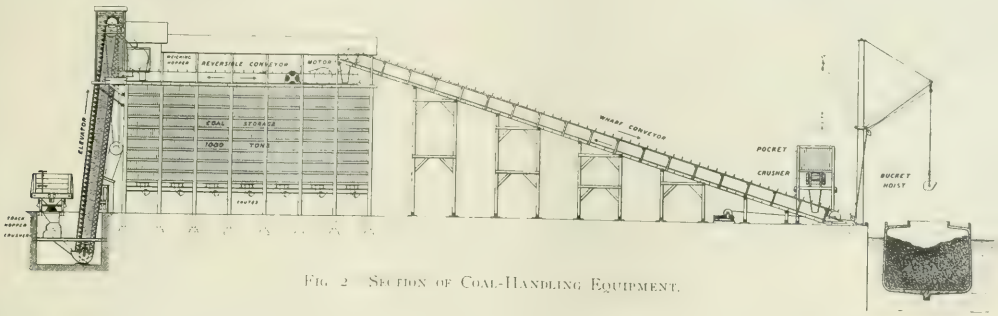
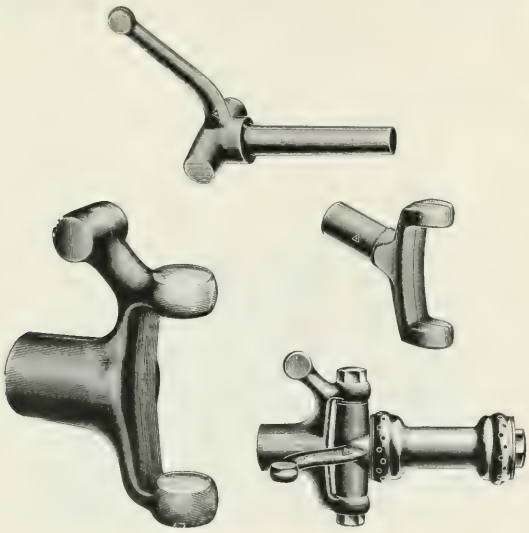


FIG. 2.—SECTION OF COAL-HANDLING EQUIPMENT.

Drop Forgings for Automobiles.

In considering the question of the advisability of the use of drop forgings for automobile parts by the manufacturer, the desirability is unquestioned as compared with parts and fittings made by any other method. The great obstacle is the cost of necessary dies and tools required to produce these forgings. If the vehicle is in the experimental stage, it is undoubtedly advisable to use castings, as they can be produced cheaply, and if changes are required, the alteration or making of new patterns is comparatively inexpensive. But when the vehicle has outgrown this experimental stage and is ready to be manufactured in fair quantities for the market, then comes the opportunity for the profitable use of drop-forgings. First, because on account of larger quantities, the maker can produce them at less cost; second, because they are less expensive than castings to machine and finish; and, last, but not least, the motor vehicle manufacturer cannot afford to use anything but the strongest, toughest and best material in his product, for the vehicle is now going to be put into the hands of a more or less uneducated public, a regards machinery, which will have no mercy for a weak joint or faulty construction.

It is evident that the makers of drop-forgings are alive to the possibilities of the use of their product in the automobile field, and show an inclination to promote the use of standard parts as far as possible. This is now a recognized condition of the cycle trade. It is



DROP FORGINGS FOR AUTOMOBILES.

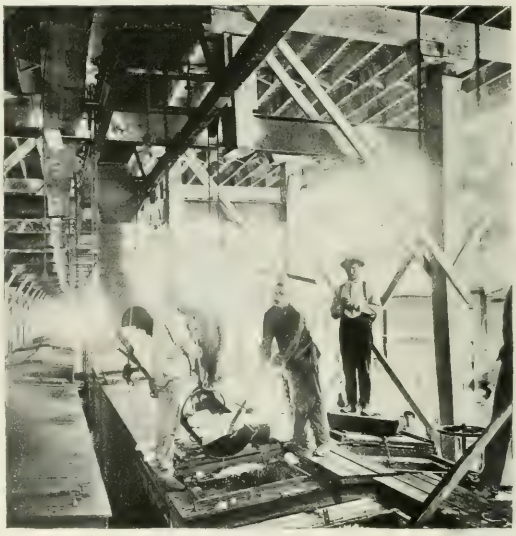
not, however, possible to create a line of standard parts of any extent at this time, owing to the unlimited variety of styles and designs of running gear, etc.

Various sizes of front axle ends and steering knuckles seem to be about the only parts that are safe for a maker to stock up on at this time, and the Billings & Spencer Company, of Hartford, also well known already to electrical manufacturers, is taking a lead in this direction. These parts are protected by patent, and made under license.

The steering knuckle and axle end shown is machined and fitted with a special ball-bearing automobile hub. The bearings are fitted with hardened and ground tool steel cups and cones, and have a positive adjustment that can be worked by removing the dust cap. The hubs are drilled for either straight or tangent spokes, and are fitted with felt and leather washers, also with dust caps. The upper end of the hub of the steering knuckle works on a fiber washer. The drilling of the eye in the arm of the steering knuckle and the drilling for the axle and of the spring lug in the axle end are left blank. This steering equipment is suitable for carriages weighing up to 1600 lbs. without passengers.

Icing Refrigerator Cars.

The illustration shown herewith affords an interesting idea as to the ingenious manner in which perishable food is refrigerated for transit on American railroads. The view is taken in the Armour icing plant, Kansas City, and represents the method devised by the Jeffrey Manufacturing Company, of Columbus, Ohio, for delivering ice to the refrigerator cars. The conveyor is supported over the cars. The ice which has been broken or crushed before it enters the conveyors is carried along by a system of flights attached to chains, to



ICE CONVEYOR.

the point where the revolving chute is located. The ice passes from this revolving spout by gravity to the ice pockets in the cars. The system is driven at the factory end by a 25-hp electric motor, and is probably the most extensive of its kind in the world. The connections are arranged to enable the icing crew to start or stop the conveyor at will. The ice conveyor has a large capacity, sufficing to ice a whole car in a very few minutes, and at a slight expense.

The steel conveyor is an important feature of this outfit, and is of such proportion as to insure reliable and satisfactory operation.

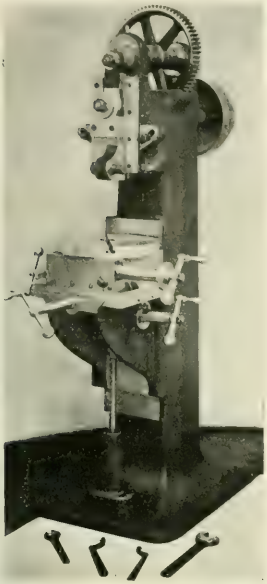
A Small Die Slotter.

A small machine tool, which is to be found in a great many American electrical shops, is the die slotter shown herewith, made by the Garvin Machine Company, of Spring and Varick Streets, New York City. This tool has been found highly suitable for all die work, small key seating, both straight and taper; also internal or external gear patterns, where draft is required, and all that class of common slotting.

The two cross motions and the rotary table provide for following any outline. The handle for the rotary table is arranged for using dials for dividing purposes, but for small divisions and rapid work it may be entirely removed, and the table revolved by hand, using the lock-pin device, which provides 12 divisions for square, hexagon, octagon, duo-decagon, etc.

The stroke of the machine has been fixed at 2½ inches, which is ample for this class of work for which the machine is intended, and affords greater strength than an adjustable pin. The speed can be changed by means of the cone pulley. The slide for the ram can be swiveled 5 degs. either way, and set by a graduated index, thereby insuring the same draft to every part of the die. The tool block is well adapted for holding special tools. It swivels in a center near its lower end, and at the upper end, carried in a yoke, are two hard-

ened plugs which bear on a cam that is bushed into the lower end of the connecting rod, and from it derives a partially rotary motion,



DIE SLOTTER.

thus locking the tool block on the down stroke and causing the tool to clear on the up stroke. Among the shops where the tool is in use may be mentioned those of the Westinghouse and General Electric Companies.

Panel Board with Removable Enclosed Fuse Carrier.

The accompanying illustrations show a new type of enclosed fuse carrier and panel board, which are being placed upon the market by

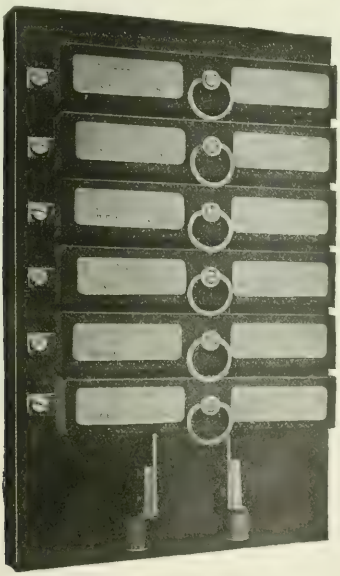


FIG. 1. PANEL BOARD.

the General Incandescent Arc Light Company, of New York.

Fig. 1 shows a panel board for six circuits on a two-wire main and Fig. 2 a combined switch and enclosed fuse carrier, the latter being installed on the board of Fig. 1. It will be seen that the fuse carrier of Fig. 2 includes the functions of a knife switch, a removable fuse holder and an enclosed fuse. To use the carrier as a switch it is merely pulled out by means of the ring handle shown, upon which the circuit is opened. To renew a fuse the carrier is removed by simply taking out a screw, thus enabling a new fuse to be inserted in the most convenient position away from the panel, thus obviating the risk of short-circuits or other trouble through the use of a screw-driver near a live circuit.

Each fuse carrier is designed to receive a directory card on which

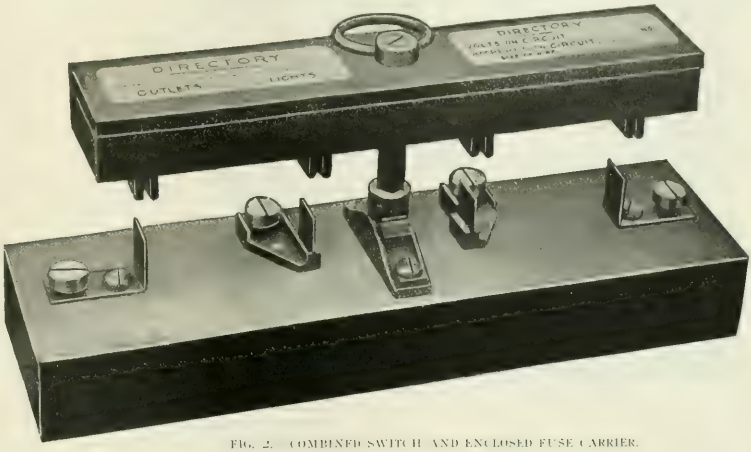


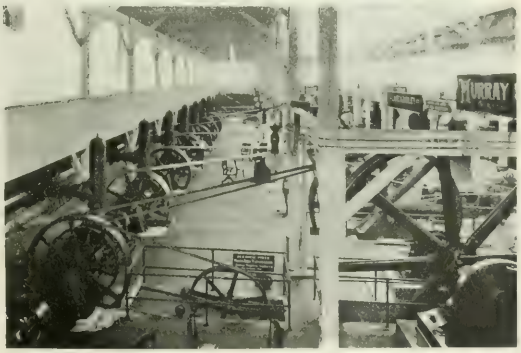
FIG. 2. COMBINED SWITCH AND ENCLOSED FUSE CARRIER.

can be written, under properly printed headings, the number of outlets, lights and locations, the size of wire, the amperes and volts. This information being labeled directly at the point where the circuit is controlled is obviously more convenient than the present method of placing directory frames on the doors of the panel boxes.

The carriers are designed for a capacity of 10 amperes and 125 volts, and the main feed bus-bars are figured to carry 6 amperes per circuit.

Arc Lighting at the Pan-American.

At the Pan-American Exposition the functions of the arc and the incandescent lamp appear to have been curiously reversed. The incandescent lamp is gloriously conspicuous outdoors, while indoors there is a notably large use of the arc lamp. The C. J. Toerring Company, of Philadelphia, has quite a large display of its well-known arc lamps, for example. Its exhibit proper is with that of the D'Olier Engineering Company, of Philadelphia, as shown. Beyond that, it has 30 lamps used for lighting the Court of the Machinery Building, where the water for the fountain is pumped, and some of



ARC LIGHTING IN MACHINERY BUILDING.

the current for the lighting of the grounds is generated. The Graphic Arts Building is also lighted by 20 more Toerring lamps.

Exhibit of Automatic Telephone Apparatus.

Electricity Building at the Pan-American Exhibition includes among its exhibits a remarkably large proportion of telephone apparatus; in fact, it is said that it is the most varied and complete display of the kind ever made in this country. One of these noteworthy telephone exhibits is that of the Clark Automatic Telephone

AUTOMATIC TELEPHONE EXHIBIT

Switchboard Company, of Providence, R. I., and the apparatus is attracting considerable attention from its ingenuity, neatness and excellent construction. The company has installed the switchboards having capacities of 12, 24, 48 and 72 Clark automatic switches, as well as samples of its different types of wall and desk telephones. One of the boards is wired up to the wall and desk instruments in order to illustrate practically the operation of the Clark system. As thus shown, the system, which is obviously both simple and durable, is designed for use in small towns, mills, factories, warehouses, etc., the present capacity being 76 subscribers or stations. This number can, however, be readily doubled, but the smaller number covers a vast range of demand, and the company shows orders and plants not only all over this country, but for the far ends of the earth.

The E. G. Bernard Company at the Pan-American.

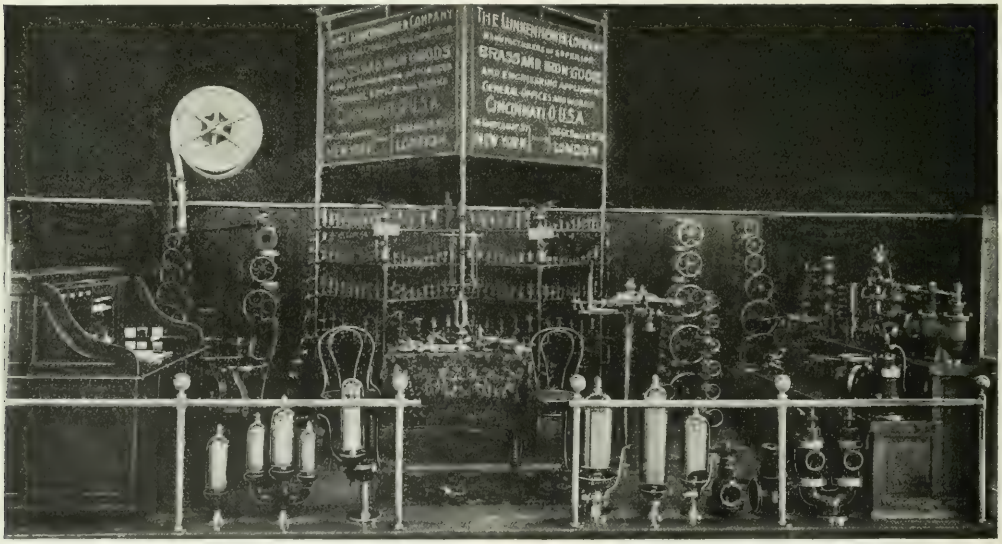
The E. G. Bernard Company, of Troy, N. Y., occupies a building on the west side of North Bay, a short distance south of the New York State Building. Here is located the motor generator which transforms the 500-volt current of the Exposition power service to 110-volt current for use in the searchlights of the electric fountain located in the middle of North Bay. This motor generator is loaned the Exposition by the Bernard Company.

The main motor generator set consists of a 130-hp. 500-volt motor, direct connected to a 125-volt, 680-ampere generator. A smaller motor-generator consisting of a 3-hp. 500-volt motor driving a 125-volt, 12-ampere dynamo supplies current for the arc and incandescent lights in and around the building. Each set has a separate switchboard panel equipped with Whitney ammeters and voltmeters, circuit breakers, rheostats and controlling switches.

Adjoining the dynamo room the company has fitted up a reception room for the entertainment of guests, and also exhibits a 9-kw multipolar generator. The E. G. Bernard Company's building is headquarters for its customers, and the company is keeping "open house" for electrical men and others when they wander down to that part of the grounds.

Exhibit of Steam and Engineering Specialties.

One of the handsomest, most complete and interesting exhibits at the Pan-American Exposition is that of the Lunkenheimer Company, installed in the Machinery and Transportation Building. Visitors to the Exposition who are interested in brass and iron steam specialties and engineering appliances find much to occupy their attention in it. Mr. F. L. Swanberg is in charge. There can be seen a complete line of regrinding valves, handy valves, lever throttle valves, pop safety valves, plain whistles, chime whistles, fire alarm whistles, injectors, sight-feed lubricators, oil cups, grease cups, glass cups, glass body oil pumps and a complete line of brass valves and fittings for marine work in medium and extra heavy patterns. The "Lukenheimer" specialties, such as are shown here, were awarded three highest medals at the Exposition Universelle, Paris, 1900. The headquarters of the Lunkenheimer Company are in Cincinnati, and they have branches in New York and London.



STEAM AND ENGINEERING SPECIALTIES AT THE PAN-AMERICAN.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money is nominal, at quotations ranging between 2 and 3 per cent. Time money is quoted at 4½ per cent for 60 to 90 days, and 5 per cent for four, five and six months. Mercantile paper closed at 4½@5 per cent for 60 to 90 days' indorsements; 5@5½ for choice four to six months' single names, and 5½@6 for others. In the stock market, speculation was extremely dull, mainly in consequence of the closing of the exchange from last Friday to Tuesday of this week. Stock values are steady at slight reaction from the recent advances. The strength of the steel stocks was a prominent feature of the market. Other industrial stocks were somewhat neglected. Amalgamated Copper rose to 122¾ on further reports that a big combination was on foot among copper producers, and that the dividends on the stock might be increased. Tractions were weak and little trading was done. Brooklyn Rapid Transit fluctuated between 74⅞ and 77⅜, closing the week with a net loss of 1⅝ points, the sales being 14,630 shares. Metropolitan Street Railway lost ⅞ of a point, net, at the close, the range of prices during the week being between 167¼ and 170, the sales being only 1950 shares. General Electric closed with a net gain of 2¼ points, although the trading was limited to 900 shares for the week. There was a wide range of prices, the extremes being 255 and 268. Western Union closed with a net gain of ½ point, on sales of 9170 shares. Following are the closing quotations on Tuesday, Sept. 3:

NEW YORK.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
American Tel. & Cable	—	—	General Carriage	34	34½
American Dist. Tel.			Hudson River Tel	120	120
Brooklyn Rapid Transit	75¼	75	Illinois Elec. Veh. Trans.	—	—
Commercial Cable	—	—	Metropolitan Street Ry	167¼	167½
Electric Boat	19	23	N. E. Elec. Veh. Tran	—	—
Electric Boat pfd.	48	48	N. Y. Elec. Veh. Tran	10½	10½
Electric Lead Reduc'n	1½	1½	N. Y. N. N. J. Tel	168	168
Electric Vehicle	5	5½	Tel. & Tel. Co. of Am.	3	5
Electric Vehicle pfd.	10	10	Western Union Tel.	93	93⅛
General Electric	265½	267½			

BOSTON.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
Am. Tel. & Tel	164½	166	Mexican Telephone	2½	2½
Cumberland Telephone			New England Telephone		
Boston Electric Light	250	250	Westinghouse Elec		
Erie Telephone	45	42	Westinghouse Elec pfd.		
General Electric pfd.					

PHILADELPHIA

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
American Railways	40	40¼	Phila. Traction	97½	97½
Electric Storage Battery	74	72	Philadelphia Electric	5⅝	6
Elec. Storage Batt'y pfd.	74	72	Pa. Electric Vehicle	⅞	⅞
Elec. Co. of America	7⅝	7⅜	Pa. Elec. Veh. pfd.	¾	¾

CHICAGO.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
Central Union Telephone	—	—	National Carbon pfd.	84	—
Chicago Edison	162½	—	Northwest Elev. com	38	
Chicago City Ry.	209	206	Union Traction	17⅝	
Chicago Telep. Co.	268		Union Traction pfd.	60	
National Carbon	17	18			

TELEPHONE, TELEGRAPH & CABLE COMPANY.—A circular has been sent to the stockholders of the Telephone, Telegraph & Cable Company of America which states that a proposition has been received from C. W. Morse to purchase the holdings of each stockholder at 50 per cent of the amount each has paid in. The purchase is conditional upon at least two-thirds of the total number of shares being delivered to the City Trust Company before Sept. 10. The circular states that the board of directors, realizing the need of large sums of money to put the company in operation, and as a large number of the stockholders are unwilling to advance additional funds, recommends the acceptance of Mr. Morse's offer. As the amount paid in thus far is about $4,000,000, Mr. Morse's offer will involve the payment of about $2,000,000. Mr. Morse says that he is assuming the responsibility of the purchase as an individual. Mr. Morse is known in financial and political circles as the head of the American Ice Company, of New York, and is said to have friendly relations with Tammany leaders.

GENERAL ELECTRIC.—The amount of stock which it would be necessary to issue ultimately in order to return to the stockholders the scaling down of July, 1898, would be 66⅔ per cent of their present holdings, say, about $16,500,000 new stock, assuming all debentures and preferred stock to be exchanged into common stock. In any stock distribution only such an amount of stock can be actually issued as is equaled by the actual surplus of the company. This surplus on Jan. 31 last stood at $6,629,180, having been increased $4,276,150 in the operations of the company for the year ended Jan. 31, 1901. It would, of course, be within the province of the directors, whenever they deemed such a course safe, to recommend to the shareholders such an issue of new shares as would be warranted by the condition of the surplus, even should such division not wholly complete the restoration mentioned above.

DIVIDENDS.—The Chicago City Railway Company has declared a dividend of 2¼ per cent on the increased stock, payable on Sept. 30. While this is at the rate of 9 per cent a year it is understood that no decision has been reached as to the permanent rate of dividend on the stock. At the 9 per cent rate the dividend requirements are $1,620,000, or precisely what they were when 12 per cent was paid on the old stock. When on July 1 the stock was increased from $13,500,000 to $18,000,000, the proceeds of the new issue were used to retire $4,610,500 of 4½ bonds which matured on that date. The company has this saving of interest, and can easily pay 10 per cent on its stock unless it has decided to save up a cash surplus. The Southern Ohio Traction Company has declared a ¾ per cent dividend, payable Sept. 1.

PURCHASE OF PROPERTIES.—The Minneapolis General Electric Company has gained control of the International Electric Company by a purchase of its bonds. The American Light & Traction Company, of which Emerson McMillin is president, has bought the Binghamton, N. Y., Gas Company.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a further enlargement of general trade distribution and a more cheerful tone, due to various causes, chief of which were better corn crop advices, confidence in the early termination of the steel strike, a further advance in cotton, and the advent of cooler weather. In the iron and steel trades there is a much stronger feeling of confidence as to the early settlement of the strikes in those lines, business being in good shape and consumption large. Finished products are still bringing high premiums. Structural material, plate and bar mills have orders for months ahead. Gross railway earnings maintain their previous gains on 53 roads for the third week of August, aggregating $10,161,692, a gain of 12 per cent over the corresponding week last year. The business failures for the week, as reported by *Bradstreet's*, were 188, against 181, the week previous, and 165 the same week last year. In the metal market there was considerable activity in copper both in the home and in foreign markets. The home consumption is very heavy, and abroad the market appears to be improving. Prices at home remain unchanged, however, Lake being quoted at 16½ cents; electrolytic in cakes, bars or ingots, 16¼ cents; cathodes, 16 cents; casting copper, 15⅞ cents.

CITY OF MEXICO STREET RAILWAY.—Advices just to hand from the Mexican capital state that work on an extension of the lines of the Compania Limitada de Tranvias de Mexico to the suburb of Tacuba will be commenced immediately after the consent of the Mexican Government is given to the project. Such sanction, it is anticipated, will be secured within the next week. Mr. A. E. Worwick, the resident manager of the Mexican system, which is controlled by the well-known Anglo-African financial house of Wernher Beit & Co., is expected to return next week from his visit to London, and it is believed that during his stay in New York he will make arrangements for the purchase of the material, etc., required. Mr. Worwick, while in New York, it is said, will stay at the Holland House.

INSTRUMENTS FOR THE GOVERNMENT.—Mr. James G. Biddle, Stephen Girard Building, Philadelphia, has recently taken some important orders from the United States Signal Corps, Washington, D. C., including one Anthony type standard resistance box, and Wheatstone bridge, one conductivity bridge with accessory apparatus, D'Arsonval galvanometers, portable testing sets, and a large number of portable testing magnetos and Weston portable voltmeters. All of the apparatus, with the exception of the magnetos and Weston voltmeters, was made by Morris E. Leeds & Co.

AUTOMATIC TELEPHONE CONTRACT.—The Clark Automatic Telephone Switchboard Company, Banigan Building, Providence, R. I., have just executed a contract for a 9-point system in the works of the Semet-Solvay Company, at Ensley, Ala. This neat little telephone plant included considerable outside construction, and is scattered over a wide area, thus illustrating very forcibly the adaptability of the Clark automatic apparatus and system for such industrial plants.

THE [illegible] ELECTRIC COMPANY reports that it is experiencing a most gratifying demand for its product, and is daily making some unusually nice sales. It expects very shortly to have to largely increase its force. Among the more interesting of its sales during the last month we mention the following: Its series-parallel equipments for driving large printing presses are becoming popular, and it now has orders for one 30-hp equipment for the *Peoria Star*, one 50-hp equipment for the *Milwaukee Free Press*, and one 15-hp equipment for the Chester, Pa., *Times*. Among the orders for generators the most interesting are for one 50-kw and one 25-kw engine type generators for the Stafford apartment house, Philadelphia; two 100-kw and one 50-kw engine type generators, besides quite a number of small motors for the Kirchbaum Building, owned by John Wanamaker, of Philadelphia. For the same customer they have just shipped a 75-kw engine type generator, to be followed by two 10-hp and two 15-hp motors. They are building a 20-kw belt type generator and switchboard and 15-hp electric hoist for the International Phosphate Company, of Carteret, N. J. They are building two 60-kw engine type generators for the Brooklyn Bridge, and are installing for the Dewey Warehouse, New York, a complete lighting and power transmission plant with wiring, consisting of an 85-kw belt type generator, handsome switchboard, and 50 horse-power in motors of various sizes. An 85-kw belted generator is also being built for the Eagle Pencil Company, of New York. The United States Watch Case Company, of Riverside, N. J., has ordered two 40-kw generators and four small motors. The Wolf Company, of Chambersburg, Pa., has ordered a 100-kw belted generator and a 105-hp motor. For the Bartlett Building, Atlantic City, they are building one 50-kw and one 75-kw engine type generators. For driving the ventilating blowers in the new Mt Sinai Hospital, New York, 10 motors ranging in size from 1½ to 20 horse-power will be furnished. They are also furnishing about an equal number of motors for driving the exhaust fans in the same building.

FOREIGN AND DOMESTIC ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., have recently secured orders for a 50-hp standard simple engine, which is to be direct connected to a 30-kw generator of General Electric make for installation in an electric light station at Vera Cruz, Mexico. Another Mexican order lately received was for a 50-hp tandem compound engine. The contracts obtained by the Harrisburg people within the past two weeks are reported to have been especially numerous. The principal ones include orders from the Otis Elevator Company, of Yonkers, N. Y., for two tandem compound, high-speed engines, one of 300 horse-power and the other of 200 horse-power, to be direct connected to generators of 200 kilowatts and 125 kilowatts, respectively, manufactured by the Crocker-Wheeler Company. The Union Club, Fifty-first Street and Fifth Avenue, New York City, is to have installed three 75-hp Harrisburg standard simple engines, direct connected each to a 50-kw generator built by the General Electric Company. A 120-hp standard simple engine has been ordered by the American Agricultural & Chemical Company, Baltimore, Md. This engine is intended to be direct connected to a 75-kw generator of General Electric make. The Teachers' College, 120th Street, has requisitioned for a 200-hp standard simple engine, to be direct connected to a 125-kw General Electric generator. A four-valve belted engine of 150 horse-power has been called for by the Clotx Throwing Company, of Scranton, Pa., which will be belted to shafting. All these contracts were closed through the New York representative of the Harrisburg Foundry & Machine Works, Mr. W. P. McKenzie, whose offices are in the Mail and Express Building, [illegible]

CONTRACTS FOR TOKIO TRACTION SYSTEM.—Chief engineer Enyo, of the Tokio Deusha Tetsudo Company, Japan, who has been in the United States for some time past for the purpose of securing quotations from American concerns for the equipment of the company's projected electric traction system, has just dispatched all the necessary data to his directors in Japan, and it is expected that confirmation as to the purchase of American equipment will be received by cable within the next 30 days. The General Electric Company, it is stated, has submitted a proposition for the equipment of the projected road. The Tokio Company's system will be double tracked, and 12 miles in length. Three hundred cars will be utilized on commencing operations. While car bodies, owing to the cheapness of wood in Japan, will be manufactured there, the requisite trucks and motor equipments will be purchased in the United States. Close on $1,000,000 will be expended in the initial equipment of the road. The generating plant will have a capacity of 4000 horse-power. About 2500 tons of rails will be utilized. As the Tokio company, in view of the monetary stringency at present existing in Japan, is desirous of obtaining an extended credit for its purchases here, financial arrangements, it is said, have been made through the Japanese banking house of Mitsui & Co., whose New York offices are at 445-7 Broome Street, for the handling of the deal. Mr. Eyno intends to remain here for several months to attend to the several details in connection with the completion of the contracts. Mr. Enyo can be reached through Mitsui & Co., or at the offices in the Havemeyer Building, of McIntosh, Seymour & Co.

ELECTRICAL EQUIPMENT IN PORTO RICO.—The South Porto Rico Sugar Company, which was recently organized with a capital of $3,000,000, is considering the advisability of adopting electricity somewhat extensively in its sugar factory. It is anticipated that everything outside the mills and crushers will be driven by electric motors. Mr. Hugh Kelly, the well-known sugar plantation expert of 71 Wall Street, New York City, is now designing the sugar factory. Its equipment will entail an expenditure of not far short of $1,000,000. The company has secured some 4000 acres of sugar lands near Guanica, on the south coast of Porto Rico. The sugar factory will have a capacity for handling 1600 tons of cane per day, and is to be capable of annually manufacturing 16,000 tons of sugar. Everything in the way of material, equipment, etc., will be purchased in the United States, with the exception of a few articles, of special machinery not manufactured by American concerns. In addition to the sugar plant contracts, a considerable quantity of steel rails and rolling stock will be ordered. A dock will also be constructed in the harbor of Guanica. The company's offices are at 44 Wall Street. Mr. William Schall, Jr., of Muller, Schall & Co., bankers, 44 Wall Street, is the president of the company. Mr. E. Pavenstedt, of the same financial house, is treasurer. Mr. Frank A. Dillingham is secretary. The plant is expected to be in full working operation by December, 1902.

ORDERS FOR TELEPHONE PLANT.—The Haines & Noyes Company, Chicago, through its private telephone department, has closed the following large contracts: The Tampa Electric Company, Tampa, Fla., a complete telephone system for the Tampa Electric Railway. This order was closed with Stone & Webster, Boston. A private telephone plant for the large publishing house of David C. Cook & Co., Elgin, Ill.; a complete central energy telephone plant for the new factory of the Storey & Clark Piano Company, Grand Haven, Mich.; A complete private telephone plant for the new Wesley Hospital, Chicago, through the Arthur Frantzen Company, Chicago; a private telephone plant for the Chicago branch of the Pabst Brewing Company; the College of Physicians and Surgeons, Chicago, for a large plant through the Arthur Frantzen Company, Chicago. The Haines & Noyes Company is also closing a great many contracts for apartments, and in the last two weeks it has closed five contracts for apartments in Chicago alone. It has recently shipped a large consignment of telephones to St. Johns, N. B., and to Skagway, Alaska. It reports an increasing business, and is enlarging its factory. It has just closed a contract with Roak & Rittenhouse to represent it in Philadelphia.

NEW YORK EXPRESS DELIVERY CARS.—The Metropolitan Express Company, of New York City, which operates suburban express service over the lines of the Metropolitan Street Railway Company, is in the market for 25 express cars. They will be equipped with the overhead trolley, underground electric and storage-battery systems. It has been slow work starting this urban railway express system, and rivals declare that it cannot succeed. The company's intention of putting more cars in service is taken as indicative of something different.

MAXWELL M. MAYER ELECTRIC COMPANY, of 42 Cortlandt Street, New York City, reports the following orders: Grinberg Brothers, New York, one 1-hp, two 2-hp, one 3-hp and one 4-hp motors; Crescent Gas Fixture & Art Metal Company, Bridgeton, N. J., one 100-ampere plating dynamo; also one 75-light compound-wound dynamo for Pueblo, Mexico, and a 1000-ampere plating dynamo for Montreal, Canada.

BRILL CAR MATERIAL FOR SPAIN AND GERMANY.—The J. G. Brill Company, of Philadelphia, is about to make shipment of 32 pairs of wheels on axles for the Barcelona electric traction system, also fair-sized lots of car material to Bilbao, Spain, and Neuhausen, Germany.

BALL ENGINE SALES.—The C. Reiss Coal Company, of Sheboygan, Wis., is equipping its coal docks with electricity. A 350-hp Ball engine, direct connected to a Milwaukee generator, furnishes the power. St. Mary's Hospital, Philadelphia, is being equipped with an electric plant. The Ball Engine Company will furnish the engines.

APPARATUS WANTED FOR TEXAS.—Mr. C. P. Dodge, State Purchasing Agent, Austin, Texas, is in the market for a direct-coupled, three-phase generator, 90 kilowatts, voltage 125, speed 270 revolutions, together with switchboard, etc., and a 4-ported automatic high-speed engine, vertical preferred, of corresponding capacity.

MR. ELMER P. MORRIS, treasurer of the Morris Electric Company, of 15 Cortlandt Street, New York City, has just returned from a short trip to Cuba, where he has been the guest of General Manager Greenwood, of the Havana Electric Railway Company.

MACHINERY EXHIBITION IN PERU.—At the machinery exhibition, Lima, Peru, the Westinghouse Electric & Manufacturing Company is one of the chief exhibitors to secure awards.

FOREIGN ORDERS FOR AMERICAN ELECTRIC ELEVATORS.—The Otis Elevator Company reports a rapidly increasing foreign demand for electric elevators for both passenger and freight purposes, also dinner elevators. The chief markets at present are in Great Britain and Germany, notwithstanding that these two countries present the strongest competition on the part of domestic manufacturers. Belgium, Spain, Hungary and South America also are steadily showing a preference for American elevators. The Otis people have just secured through their London interests a contract calling for the installation of electric elevators in Buckingham Palace, London. The contract provides for two electric passenger elevators, one of which is intended for the Royal Privy Purse Department, one electric baggage "lift," and one electric dinner elevator to connect with the State dining hall. The contract was secured in the face of the severest British competition. The American elevators will take the place of the old hand power "lifts" which were installed in the Royal Palace during the late Queen's reign. The elevators will be furnished with all the very latest American improvements and contrivances. They are to be operated by push buttons. An electric dinner waiter apparatus has also been ordered for the Royal Castle at Windsor, and the Duke and Duchess of York's London residence, Clarence House, is to be equipped with an Otis electric luggage "lift." Other royal orders recently awarded to the Otis Company include one for two electric passenger elevators for the Royal Palace at Budapest, Hungary. Miscellaneous contracts lately in hand from Europe comprise one electric passenger, one electric luggage and two electric dinner "lifts" for Andrew Carnegie's Scotch residence, Skibo Castle; A. Stavenow, Berlin, Germany, four electric passenger and two freight elevators; Hotel Bristol, Warsaw, Poland, three electric passenger, two freight and six dinner "lifts"; Grand Hotel, Brussels, two electric passenger and one electric luggage elevators; Hotel Metropole, Brussels, two electric passenger and two dinner "lifts"; Hotel de l'Europe and Hotel de Volder, Brussels, one electric passenger elevator each; Hotel de Globe, Ostend, Belgium, one electric passenger elevator; Deutsche Bank, Munich, Bavaria, two electric passenger elevators, and A. B. Sperlingensbache, Stockholm, Sweden, two electric freight elevators. Australian orders secured within the last few weeks include one for an electric freight elevator, which will be shipped to Felton, Grinwade & Co., of Perth, Western Australia. Nearer home, the Lake Superior Power Company, Sault Ste. Marie, Ont., has called for two electric hoisting engines of very large capacity. The South American Electric Company has requisitioned for three electric passenger elevators for Buenos Ayres, while an electric passenger elevator has also been ordered for installation in the Treasury Building at Havana.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended Aug. 22, 1901: Antwerp—83 packages electrical material, $3,761; 24 packages electrical machinery, $241. Argentine Republic—14 cases electrical material, $4,250. Arnheim—1 case motor vehicle, $130. British Guiana—6 packages electrical material, $345. Brazil—126 packages electrical material, $1,776. British West Indies—4 packages electrical material, $357. Bremen—18 packages electrical goods, $569. British East Indies—3 packages electrical material, $59. Berlin—3 cases electrical machinery, $50; 2 packages electrical material, $215. Bristol—1 package electrical machinery, $50. All other British Possessions—37 packages electrical material, $693. Brussels—12 cases electrical material, $600. British Africa—41 cases electrical material, $2,926. Central America—34 packages electrical material, $455; 1 roll cable, $700. Cuba—72 cases electrical machinery, $3,510; 76 cases electrical material, $3,144. Chili—10 packages electrical material, $734. Dutch West Indies—2 cases electrical material, $22. Florence—1 package electrical material, $100. Genoa—3 packages electrical material, $100. Glasgow—4 packages electrical material, $159; 91 packages electrical machinery, $18,293; 2 rolls electrical cables, $1,016; 12,500 pieces electrical conduit, $6,000. Hamburg—1 package electrical machinery, $100; 36 packages electrical material, $2,499. Havre—10 packages electrical material, $295; 1 motor vehicle, $400. Haarlem—1 package electrical material, $136. Hayti—1 package electrical material, $40. London—216 packages electrical machinery, $7,907; 116 packages electrical material, $6,272; 13 cases auto vehicles, $2,480. Leicester—3 cases electrical machinery, $120. Liverpool—182 packages electrical machinery, $20,886; 33 packages electrical material, $1,532. Milan—2 cases electrical material, $30. Malta—1 case electrical material, $23. Manchester—9 cases electrical machinery, $2,576. Marseilles—2 packages electrical material, $134. Mexico—82 packages electrical material, $1,538. New Castle—1 case electrical machinery, $50. Peru—4 packages electrical material, $129. Rome—1 package electrical material, $100. Southampton—52 packages electrical material, $2,089; 85 packages electrical machinery, $1,865; 7 cases auto vehicles, $350. Stettin—4 packages electrical machinery, $435. Uruguay—1 package electrical material, $42. U. S. Colombia—2 packages electrical material, $39; 178 cases electrical machinery, $4,565. Venezuela—19 cases electrical material, $502.

ORDERS FOR ELECTRIC CRANES.—Pawling & Harnischfeger, Milwaukee, Wis., are operating with a double crew, and have a larger force of men employed than at any previous time in their history. They have an initial order for the new Allis-Chalmers Works at Milwaukee for one 75-ton, one 25-ton, three 40-ton electric traveling cranes. Other orders are for the Baldwin Locomotive Works, Philadelphia, five 10-ton electric traveling cranes, one 10-ton and two 20-ton; Lackawanna Iron & Steel Company, Buffalo, four 5-ton; Oil Well Supply Company, Oil City, Pa., one 40-ton; Pennsylvania Railroad Company, four 5-ton; Standard Steel Works, Burnham, Pa.; Lukens Iron & Steel Company, two 10-ton, 97 ft. 8-inch span; Columbus Iron Works Company, Columbus, Ga., one 20-ton; Crucible Steel Company, of America, Atha Works, one 15-ton; Pittsburg Reduction Company, one 50-ton; American Locomotive Company, one 10-ton; Fred M. Prescott Steam Pump Company, two 10-ton; Monongahela Manufacturing Company, one 10-ton; Northern Foundry & Machine Company, one 15-ton. They have also sold a large number of one and two-motor electric hoists during the past month, and the inquiries received indicate a large volume of business for the future.

CARS FOR SOUTH AFRICA.—The British engineering and contracting firm of Macartney, McElroy & Co., whose New York offices are located in the Havemeyer Building, 26 Cortlandt Street, has secured a contract from the Durban Corporation, calling for the shipment of eight cars for utilization on the electric traction system of that South African city. The cars, which will be of double-deck type and will have a seating capacity for 50 persons, are to be built at the Jackson & Sharp plant at Wilmington, Del.; now controlled by the American Car & Foundry Company. The General Electric Company has been allotted the order for the requisite double-motor equipments, and the J. G. Brill Company, of Philadelphia, will furnish the trucks. The cars will be forwarded by direct steamer to Port Natal in the late fall. The Durban system's cars already in use are of British manufacture.

AMERICAN MANUFACTURING DATA.—Mr. Carroll D. Wright, in a recent article in the *World's Work*, says: The number of manufacturing establishments in 1890 was 355,415. At the present time the Census Office has received the schedules of 653,000, but probably not more than 500,000 of these are for establishments comparable with those counted in 1890. Taking this calculation as fairly correct, however, there has been a gain in the 10 years of nearly 150,000 establishments engaged in the manufacture of goods. The total value of products, including receipts from custom work and repairing, in 1890 was $9,372,783. Basing an estimate on the increase in the number of establishments and the tabulations of States already completed, a most conservative figure for the value of all products in 1900 is $15,000,000,000.

TRADE WITH SOUTH AFRICA.—The effects of war and plague are still evident in South Africa, and in several of the colonies industry and trade are almost paralyzed, according to Consul-General Stowe, who reports to the State Department from Cape Town, as follows: Trade is not inactive, however, and many arrangements in anticipation of an early termination of the war are being made. Orders have been placed for steel rails and rolling stock, which will be required on the cessation of hostilities; also for bridge and structural iron and galvanized sheet iron, immense quantities of which will be needed. The rebuilding of the telegraph lines will call for much material, and the various electric installations and sanitary and water works planned or under way are to be completed.

BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES FOR FRANCE.—The Societe Industrielle d'Electricite Procedes Westinghouse (The French Westinghouse Electric Company) have just ordered 12 Baldwin-Westinghouse electric locomotives which are intended for mining use in the French coal regions. The electrical parts of these locomotives will be manufactured at the Pittsburg works of the Westinghouse Electric & Manufacturing Company. The engines will weigh somewhat over 4½ tons each. They will be shipped to Marseilles.

MORE ELECTRICAL MACHINERY FOR SYDNEY TRAMWAYS.—The Allis-Chalmers Company will next month make a shipment from its Milwaukee plant of 10 carloads, consisting of a 1500-hp vertical cross-compound engine, etc., for the central generating station of the Sydney City & Suburban Tramways.

CARS FOR ARGENTINE REPUBLIC.—The St. Louis Car Company will soon commence shipment on a contract for 250 cars, recently secured from one of the principal electric traction systems in Buenos Aires, South America. It is also about to make shipments of some 40 cars for use on the Lisbon, Portugal, tramways.

ELECTRICAL SUPPLIES FOR CHINA.—The Manhattan Electric Supply Company, of 32 Cortlandt Street, New York City, is at present shipping some fair-sized quantities of its specialties to E. E. Porter, Shanghai, China.

Special Correspondence.

ENGLISH NOTES.

London Office Electrical World and Engineer Aug. 22, 1901

EQUIPPING THE MERSEY TUNNEL.—The bill for the electrical equipment of the tunnel under the Mersey of the Mersey Railway Company has finally passed, and Liverpool will now have a third system of electric haulage. It already has a magnificent surface tramway system, a well conducted and efficient overhead electric railway, and it will now have a deep level tunnel railway operated by electricity, a large portion of which is underneath the Mersey between Liverpool and Birkenhead. At the next meeting of the company it is expected that an important pronouncement will be made as to the new scheme. The Mersey Railway, it is interesting to note, was opened on Jan. 20, 1886, by his Majesty the King (then the Prince of Wales).

UNDERGROUND IN LONDON. The Great Northern & City Railway is making good progress, and so far as tunneling is concerned it is practically completed. This road is to connect the Great Northern Railway system at Finsbury Park with a station in the city at Finsbury Pavement, and the tunnels have been constructed large enough to accommodate the regular rolling stock of the Great Northern Railway. The contract for the electrical equipment is to be given out immediately, and though no contracts are yet decided, it is understood that the British Thomson-Houston Company is looked upon as the likely contractor. The new line will be about three and a half miles in length. There will be five stations and the two termini. The two tubes vary in depth from between 60 ft. to 90 ft., the railway in the vicinity of the Essex Road Station being the deepest part. To prevent or minimize vibration the lower half of the tunnels is built of concrete and brick, while the upper portion has a "roof" of iron.

"PRODUCER" GAS PLANT.—Electrical engineers are interested at present in the formation of a company called the Power Gas Corporation, which is a company formed to install throughout the country the new "Mond gas" plants for the production of gas for power purposes only. The bill giving statutory rights for the installation of these plants recently passed both Houses of Parliament, and it is understood that the company claims that it can produce gas for heat and power, which can be used for the production of electricity, cheaper than electricity can be generated at Niagara Falls. From such reports as are available "Mond gas" can do all that is claimed for it, and the new power is to be backed by a most influential syndicate. The chairman is to be Sir Henry Fowler, M. P., and the two vice-chairmen, Dr. Ludwig Mond, of Brunner, Mond & Company, and John Brock, of the United Alkali Company, while among the other members of the board will be one of the directors of Pease & Partners, and also one of the directors of the Castner-Kellner Alkali Company.

SCOTTISH POWER TRANSMISSION.—After an exhaustive inquiry, which lasted over five days, the Select Committee of the House of Lords has accepted the preamble of the Clyde Valley Electrical Power bill. Though the area of supply contained in the Clyde Valley bill comes to 700 square miles, it is all connected with the one county of Lanarkshire. The new company will start at a charge of 4 cents per unit and expects to go down as low as 2 cents. The circumstance that Messrs. Denny and some of the other largest industrial consumers in the Clyde Valley were numbered among its promoters may have weighed largely with the Lords as well as with the Commons in passing the scheme. These firms have in view not so much direct profit as the improvement of their works by the importation of a cheap supply of electric energy. The introduction of electric power forms a valuable step in this direction, and the more widely it is spread the greater will be the benefits it is capable of conferring on our industries. So far the area included in the Clyde Valley bill has been to some extent curtailed by the concessions granted on a previous occasion to Govan, Patrick, Paisley, Port-Glasgow and Hamilton, and now to Motherwell and Hamilton. But though these burghs have succeeded in depriving the company of the power to enter their boundaries compulsorily, they can still treat with it for adequate supplies of energy.

THE NEW WESTINGHOUSE WORKS. The ceremony of the laying of the cornerstone of the new works of the British Westinghouse Electric & Manufacturing Company at Trafford Park, Manchester, by the Lord Mayor of London, supported by the Lord Mayor of Manchester and Sheriffs of London, has gone off with great eclat. Special trains were provided from London and special accommodations at the hotels, and after the ceremony an elaborate but informal luncheon was served. The ceremony itself was performed on a covered platform decorated with flowers and flags, and the stone was placed in the full view of all interested. Among those present were: C. W. Benson (deputy chairman), Lemuel Bannister, P. F. Kobbe, J. H. Lukach, J. Annan Bryce, J. F. Mason, Arthur E. Scanes (secretary), W. H. Wells (business manager), and J. E. Stewart (building manager). Other guests who had seats on the platform were: Sir J. H. Rider (electrical engineer to the London County Council), Mr. Turnbull (electrical engineer to the Corporation of Tynemouth), and Mr. Chattock (electrical engineer to the Corporation of Bradford), while among the prominent firms represented at the function were the following: J. G. Brill Company, Callender's Cable & Construction Company, Lacey, Clirehugh & Sillar, Maguire & Baucus, Metropolitan Railway Carriage & Wagon Company, Niles Tool Works, James Simpson & Company, Sloan Electrical Company, South Durham Steel & Iron Company, and many others. The list of guests also included the chairman of the electrical committees of the following towns: Accrington, Ashton-under-Lyne, Bacup, Bolton, Burnley, Buxton, Darwen, Farnworth, Halifax, Haslingden, Huddersfield, Manchester, Macclesfield, Middleton, Oldham, Preston, Radcliffe, Royton, Salford, Stalybridge, Stockport, Saint Helen's, Bury and Rochdale. R. H. Porter, formerly chief of the United States Census Department, seconded the vote of thanks, and aroused the enthusiasm of the audience that the warp of British finance, of British experience and British conservatism, interwoven with the ingenuity, energy and enterprise of American weft, would offer a pretty hard front for the rest of the world to combat. The works have already been described in these columns.

General News.

THE TELEPHONE.

RUSSELLVILLE, ALA.—The telephone line from Tuscumbia to this place has been completed. An exchange will be established here in a few weeks.

CAMDEN, ARK.—The Eastern Telephone Company, with a capital stock of $1,000, started business on July 16 last with 32 miles of toll line, and connects with other lines in Camden. Extensions will be made next spring to Warren, Ark.

WILMINGTON, DEL.—The Delmaravia Telephone Company has nearly completed the work of extending its lines to Elkton.

KISSIMEE, FLA.—C. A. Carson has obtained a charter and will establish a local telephone exchange.

ATLANTA, GA.—The Standard Telephone Company's plant in this city is being overhauled. New apparatus will be installed.

COVINGTON, GA.—The Covington Telephone Company has organized, with C. C. Brooks president, and has commenced work on the construction of its system.

ROME, GA.—The Southern Bell Telephone & Telegraph Company has begun work on its new system in this city, and will erect a new exchange, taking out the old telephones and replacing them with the metallic, long-distance instruments.

AUGUSTA, GA.—As a result of the arbitration as to the value of the Augusta Telephone Company, operating the Strowger system, it was determined that the property be returned for taxation at $22,000 instead of at about $18,000, as the owners had returned it.

AVON, ILL.—A new telephone exchange is being installed at Avon.

CLINTON, ILL.—B. F. Wasson was in Beason arranging to put in a local telephone exchange.

JERSEYVILLE, ILL.—A telephone line has been constructed from Carrollton to Hardin via Kampsville.

FAIRBURY, ILL.—The Fairbury Telephone Company has been granted a franchise by the City Council.

MACOMB, ILL.—The Kurtz Telephone Company was granted a franchise to enter the city and operate an exchange.

CENTRALIA, ILL.—E. A. Knapp, representing the Central Union Company has asked for a telephone franchise in Salem.

CLINTON, ILL.—The Farm & City Telephone Company will rebuild the local lines here as soon as the Decatur line is completed.

STERLING, ILL.—S. S. Creider has been awarded the contract for rebuilding of the telephone line along the canal south from Rock Falls.

CARLISLE, ILL.—A telephone exchange will be established in Sandoval by Charles E. Hull, of Salem. Fifty subscribers have been secured.

DUNDEE, ILL.—A new switchboard has been placed at the central telephone office, which will accommodate about 300 subscribers. There are now about 100 subscribers on the local exchange, and the number is constantly increasing.

HUMBOLDT, ILL.—The Humboldt Telephone Company, capital stock $2,500, has been incorporated. Incorporators: James McDougle, S. C. Ashbrook and E. M. Mulliken. The line will be connected with the exchange at Arcola.

CHAMPAIGN, ILL.—The Palmer Darnell Electric Company, of Atlanta, has purchased the telephone lines and exchange belonging to Dr. J. H. Banks, and will consolidate with the extensive telephone system recently incorporated.

CHICAGO, ILL.—The Eureka Telephone & Construction Company has been incorporated in Chicago, with a capital stock of $50,000 to manufacture telephone and electrical appliances. The incorporators are Henry R. Platt, John Rollings, Sydney Stein.

CARLISLE, ILL.—The resident manager of the Clinton County Telephone Company, J. W. Johnson, has announced that the line will be extended to Keyesport, fourteen miles northeast of this city. Extensions will also be built to Boulder, Hoffman, Posey, Bartelso, St. Rose and Jamestown, which places are at present without telephone facilities.

PEKIN, ILL.—The Citizen's Telephone Company has awarded the contract for the construction of its telephone system in Pekin to Jones & Winters, of Chicago, for $26,672. This does not include dynamos, switchboards, power plant and instruments; these contracts are to be let later. It is estimated that by the time the plant is in working order from $35,000 to $40,000 will have been expended.

DIXON, ILL.—At a meeting of the Dixon merchants it was agreed to use the Central Union telephone service only until Oct. 1, at the old rates of 50 cents a month for residences and $1.50 for business houses. The proposition that the Central Union Company submitted to the merchants that after Oct. 1, the rate would be $1.50 for residences and $2 for business houses, is held for further consideration.

GOSHEN, IND.—The Wakarusa Telephone Company is extending its line in the country to the south.

ELKHART, IND.—E. C. Bickel, of this city, has just purchased the Home Telephone system of South Haven, Mich., for a consideration of $10,000.

RICHMOND, IND.—The American Bell Telephone Company has appealed to the State Board of Tax Commissioners from the assessment placed on its property by the Wayne County Board of Review.

ELKHART, IND.—The Central Union Telephone Company announces that it wil put in an exchange at Wakarusa to compete with an independent plant there. The independent concerns are strong in this section, and it will only be a few weeks when Elkhart and Goshen people may talk to Cleveland and Indianapolis over independent wires.

LOGANSPORT, IND. Fort Wayne capitalists, headed by Theodore Thorward, has submitted to the City Council a petition for a fifty-year franchise to build and operate an independent telephone plant in this city. The prospects for a grant are good. Councilmen favor but one exchange, and the Central Union's franchise expires in January. A petition for a renewal will likely be denied.

INDIANAPOLIS, IND.—The Indiana Tax Commissioners have just finished their forty-five day's session. Secretary Martin gave out a comparative statement showing the total amount of corporate telephone assessments this year to be $4,436,663, against $2,929,190 for last year, an increase of $1,509,473. The increase during the year in telegraph property is shown to be only $1,120. The rapid increase of telephone property over that of telegraph property is a subject of considerable comment.

FRANKLIN, IND.—Great excitement prevails here over the controversy between the Central Union and independent telephone companies. Originally the Central Union was given a franchise to operate a telephone exchange in this city, but after establishing a plant it was removed elsewhere, and this territory was abandoned, as claimed by its opponents. An independent company was recently given a franchise, thereupon the Central Union attempted to establish another exchange here, but the Council revoked its franchise and ordered the city marshal to arrest any person attempting to erect poles. Undaunted, the Central Union put linemen to work, but all were arrested on the charge of trespass and obstructing the streets. The Central Union then obtained from Judge Baker, of the United States Court, a temporary restraining order against the city officers enjoining them from removing poles and wires and interfering with the company's property until Oct. 1, when the case will be finally determined. The next move expected is for the city to obtain an injunction from the County Court to prevent the Central Union from constructing its plant until Oct. 1.

GRUNDY CENTER, IA.—The Grundy County Telephone Company has been organized here.

AFTON, IA.—Articles of corporation have been filed for the Afton Mutual Telephone Company. Incorporators: J. H. Van Scoy, H. P. Armitage, C. A. Pierson, M. W. Keating, J. W. Coen and A. B. McDaniels and L. M. Walker.

HARPER, KAN., is to have a telephone exchange.

SALINA, KAN.—The Salina Telephone Company has increased its capital stock from $25,000 to $50,000.

STANDISH, MAINE.—The telephone line from this village to Watchie Pond will soon be in operation.

SKOWHEGAN, MAINE.—The Somerset Traction Company is putting in a private telephone line between Madison and this place.

SOUTH PARIS, MAINE.—The Sumner & Paris Telephone & Telegraph Company has been organized, with A. E. Dean president.

GRAY, MAINE.—The New England Telephone & Telegraph Company has a large force of men at work on a telephone line from Gray Corner through West Gray and to North Windham and other points west.

BUCKFIELD, MAINE.—At a hearing before the selectmen of Buckfield, the New England Telephone & Telegraph Company was granted pole rights in the town of Buckfield. It is understood that the company will at once begin work on the establishment of a line between Buckfield and Turner. At a similar hearing the Oxford County Telephone & Telegraph Company was also granted pole rights in that town. This telephone line is already very nearly completed.

LANSING, MICH.—The Union Telephone Company, of Alma, has increased its capital stock from $150,000 to $200,000.

DETROIT, MICH.—At the Wyandotte Council meeting the Aldermen will consider the granting of an independent telephone franchise.

BAY CITY, MICH.—The Michigan Telephone Company is preparing to extend its lines in the territory north of this city, and will eventually cover every important point between here and Alpena and Mackinaw City.

HART, MICH.—The Oceana Telephone Company has sold to the Pere Marquette Telephone Company, of Ludington, that portion of its telephone plant located in Mason County, on the north of the county line between Mason and Oceana counties. The Pere Marquette Telephone Company will collect all moneys due the Oceana Telephone Company in this district and pay all debts owing by said Oceana Telephone Company. Geo. S. Root is secretary of the Oceana Company.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will erect a new two-story brick and stone building to cost $25,000.

ST. PAUL, MINN.—The Winona Telephone Company has secured the passage by the Rochester City Council of an ordinance permitting it to install pay telephone stations in that city.

ST. PAUL, MINN.—The assembly has passed the resolution directing City Engineer Clausen to remove all telephone, telegraph, electric light and power wires on streets where the orders of the Council for their removal had not been obeyed.

LAUREL, MISS.—The Mississippi Telephone Company, capital $3,000, has been incorporated by W. Welborn, E. D. Pierce, J. W. Watt and N. P. Welborn.

SUMNER, MO., is to have a telephone exchange.

KANSAS CITY, MO.—More than 1000 farmers in Mercer County have telephones in their houses.

BOZEMAN, MONT.—The Bozeman & Pass Creek Telephone Company has been incorporated, with a capital stock of $5,000.

REIDSVILLE, N. C.—The Southern Bell Telephone & Telegraph Company has made application for franchise for a telephone exchange at Reidsville.

FINGAL, N. D.—The telephone line from Fingal to Valley City will soon be in operation.

BISMARCK, N. D.—The State's attorney, Allen, has begun work on the installation of a telephone system in Bismarck.

JAMESTOWN, N. D.—C. L. King, in charge of the exchange of the North Dakota Telephone & Electrical Company at Harvey, has refused to turn it over to C. E. Leslie, who purchased the line from Receiver Murphy at a sale held July 25. Judge Glaspell has issued an order confirming the sale and ordering the line turned over to Leslie and proceedings to secure the possession of the central outfit at Harvey will be instituted.

BRADY, NEB.—The Maxwell & Brady Telephone Company has been incorporated, with a capital stock of $200,000.

WISNER, NEB.—The Holt County Telephone Company has been organized at O'Neill, with a capital stock of $10,000. It will connect with the Nebraska Company at Ewing, thence to Spencer and Butte on the north, and south to Chambers.

FORT EDWARD, N. Y.—The Hudson River Telephone Company will reconstruct the telephone system in this village.

SCHENECTADY, N. Y.—The Schenectady Home Telephone Company has been incorporated, with a capital stock of $250,000, to maintain lines of telephone in Schenectady and Niskayuna, Duanesburg, Braman's Corners, Rotterdam Junction and intermediate towns in Schenectady County. The directors are Samuel B. Rawson, T. M. Brush, I. H. Griswold, J. A. Dake, D. H. Sudro, A. E. Lord and E. M. Brush, of Elyria, Ohio, and Howard Hendrickson, of Albany.

TROY, N. Y.—The Cohoes-Waterford Home Telephone Company, whose principal office is to be in Cohoes, has been incorporated with the Secretary of State. It proposes to carry on operations in the counties of Albany and Saratoga, especially between Cohoes and Waterford. The capital stock is $200,000. The directors are S. B. Rawson, F. H. Sudro, I. H. Griswold and J. A. Dake, of Elyria; Howard and Hendrickson, of Albany; Jas. H. Shine and John Clute, of Cohoes, and Thomas Breslin, of Waterford.

CLYDE, OHIO.—The Clyde Telephone Company has increased its capital stock from $10,000 to $40,000.

TROY, OHIO.—The Home Telephone Company is considering the matter of extending its line throughout this vicinity.

MASSILLON, OHIO.—The Massillon Telephone Company has opened its branch exchange at Dalton with 40 subscribers.

CANTON, OHIO.—The Stark County Telephone Company, Canton, has increased its capital stock from $100,000 to $500,000.

DELAWARE, OHIO.—The Citizens' Telephone Company has increased its capital stock from $40,000 to $60,000. The company now has 600 subscribers.

HUBBARD, OHIO.—The Hubbard Council has granted a franchise to the Youngstown Telephone Company for the purpose of operating a telephone system here.

GREENBUSH, OHIO.—The local telephone exchange has been sold to the Gratis Telephone Association, and that company is making preparations for a number of extensions.

FOSTORIA, OHIO.—The Central Union Telephone Company is preparing to rebuild its local exchange at an expense of $20,000. A farmers' line is being built to the village of Arcadia.

CEDARVILLE, OHIO.—The Council has granted a franchise to the Home Telephone Company, an independent company that will work in conjunction with other independent companies.

COLUMBUS, OHIO.—The New Washington Telephone Company and the Huron County Telephone Company, of Bellevue, have consolidated under the name of the Huron County Telephone Company.

KENT, OHIO.—The Central Union Telephone Company has refused to accept the franchise granted by the City Council, claiming that the rate clause is unsatisfactory. The Probate Court will probably be appealed to.

GENEVA, OHIO.—The new system of the Madison Telephone Company at this point will be placed in operation within a few days. The lines are being rapidly equipped with new instruments and the switchboard is neadly ready.

NEW LEXINGTON, OHIO.—Application was made to the Council for a franchise for a new telephone line, the object being to secure direct telephone connection between this place and other points in this and adjoining counties.

TOLEDO, OHIO.—Construction work on the new system of the Toledo Home Telephone Company has been started by a large force of men. Over one hundred carloads of material have been received and the work is progressing on all parts of the system. Manager Graves expects to have a large portion of the system in operation by Jan. 1.

CINCINNATI, OHIO.—The Board of Trade and other business men's associations are agitating a movement for the establishing of an independent telephone exchange in Cincinnati. The City & Suburban Telegraph Association, a Bell licensee, is said to have only about 10,000 subscribers, while Cleveland alone has over 22,000, and Columbus, which is only about one-half as large as Cincinnati, has nearly as many telephones. It is claimed that the lack of independent telephone facilities is a serious drawback to the development of the business at this point. A company, known as the Fitzsimmons Telephone Company, claims to hold a grant covering a system throughout the city, and it has in operation about 1,200 telephones, the majority of them being in private systems not connected with a main exchange, and this grant will be utilized by a new company which is said to be in process of organization.

PORTLAND, ORE.—The Board of Public Works of Portland has granted a ten-year franchise to the Pacific States Telephone Company.

GUTHRIE, O. T.—The Red River Valley Telephone Company has been issued a charter, with a capital stock of $50,000, to do a general telephone business in Oklahoma. The place of business is to be Lawton, Comanche County. J. A. Overstreet, of Kingfisher, is president.

MANSFIELD, PA.—The Citizens' Mutual Telephone & Telegraph Company, capital stock $1,000, has been incorporated.

UNIONTOWN, PA.—The Farmers' telephone line from Greensboro to Davidson and branches have been sold at this place by the Sheriff.

PHILADELPHIA, PA.—The Perkiomen Telephone Company has received the right to erect poles and to string wires through Pennsburg and East Greenville.

PENNSBURG, PA.—The Home Telephone Company of this place is planning to extend its lines to Red Hill, East Greenville, Greenlane, Sumneytown and other villages.

COATESVILLE, PA.—The United Telephone & Telegraph Company has erected poles from Coatesville to within one-half mile of the borough line of Parkersburg, and expected to have the wires strung and connection established by Sept. 1.

LEBANON, PA.—The United Telephone & Telegraph Company is constructing a direct trunk line between Lebanon and Lancaster.

ALLENTOWN, PA.—The Lehigh Valley Traction Company has announced the purchase of the line from Quakertown to Perkasie from the Quakertown & Philadelphia Traction Company. The line is needed as a connecting track between this city and Philadelphia.

ALTOONA, PA.—The Cresson Telephone Company has bought the stock and franchises of the Northern Cambria Telephone Company, operating lines at Nicetown, Spangler, Barnesboro, Hastings and Patton. The Cresson Company now connects with Altoona and Johnstown.

UNION, S. C.—The Southern Bell Telephone & Telegraph Company will establish an exchange at Union.

PITTSTON, PA.—A movement is on foot for consolidation of the Central Pennsylvania and People's Telephone lines. The patrons, who have been enjoying a cut rate telephone service, will shortly be given the reverse. Already the Pennsylvania Company, which will absorb the People's Company, has increased the rental for business places. The People's Company is but a young concern, with lines extending from Hazleton to Carbondale.

BRIDGEWATER, S. D.—The Bridgewater Union Telephone Company at Bridgewater, capital stock $1,500, has been incorporated. Incorporators: P. H. Hyntom, J. J. Heinrich, Ed. Guenther, Alex. N. Meyers and Charles L. Marsh.

PIERRE, S. D.—A project is under way for the construction of a telephone line from this city to the Black Hills. The company for the purpose is to be incorporated, and work is to be begun at once. The line will connect with the Black Hills system and give that section direct communication with the eastern part of the State.

MEMPHIS, TENN.—The Cumberland Telephone Company and the Memphis Telephone Company have reached an agreement by which there will probably be no more litigation between them over the erection of the new telephone system in this city.

MEMPHIS, TENN.—The Memphis Telephone Company, the representative of the independent system of this city, will build its own exchange. The contract has just been let. The building will be three stories high, will be built of brick and stone, will cost about $30,000, and, when completed, will be one of the handsomest structures of the kind in the entire South.

SAN ANGELO, TEX.—The San Angelo Telephone Company has been incorporated, with a capital stock of $80,000.

ANDERSON, TEX.—The Anderson Telephone Company has completed the line to Retreat and White Hall, and will soon build to Courtney.

ORANGE, TEX.—The Orange Telephone Company has been incorporated, with a capital stock of $40,000. The incorporators are Melville D. Shaw, Walter D. Bettes, C. N. Haskell, J. S. Brailey, and others.

WAXAHACHIE, TEX.—The Commissioners Court, in session here, granted a franchise to Malloy & Company, of Ferris, and Truitt & Thompson, of Bristol, for the erection of a telephone line between the towns of Ferris and Bristol, also taking in the town of India.

PARIS, TEX.—The directors of the Southern Telephone Company met in Paris and elected Jasper N. Yeager, of Lake Creek, Delta County, manager, in place of W. L. Miller, resigned. It was decided to put in a central office and establish a local exchange in Paris.

RICHMOND, VA.—F. D. Drewry and others have organized the Virginia Telephone Company (copartnership) for the construction of a telephone system connecting various mines with the long-distance lines.

GRAFTON, W. VA.—The Consolidated Telephone Company has been incorporated. Authorized capital $300,000; incorporators, William Morgan, B. T. Bailey, of Grafton; C. E. Pride, of Clarksburg, and others.

WILLIAMSBURG, VA.—The stockholders of the Chesapeake Telephone & Telegraph Company re-elected the present officers as follows: President, E. E. Slaight; Vice-President, George L. Smith; Treasurer, E. T. Hudgins; Secretary, J. E. Crockett. The following board of directors was elected: Messrs. J. W. Clements, E. T. Lee, S. R. Curtis, H. S. Bird, G. L. Smith, G. W. Warburton and J. E. Crockett.

SPOKANE, WASH.—The Rocky Mountain Bell long-distance telephone line has been extended to Hailey.

LA CROSSE, WIS.—A plan is being matured whereby the La Crosse Telephone Company will extend its lines from this city to La Crescent, Minn., and Eagle Bluff.

BABCOCK, WIS.—The Independent Telephone Company, of Grand Rapids, recently completed a line from Pittsville to Babcock, by way of Dexterville. During the fall a central office will be established here, providing the company can secure enough subscribers.

TWO RIVERS, WIS.—The Two Rivers Telephone Company has let a contract for the installation of an entire new system, to take the place of the one now in use, which is no longer adequate to meet the demands. The system will have long-distance connections.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company has been incorporated. This move is the preliminary step to the final combination of all independent telephone interests in the State. The main office of the company will be in this city, but the active field of operations will be the Fox River Valley, as the company has options on all the property and franchises of the Fox River Valley, Little Wolf River and Wolf River Telephone Companies, with about 30 exchanges. The systems under the control of the new company will be greatly improved and extended. W. W. Townsend and F. H. Lord, of Chicago, and A. L. Hutchinson, of Weyawega, will have active charge of the affairs.

ELECTRIC LIGHT AND POWER.

SAN BERNARDINO, CALIF.—The Edison Electric Company has purchased the California Power Company, and the plant of the latter concern will be pushed to completion.

SAN FRANCISCO, CALIF.—The Central Supply Plant has been incorporated, with San Francisco as the principal place of business. Directors: W. H. Payson, H. F. Peart, E. A. Clauson, N. Fancher and C. S. Chandler. Capital stock, $75,000; subscribed, $500.

LOS ANGELES, CALIF.—The Mentone Power Company, with principal place of business in Los Angeles, has incorporated, with a capital stock of $500,000, of which amount $5,000 has been subscribed. The directors are W. G. Kerckhoff, E. A. Beck, Otto Weiss, H. W. O'Melveny and M. G. Eshman, all of Los Angeles.

WOODLAND, CALIF.—The city of Woodland is soon to pump all of its water by electric power, steps to that end having already been taken. Arrangements have been made with the Bay Counties Power Company, through its local agent, to furnish the necessary power and a contract will soon be let to a San Francisco firm for the construction and installation of an electrical pump at a cost of $2,750. The City Trustees figure on saving $275 per month as a difference between the cost of pumping the water by steam now in use and electricity.

PEORIA, ILL.—The Central Electric Company of this city has increased its capital from $5,000 to $25,000.

WARREN, IND.—This city has just completed and installed a new electric light plant at a cost of upwards of $30,000.

MUNCIE, IND.—Officers of the local Heat, Light & Power Company have demanded a new franchise and assert that unless a new and more liberal franchise is granted whereby an increase in rates may be exacted, the company will be unable to furnish current for heat, light and power. The company has already cut off the factories, and without an increase in rates improvements necessary cannot be made. The people are opposed to yielding to the company, after fighting the rate question through the courts.

MUSKEGON, MICH.—Plans have been drawn for a new plant for the Muskegon Traction & Lighting Company. They provide for the expenditure of $100,000 in the erection of a modern fireproof structure to be completed by Dec. 1. Power will be furnished for both the street railway and the city lighting system.

ST. LOUIS, MO.—The Board of Public Improvements Aug. 27 took the first step towards municipal management of the lighting of public buildings. An ordinance was approved and sent to the House of Delegates which authorized the board to wire all buildings owned by the city. The city owns the wires and attachments in the City Hall, but not in other buildings. The cost of wiring is not a small item financially. Members of the board believe that it would be to the city's advantage to own the wiring and attachments, for independence, if for no other reason. It is said that the plan is to purchase the wires now in use.

GREENSBORO, N. C.—The Greensboro Gas & Electric Light Company is making extensive improvements to its plant, including a new building and new machinery.

LAURENBURG, N. C.—A meeting of citizens has decided to employ a civil engineer to make surveys to ascertain the probable cost of an electric light and water system.

LEXINGTON, N. C.—It is said that the present owners of the town electric light plant have decided to suspend operations indefinitely, thus creating an opening for a new company.

ORANGE, N. J.—The National Electric Heat, Light & Power Company is trying to oust President John Seymour of the Common Council from office because he voted against the company on the question of the contract for street lighting. The United Electric Company is the competitor of the National Electric Company, which submitted a bid for municipal lighting in Orange in competition with the United Electric Company, which holds the contract. Had the bid of the National Company been accepted, it would have resulted in a saving of $22,500 to the city in five years. A motion to grant the contract to the National Company was lost by a tie, President Seymour voting in the negative. The National Company now claims the contract was awarded it by a vote of 8 to 7 on the ground that Mr. Seymour is not a legal member of the Council and had no right to vote.

BUFFALO, N. Y.—The Western New York Water Power Company, of Buffalo, has been incorporated to manufacture electricity; capital, $50,000. Directors: Edward S. A. McLeod, W. E. Frampton and F. B. Hartzell, of Buffalo.

BUFFALO, N. Y.—What is said to be the first planing mill run by electricity in this country has begun operations on Goode Island, near Tonawanda. Two motors of 125 horse-power each were installed by the owner, Frank I. Allinger, and these suffice to run all the machinery in the mill. The owner thinks he will make a great saving by substituting electricity for steam.

CINCINNATI, OHIO.—The contract for street lighting in this city for ten years after June 1, 1902, has been signed by President Hickenlooper, of the Cincinnati Gas & Electric Company, and by the city representative. The company will install an underground conduit system. The contract involves about $4,000,000.

FREMONT, OHIO.—An independent company has been organized by local business men, to build a steam heating, gas and electric lighting plant for the purpose of competing with the company which has recently bought up the local plant and raised prices for illumination. A franchise ordinance has passed its first reading.

HUBBARD, OHIO.—Lamprecht Brothers, Cleveland brokers, who were awarded the issue of $8,000 in bonds for the purpose of building a municipal lighting plant, have declined to take the bonds, claiming the issue was illegal.

An attempt is being made to place the bonds with the next highest bidder. Bids have been received for the equipment of the plant.

AKRON, OHIO.—It is said that the scheme of the Hartford, Conn., syndicate to build a large power plant at the falls in the Cuyahoga River, near Cuyahoga Falls, has been blocked by Henry A. Everett, who is stated to have secured control of the water front on both sides of the river for a distance of half a mile from the large falls. The syndicate has secured options on a long strip of water front, but the Cleveland gentleman controls the situation at the vital point. It seems probable that he has other plans for utilizing the power developed at the falls.

WINSBORO, TEX.—The Chickasha Electric Company, of Winsboro, Wood County, capital stock $60,000, has been incorporated by L. S. Schluter, W. T. Muteman and E. M. Decker.

MILWAUKEE, WIS.—Messrs. Keelyn & Smith are installing an electric lighting plant in the coal docks of the C. Reis Coal Company, at Ashland, Wis.

WAUKESHA, WIS.—The Waukesha Sheet Steel Company will install an electric power plant, consisting of a 75-kw generator, electric crane, electric pump, two 20-hp, one 10-hp and one 5-hp motors.

MILWAUKEE, WIS.—Geo. F. Rohn has secured the contract for the electrical equipment of Gimbel Brothers' new department store in this city. The equipment comprises wiring and iron conduit for one 75-hp and six 40-hp motors, 200 enclosed arc lamps and 500 incandescent lamps.

THORP, WIS.—The brick power-house of the Thorp electric light plant has been completed. A force of workmen is now engaged in setting poles and wiring the same for the thirteen 1500-cp arc lights, while business houses and private residences are being wired preparatory to the introduction of lights as soon as the engine, boiler and dynamo shall have been placed in position and connected ready for operation. All the machinery is new and the plant is expected to be ready for operation by October 1. The plant when completed will cost $10,000 and will be owned and operated by the village.

LA CROSSE, WIS.—In view of the fact that the Council has been asked for a twenty-five-year extension of the lighting franchise at rates merchants deem extortionate, all stores between Fourth, Fifth and Main and Jay Streets will be lighted by a lighting plant which will be erected and operated privately by the business men of the block. The business men say they could secure light much cheaper through the private plant. Included in the block are the largest consumers of light in the city, and owners say that they will not now withdraw, even if the company should withdraw its ordinance and make a suitable reduction in prices.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will spend $1,000,000 in improving the street railway systems of Birmingham and vincinity. New electric cars, costing $7,500 each, have been purchased, and will be put on the suburban lines between Birmingham and Ensley and Birmingham and Bessemer.

GADSDEN, ALA.—W. H. Weller, J. T. Weller and C. S. Ward have purchased from Capt. J. H. Elliott the Gadsden & Attalla Union Railway Company, consisting of the electric car line from Gadsden to Attalla, and the power-house and improvements. The electric car line will be consolidated with the Gadsden Light, Iron & Coal Company.

SANTA CLARA, CALIF.—A franchise has been applied for by George T. Dunlap, to construct an electric line in this county.

COLORADO SPRINGS, COLO.—W. A. Otis & Company, C. M. MacNeill, E. P. Shove, Henry Hine, A. Sutton, C. E. Noble, and Hall, Babbitt & Company, well-known Colorado Springs capitalists, have organized a company to build an electric railway to the top of Pike's Peak. The road will cost $500,000 or more. It will start from Colorado Springs or from some station on the Cripple Creek Short Line. The height will be 14,143 feet. Work will be begun immediately.

NEW HAVEN, CONN.—An Attleboro, Mass., dispatch says that some of the directors of the Massachusetts Electric Company's are back of a project to parallel the New Haven Railroad with an electric road between Boston and Providence.

JOLIET, ILL.—The Joliet & Chicago Electric Railway Comany, owned by the American Railways Company, will probably be ready to open the new line from Lamont to Chicago by the first week in September. The road is practically completed.

CHICAGO, ILL.—The Valparaiso, Michigan City & Chicago Electric Railway Company has been incorporated, with a capital stock amounting to $25,000, all of which is subscribed and paid in. The road proposed extends from Valparaiso to Chicago, passing through the following towns en route: Furnessville, Chesterton, Porter, Wheeler, Hobart, Tolleston, Clarke, Whiting, Crown Point, Hebron, Hessville and Highlands.

LA PORTE, IND.—The Lake Michigan & Central Indiana Railroad and Navigation Company has been organized by a syndicate of Chicago and Knox capitalists to build an electric line from Michigan City to Indianapolis, via La Porte.

LEAVENWORTH, KAN.—The Interstate & Leavenworth Railway Company of Kansas City, with a capital of $500,000, has been formed. The company is to operate street railways in Kansas City and Jackson County, Mo.; in Kansas City and Wyandotte County, and in Leavenworth and Leavenworth County Kan.

NEW ORLEANS, LA.—A deal is on foot which may result in the consolidation of the four street railway companies at New Orleans. H. H. Pearson, representing Edward C. Jones & Company, of New York, has been in New Orleans, for some time with the above end in view. The combined capital of the four companies is $9,903,300 and the aggregate bonded indebtedness is placed at $8,600,000. The four companies are: The New Orleans City Railway Company; capital $7,500,000; the Orleans Railway Company, capital $250,000; the New Orleans & Carrolton Railway Company, capital $1,200,000, and the St. Charles Street Railway Company, capital $953,000. Edward C. Jones & Company have recently purchased the electric light company at New Orleans, and are said to have about $5,000,000 invested in that city.

MYERSVILLE, MD.—After selling $35,000 of the bonds and a controlling amount of stock to Hagerstown people, a majority of the old directors of the Myersville and Catoctin Electric Railway have leased the road for ten years to the Frederick & Middletown Electric Railway Company, which still has a lease on it for over two years.

FITCHBURG, MASS.—The new electric railway between this city and Lunenburg has been opened.

WORCESTER, MASS.—The directors of the Uxbridge & Blackstone Street Railway Company have voted an assessment of 40 per cent on the capital stock of the company, the money to be used in constructing the road.

BOSTON, MASS.—Stone & Webster, of this city, have purchased the principal light plant, and have obtained a favorable street-railway franchise in the city of El Paso, Tex. Plans for the construction of the railway are under way.

BOSTON, MASS.—An order has been issued by the Railroad Commissioners authorizing the Middleboro, Wareham & Buzzard's Bay Street Railway Company to operate a line from Middleboro to the village of Rock, a distance of about five miles.

LANSING, MICH.—The incorporators of the new Western Michigan Electric Railway Company are: C. I. Hadley, of New York; C. W. Haight, New Haven; F. A. Hanshaw, S. F. Marchout and S. M. Howard, of Chicago.

LANSING, MICH.—Articles of incorporation of the West Michigan Traction Company, organized with $1,000,000 capital have been filed with the Secretary of State. The company proposes to build an electric line from the vicinity of Benton Harbor to Dowagiac, Cassopolis, Decatur, Pawpaw and Kalamazoo, a distance of 90 miles.

GRAND RAPIDS, MICH.—The Grand Rapids, Belding & Ionia is the name of a new electric interurban line which will, in the near future, connect Grand Rapids with Ionia, Ada, Lowell, Saranac and Belding. The organization has been effected. The company has a capital stock of $100,000, the incorporators being Wallace Franklin, Detroit; Thomas F. Carroll, and Joseph Kerwin. Thomas F. Carroll is the president of the new company; Treasurer, Wallace Franklin, and Secretary, Joseph Kerwin.

WILMINGTON, N. C.—The Wilmington Seacoast Railroad, from Wilmington to Wrightsville Beach, a distance of ten or twelve miles, has been sold, and it is understood that the object of purchasers is to convert it into a modern trolley system.

PORTSMOUTH, N. H.—The directors of the Portsmouth & Exeter Street Railway have petitioned for additional locations in Greenland.

CONCORD, N. H.—The Concord Street Railway was organized in 1878 and operates an overhead line of thirteen and a half miles, with five tow cars and three others. Extensions are now being built. The apparatus is General Electric and Westinghouse. President, A. L. Tuttle; superintendent, H. A. Albin.

GLOVERSVILLE, N. Y.—It is proposed to build an electric road through Minerva and Newcomb to Long Lake in Hamilton County.

COOPERSTOWN, N. Y.—The Oneonta, Cooperstown & Richfield Springs Railway Company has filed a certificate of increase of capital stock from $750,000 to $1,000,000.

FORT PLAIN, N. Y.—The Board of Trustees of this village have granted a franchise to the Mohawk River Traction Company to construct an electric railroad through several streets.

UTICA, N. Y.—The Cleveland syndicate, which has purchased the electric roads in this city and vicinity, has signed a contract to take 2500 horse-power from the electric plant at Trenton Falls.

CLINTON, N. Y.—An application has been made to the trustees of the village of Clinton, County of Oneida, by the Utica Suburban Railway Company for permission to construct and operate a street surface railway.

FREEPORT, L. I., N. Y.—The Mineola, Hempstead & Freeport Traction Company, which has received a franchise to build a trolley road here, has filed its required bond of $5,000. The Fidelity & Deposit Company of Maryland is surety for the bond.

ALBANY, N. Y.—The St. Lawrence & Adirondack Railway Company has declared a semi-annual dividend of 2½ per cent, payable September 1. This is the first dividend declared by the company. The directors elected A. L. Meyers vice-president of the company.

TROY, N. Y.—The State Board of Railroad Commissioners has granted the application of the Troy, Rensselaer & Pittsfield Electric Railway to construct an electric road from Troy to the Massachusetts State line and from Troy Through Bath into Rensselaer.

DEFIANCE, OHIO.—The Northern Ohio Electric Railway Company has filed a certificate of extension of route or line.

TIFFIN, OHIO.—The Tiffin & Southern Railway Company has been organized, with Michael Riley, of Pittsburg, president, and B. F. Brough, of Toledo, secretary and treasurer.

BOWLING GREEN, OHIO.—Riggs & Sherman have been appointed engineers and superintendents of construction for the Lake Erie, Bowling Green & Napoleon electric line.

MARION, OHIO.—Toledo men propose to build an electric line starting from Marion, Ohio, and passing through Edison and one or two other small places to Mount Gilead. Then it is proposed to extend the line from Marion westward.

SPRINGFIELD, OHIO.—The Pennsylvania Railroad, it is said, is arranging to operate the line between Springfield and Xenia by electricity. It is stated also that the Pennsylvania has secured rights along the Miami Canal, which runs from Toledo to Cincinnati, and will build an electric line along the towpath.

TOLEDO, OHIO.—The Everett-Moore people have secured control of the Western Ohio Traction Company, which is now constructing a line between Lima and Piqua. The syndicate, it is learned, have already begun negotiations for the purchase of the line between Piqua and Troy, including the lines of both cities and the line between Dayton and Cincinnati.

CINCINNATI, OHIO.—The project to connect Cincinnati and Toledo by electric railway is rapidly assuming form. Construction on various divisions of the line is well advanced. At a meeting of stockholders, held in Columbus, the following were elected: Ellis Bartholomew, president and general manager; C. H. Wells, first vice-president; A. F. McCormick, second vice-president; I. M. Covault, secretary; Wm. P. Heston, treasurer; Claude Wyant, general counsel. Construction between Columbus and Lima is progressing rapidly.

COLUMBUS, OHIO.—The Commissioners of the county have given the Findlay & Southern Railway company permission to cross the country roads. R. Rosenstock, chief engineer of the road, said that it was the first air line electric railway in the State to operate as does a steam railway. The right of way between Findlay and Columbus has been secured. The power house will be at Kenton, and there will be sub-stations every ten miles. The line passes from Columbus to Toledo through Plain City, Marysville, Unionville, Kenton, Forest and Findlay.

CINCINNATI, OHIO.—Within a few months Cincinnati will be connected with Fort Wayne, Ind., by a continuous electric railroad, which will touch a number of cities and towns, including Hamilton, Dayton, and Richmond, besides several villages suburban to Cincinnati, that are not now connected with the city. The road is to be built by the Fort Wayne, Dayton & Cincinnati Traction Railway Company, which was organized several weeks ago with a capital stock of $1,000,000. The company is completely officered, and has established permanent headquarters in Dayton. Dr. Samuel George, of that city, is president. The company is purchasing its right of way, and arranging for construction work. The length is 356 miles of main line.

OTTAWA, ONT.—An American syndicate has bought Cow Bay Beach, near Halifax, Nova Scotia. An electric railway will be laid from the town of Dartmouth, opposite Halifax, to the beach and a large hotel erected there.

BLOOMSBURG, PA.—The Columbia & Montour Electric Railway has been opened between Bloomsburg and Lime Ridge.

McKEESPORT, PA.—The McKeesport & Suburban Street Railway has been formed to build a line two miles long; capital, $12,000.

MT. JOY, PA.—The Mt. Joy Borough Council has granted the Lancaster & Mt. Joy Railway Company the right to enter the borough.

CHAMBERSBURG, PA.—The Chambersburg Council has granted a franchise to the Chambersburg, Greencastle & Waynesboro Electric Railway Company.

BLOOMSBURG, PA.—The Bloomsburg & Millville Street Railway Company has been formed to run from Bloomsburg to Millville, ten miles; capital, $60,000.

MEADVILLE, PA.—The Meadville & Interurban Street Railway Company has been formed to build sixteen miles of road; capital, $98,000. President, F. R. Shryock, Meadville.

ALTOONA, PA.—The Belt Line Extension Street Railway Company has been formed to build one-half mile of road, beginning at Tenth Avenue and Twelfth Streets; capital, $3,000.

ALTOONA, PA.—The Finance Committee of the City Council has approved the Belt Line trolley ordinance. This means three-cent fares for workingmen. The new company will gridiron the city.

PHILADELPHIA, PA.—At a meeting of the Centre & Clearfield Street Railway Company the capital stock of the company was fixed at $500,000. An issue of an equal amount of 5 per cent thirty-year bonds were authorized.

ERIE, PA.—The Conneaut & Erie Traction Company has been formed to build twenty-five miles of road from the city limits of Erie, through Mill Creek Township, Fairview Township and Borough, Girard Township and Borough, East Springfield Borough and Springfield Township, to the Ohio State line; capital, $150,000.

PITTSBURG, PA.—The stockholders of the Pittsburg and Birmingham Traction Company held their annual meeting and elected the following officers and board of directors: W. L. Mellon, president; A. W. Mellon, vice-president; R. B. Mellon, treasurer; George S. Davidson, secretary and general manager; Weaver H. Rogers, assistant secretary. This is the road which was purchased by the Messrs. Mellon, local bankers, last May, and the new management decided at the last meeting to make a great many improvements upon the newly acquired property. Two hundred thousand dollars will be spent upon 100 new cars, which will all be in operation within four months. It has also been decided to re-lay the tracks along the entire line. The business of the company has shown marked growth during the last year, 11,408,673 passengers having been carried, which is 400,000 more than the year before.

STOCKHOLM, SWEDEN.—The Swedish Government, according to a dispatch from Stockholm to the *Politische Correspondenz*, is considering plans for the installation of electricity throughout the whole railway system of Sweden.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has decided on a complete reconstruction of its system, and will build two new lines to Cameron Hill and Sherman Heights.

WHEELING, W. VA.—Fire at Bridgeport destroyed the Wheeling Traction Company's power house and barns, together with twenty cars, entailing a loss of $50,000.

PARKERSBURG, W. VA.—A company with $500,000 capital has been incorporated to construct and operate an electric railway in Parkersburg and in the surrounding country.

BERLIN, WIS.—Plans are being made, it is said, by the Winnebago Traction Company to build a line through Como to Berlin from Oshkosh.

JANESVILLE, WIS.—P. Spooner, of Madison, has filed an application for a franchise for an electric railway in Janesville, for a term of 50 years. This is the proposed interurban line between Madison and Janesville.

JANESVILLE, WIS.—Mr. H. H. Clough, head of the Beloit, Janesville & Delavan Lake Electric Railway, has let the contract for building the line to Hayes Brothers, of this city. The contract calls for about thirty-five miles of track, which will be commenced at once and must be completed by January 1, 1902.

OSHKOSH, WIS.—The entire plant of the Winnebago Traction Company, including the Oshkosh electric street railway system of seventeen miles, the interurban line of thirteen miles, connecting Oshkosh and Neenah, electric park and park lines of four lines, has been sold to the Milwaukee Electric Railway & Light Company. The sale of the system is important in that it constitutes an important link in the proposed electric railway system from Chicago to Green Bay, a distance of 198 miles, of which lines aggregating 106 miles are now in operation.

THE AUTOMOBILE.

FOREIGN AUTOMOBILES.—Henri Fournier, the celebrated French chaffeur, was among the passengers who arrived last week on the Deutschland. His visit to this country, it is said, is in the interest of a French automobile manufacturing firm which contemplates establishing a branch here, of which Fournier will be the head. The location of the plant has not been decided upon as yet. The motor carriage is a gasoline machine and is of the type that was used by Fournier in some of his races in Europe.

OAKDALE, L. I.—W. K. Vanderbilt, Jr., intends to construct a permanent racing track for motor cycles in the vicinity of Oakdale. His plan as announced is to purchase outright the property needed for the course, to secure absolute privacy. Many of the residents in this section are enthusiastic over the sport of automobiling, and will join heartily with him in his new project. Mr. Vanderbilt's plans are novel, but promise to be most effective. The track is to be constructed with metal bed, and is to be most substantial, as he intends to make it a permanent one. His neighbors have promised to co-operate with him in the construction of the new racing track, and it is presumed that some of the foreign racing machines of high power and great racing capabilities will be brought to this country for speed trials over the path when it is completed.

BUFFALO ENDURANCE TEST.—Among those who have entered for the 500 miles automobile endurance contest from New York to Buffalo this month are President A. R. Shattuck, Elmer Apperson, R. P. Scott, C. R. Grouter, A. R. Townsend, Alexander Dow, A. C. Bostwick, B. B. McGregor, Louis Clarke, Percy Owen, H. R. Winthrop, C. A. Benjamin, W. H. Browning, H. K. Browning, W. K. Vanderbilt, Jr., William Morgan, James Macnaughton, and A. L. McMurtry. Besides these nearly all of the prominent makers of automobiles will be represented by one or more machines. Arrangements have been practically completed for the run from Chicago to Buffalo. This distance is 571 miles, and the run will be made in about eight days. It is expected that fully thirty of the members of the Chicago Automobile Club will make the journey, and most of them will be accompanied by members of their families. The start will be made on Sept. 7.

NEW INDUSTRIAL COMPANIES.

INDIANAPOLIS, IND.—The Richmond, Union City & Portland Interurban Railway Company has filed articles of incorporation. The capital stock is placed at $50.000.

THE COOPER ELECTRIC RAILROAD GATE COMPANY has been incorporated at Dover, Del., with a capital stock of $150,000. The incorporators are Dr. Thomas O. Cooper, of Wilmington; John L. Hall, of Philadelphia, and James F. Dunleavy, of Camden, N. J.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY has been incorporated at Norfolk, Va., with a minimum capital of $10,000. H. W. Summers, of Philadelphia, is president; H. B. Gay, of Baltimore, vice-president; W. J. McBriety, of Norfolk, secretary, and A. N. Palmer, treasurer and general manager.

ALBANY, N. Y.—The Hudson Valley Electric Railway Company has been incorporated, with a capital of $2,600,000. It is a consolidation of the electric railway systems from Troy to Lake George. The officers of the company are Addison B. Colvin, president; Senator George Green, vice-president; Thomas O'Connor, secretary, and F. L. Cowles, treasurer.

LEGAL.

COLUMBUS, OHIO.—The Western Electric Company, of Chicago, has brought suit in the United States Circuit Court, against the Columbus Citizen's Telephone Company, alleging infringement of a patent granted to John Seely on telephone signal appliances, which the plaintiff owns. The petitioner asks for a royalty and an injunction. The Columbus exchange is equipped with apparatus furnished by the Kellogg Switchboard & Supply Company, of Chicago.

ELECTRIC VEHICLE DIVIDENDS.—At Trenton, N. J., on Sept. 3, John Jacob Astor, Martin Maloney, of Philadelphia; George H. Day and other directors of the Electric Vehicle Company, were made defendants in two suits brought in the Court of Chancery by Richard Siegman, of New York, and other stockholders of the concern. It is alleged that the company has paid some $500,000 in unearned dividends, and that in reality the directors have wasted or lost the entire $5,000,000 received in cash for the capital stock, and that they have in addition been compelled to raise $1,500,000 by mortgage to prevent a complete suspension of business. The complainants seek to hold the directors responsible for the alleged illegally paid dividends and to compel an accounting of the funds of the company.

PERSONAL.

MR. JAMES PAXMAN, of Davey, Paxman & Company, engine builders, Colchester, accompanied by Mr. T. H. Harrison, his London manager, is on a visit to the United States.

MR. J. S. O'DONOVAN has resigned as chief electrician of the Republic Iron & Steel Company, and has become chief electrician of the Youngstown, Ohio, Iron Sheet & Tube Company.

MR. R. EMORY, superintendent and general manager of the Nashville Railway & Cumberland Electric Light Company, has resigned in order to become associated in a similar manner with the Milwaukee Railway & Light Company.

Trade Notes.

THE MARSHALL-SANDERS COMPANY, 301 Congress Street, Boston, is supplying a very large demand for the N. M. rosette.

MESSRS. SANDS & WOOD, for some years past connected with some of Colorado's largest power plants, have recently opened an independent office in Denver.

PLANT PURCHASED.—The Minneapolis General Electric Company, Minneapolis, Minn., has gained control of the International Electric Company by purchase.

MR. P. ALBERT POPPENHAUSEN has recently purchased a controlling interest in the Green Engineering Company, of Chicago, of which company he is now president.

THE ELECTRIC APPLIANCE COMPANY has just placed upon the market a new cabinet type wall telephone for both series and bridging work. Special descriptive matter is being sent upon application.

LARGE OIL FILTER.—The Burt Manufacturing Company, of Akron, Ohio, recently installed in the power plant of the Edison Electric Illuminating Company of Brooklyn Borough, New York, one of the largest Cross oil filters ever made.

ASBESTOS PACKING.—A neat little pamphlet about asbestos packing has just been issued by the H. W. Johns Manufacturing Company, New York. The contents are brief and to the point, and include illustrations of characteristic plants where asbestos packings are used.

WITTING BROS., LTD., has been organized in London to carry on business as electrical engineers and contractors at 49 Cannon Street. It is an offshoot of the firm with similar name, which has found it necessary to create a separate concern to attend to that branch of its work.

BULLETINS and prices on Manhattan arc lamps and Pittsburgh transformers can be obtained from the Central Electric Company, of Chicago, which has added these to its long list of standard goods, such as Columbia incandescent lamps, D. & W. safety devices and Okonite wire products.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, is snowed under—in September—with orders. To keep up with the demands for its apparatus, the company is working its factory to the fullest extent day and night, running the entire 24 hours with two gangs of men, one all day and the other all night.

MR. JOHN RAUSCHER, St. Paul, Minn., issues a neat catalogue of his push buttons for electric bells, in a great variety of styles which are all illustrated and described in detail, with prices. He has given great attention to neatness of design and accurate workmanship, and the quotations are remarkably moderate. He will be glad to correspond or send copies of the catalogue.

THE HAINES & NOYES COMPANY, 118 West Jackson Street, Chicago, is putting on the market several new styles of telephones for central energy work and for intercommunicating service. Its non-packing transmitter is guaranteed for five years. It will be glad to send its latest descriptive matter to those who are interested.

OUTPUT PURCHASED.—The Northern Electrical Manufacturing Company of Madison, Wis., has bought the output of the Mechanical Electric Appliance Company, of Milwaukee, which makes small power motors. This action is similar to that of the Milwaukee Electric Company, which recently bought the output of the Browning Manufacturing Company, of Milwaukee, which also makes small power motors.

PAN-AMERICAN BOOKLET.—A booklet intended for distribution at the Pan- American Exposition was recently issued by the Westinghouse companies. It gives a comprehensive idea of the industrial enterprises with which the name "Westinghouse" is associated, and refers to some of the notable work accomplished by the companies. The cover is illuminated very artistically and the illustrations are of high order.

STROBEL & WILKEN COMPANY, 591 Broadway, New York City, are pushing their Yankee searchlight, made up handsomely in torch form. They are also introducing successfully a neat little miniature electric car, which has its motor connected by sprocket and chain to the trucks. The track is sectional and can be added to or shortened up in accordance with battery used, etc. These novelties find a wide and large sale.

PERFECTION IN TELEPHONES.—With this title the Telephone Manufacturing Company, of Sumter, S. C., has issued a neat 32-page pamphlet descriptive of the telephone apparatus of its manufacture. The illustrations show several types of "Imperial" telephone sets, "Imperial" generators and "Imperial" switchboards. These latter range from a small switchboard combined with a telephone set, to a cabinet style for from 20 to 50 circuits, and a station type of 100 lines. This company, however, manufactures to order boards of any size.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the exclusive territorial selling agency for the new type Peerless incandescent lamps. It states that the factory has been experimenting on this lamp for the last two or three years, and to-day it has a lamp which is practically perfect, both mechanically and electrically. It states that its success with this lamp has been extremely flattering, and that it is willing to send out lamps for trial to any one who is on the market for a strictly high grade lamp. It guarantees them fully as to sustained candle power, energy consumption and life.

THE STUART-HOWLAND COMPANY, 279 Devonshire Street, Boston, Mass., is carrying a large stock of electric lighting, telephone and street railway supplies. Its regular weekly inventory, taken on Aug. 14, showed that it had then on hand 27,587 incandescent lamps of over 250 varieties; 4½ carloads (20 tons each) plain cross arm braces, one carload galvanized cross arm braces, four carloads standard cross arms; 337,450 feet of rubber-covered wire in various sizes, and other goods in like proportion. The company's street railway is a very large and expanding one, and its stock of overhead material is complete and ample to meet any demand. Although this company has been in existence only sixteen months it has established a business record of which it may justly feel proud.

AMERICAN ELECTRIC TELEPHONE COMPANY.—In a recent editorial in one of Chicago's dailies, attention was called to the independent telephone movement, mentioning that Philadelphia had contracted for an independent telephone plant. As already noted in these columns, the American Electric Telephone Company secured the contract for practically the entire equipment, with the exception of the switchboard, the remainder of the apparatus including 8000 "Central energy" telephones, 10,000 terminals and all other necessary protective devices. The reason for non-acceptance of the switchboard part, we are informed, is that owing to the large number of previous contracts under construction, the board could not have been completed within the time limit. Harrisburg is another important city in Pennsylvania, with 2000 capacity and provision for 3000. Two small adjoining towns will have 500 line exchanges each, and Reading, Pa., 1500 "central energy," with 5000 ultimate capacity. In New Jersey, Trenton falls in line with 3000 "central energy." Ohio is well represented with Mansfield, common battery, 1200 installed, with 3000 ultimate capacity; Zanesville, Ohio, 1500 common battery connected with provision for 3000. In Xenia, Ohio, the new exchange is running with 800 in operation, designed for 2000. Texas has realized the necessity for modern methods of communication and Austin has contracted for 1200 "central energy" immediate connection, 3000 ultimately; Temple, Tyler and Taylor, each 750 lines, "central energy," ready to connect with double the capacity as subscribers increase in number. Belton, Tex., has bought a 500-line equipment, for common battery, can increase to 1000. Oklahoma City, Ind. Ter., has already 750 subscribers on a 1200 line "central energy" switchboard. Topeka, Kan., will install 1200 lines at once and provide for increase up to 3000. Rhinelander, Wis., will start with nearly 750 subscribers on a 1200 line board. In Illinois, Pekin swells the list with a 750 to 1200 line exchange, while in Huntington, Ind., a 1000 line equipment is contracted for and construction under way.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUG. 27, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

681,185. TELEGRAPHER'S FINGER GUARD; I. H. Blessing, Albany, N. Y. App. filed Nov. 14, 1900. The guard is provided with a projection passing under the finger to overlap the key so that the pressure will be brought on the projection.

681,179. ELECTRIC ARC LAMP; Francis B. Badt, of Chicago, Ill. App. filed Feb. 25, 1901. Relates to an improved support for an arc lamp globe, which may be adapted to any form of arc lamp; and the provision of an improved yielding clamping device for the inner globe of an enclosed arc lamp whereby it may be readily placed in position and adapted to be unseated to permit of the escape of accumulated gas.

681,211. ELECTRIC DETECTOR FOR VALVES; C. G. Garrett, Minneapolis, Minn. App. filed March 20, 1900. A circuit controller is actuated by the valve when it moves to an abnormal position, to sound an alarm.

681,261. AUTOMATIC PIANO; T. B. Powers, New York, N. Y. App. filed April 13, 1899. A system of levers between the magnet armature and the key whereby the stroke of the armature is uniform throughout.

681,268. LAMP SOCKET; D. A. Schutt, Peru, Ind. App. filed July 11, 1900. Details.

681,269. MOTOR CONTROLLER; R. W. Scott, New York, N. Y. App. filed Dec. 19, 1900. Details.

681,290. BURGLAR ALARM; J. B. Yeakle, Baltimore, Md. App. filed June 9, 1900. The system is provided with a double test for conditions, one is applied periodically by the operation of a time-train at the point to be protected and the other by a manually operated key at the central office.

681,293. ELECTRIC SYSTEMS FOR RAILWAYS; D. S. Bergin, Chicago, Ill. App. filed May 23, 1901. A conduit within a conduit, the circuit

being completed by pressure of the plow upon plungers passing through the walls of both conduits.

681,295. DYNAMO ELECTRIC MACHINE; John Balch Blood, of Newburyport, Mass. App. filed March 18, 1901. The invention contemplates an increase in the cross sectional area of the winding with a given cross-section of field and at the same time increasing the circumferential distance around the active coil limbs. One-half of the slots are of one-half the width and twice the depth of the other half of the slots with which they alternate. One-half as many coils as slots are employed; one leg or limb of the coil is one-half the thickness and double the width of the other limb or leg, each coil entering a wide shallow slot at one end and a narrow and deep slot at the other end. With a given magnetic flux and a given induction the heating effect is claimed to be greatly decreased by this method of winding, thereby resulting in a machine of less weight for a given work.

681,296. TELEPHONE RECEIVER SUPPORT LOCK; A. L. Brinckle, Philadelphia, Pa. App. filed May 15, 1901. A lock for holding the receiver hook in a depressed position when the receiver is removed.

681,317. CORE AND POLE PIECE FOR FIELD MAGNETS OF DYNAMOS OR MOTORS; R. Hirsch, Milwaukee, Wis. App. filed Oct. 19, 1899. The polar faces have an area not less than two-thirds of the circumferential area of the armature and a cross-section greater than that of the faces.

681,329. METHOD OF MAKING SECONDARY BATTERY PLATES; B. E. Kuettner, London, England. App. filed Oct. 25, 1900. Mixing lead oxides with a solution of a soluble silicate to form a paste, making the paste into a plate and dipping the plate into a dilute solution of an ammonium salt.

681,341. MAGNETIC DEVICE FOR RESTORING AND AIDING HEARING; S. G. Payn, Jr., Bath-on-Hudson, N. Y. App. filed Jan. 17, 1901. Tubular magnets of opposing polarity adapted to be set into the ears.

681,352. HEATER FOR ELECTROLYTIC INCANDESCENT LAMPS; James Swinburne, of Westminster, Eng. App. filed Jan. 8, 1901. (See Current News and Notes.)

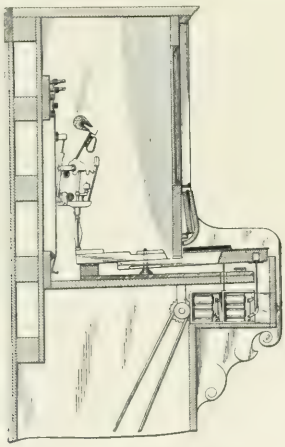
681,353. ELECTRIC SWITCH; G. B. Thomas, Hartford, Conn. App. filed March 5, 1901. Detail.

681,367. REDUCTION OF ORES OR COMPOUNDS; Hugh A. Irvine, of Niagara Falls, N. Y. App. filed Nov. 15, 1898. (See page 373.)

681,371. SIGNALLING APPARATUS; G. E. Painter, Baltimore, Md. To enable patrons to readily signal a car after dark by means of an electric light operated by the trolley current, a switch is arranged to be set by the passenger and restored by the trolley.

681,374. MICROPHONE AND TELEPHONE INSTALLATION; L. Polinsky, Berlin, Germany. App. filed April 3, 1901. A central energy telephone system in which only one main circuit is required for a number of stations.

681,408. ADJUSTABLE ARM FOR SUPPORTING TELEPHONE RE-



681,261. Automatic Piano.

CEIVERS; E. M. Cox and W. Reed, Portland, Ore. App. filed Nov. 20, 1900. Details.

681,410. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed Jan. 28, 1901. A closed conduit having a series of pockets projecting toward the roadway surface, a conductor in the conduit and armature members projecting from the conductor into the pockets and detachably connected with the conductor.

681,416. OUTLET FOR ELECTRIC CONDUCTORS; J. H. Goehst and C. M. Wilkes, Chicago, Ill. App. filed Dec. 17, 1900. The box sets flush with the wall and its watertight cover is provided with a nozzle from which the conductors lead.

681,441. SUPPORTING DEVICE FOR BRUSH HOLDERS; L. P. Mallett, Madison, Wis. App. filed May 10, 1901. A circular support fitting into a recess in the field magnet frame.

681,453. CONTROLLER FOR ELECTRIC RAILWAY MOTOR; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Sept. 28, 1900. The object is to make it possible to control the power and speed, and also the braking effort of four or more motors by a single drum.

681,461. ATTACHING PLUG FOR ELECTRIC WIRES; L. H. Stuart, Chicago, Ill. App. filed May 1, 1901. Two blocks of non-conducting material, one of which is rotatable relative to the other, and two circuit conductors extending through both blocks.

681,463. APPARATUS FOR TREATING DISEASES; H. E. Waite, New York, N. Y. App. filed March 8, 1901. Electrodes are mechanically vibrated simultaneously with the flow of current, to give a massage treatment as well as the electrical treatment.

681,374. Microphone and Telephone Installation.

681,470. REMOVABLE JACKET FOR ELECTRIC CABLES; J. Wolff, Chicago, Ill. App. filed Aug. 24, 1900. A waterproof covering connected at its edges and having a tongue bridging the joint between the edges.

681,474. ELECTRO-MAGNETIC SAFETY SYSTEM FOR RAILROAD; C. M. Cronkite, Lansing, Mich. App. filed Aug. 27, 1900. Details of a system in which the location of trains is indicated at a station.

681,532. DIAPHRAGM FOR ELECTRIC BATTERIES; John Laskey Dobell, of Harlesden, Eng. App. filed Dec. 6, 1897. (See Current News and Notes.)

681,555. STEERING MECHANISM FOR GUIDELESS LIFTS; O. Kammerer, Charlottenburg, Germany. App. filed May 11, 1900. A switch and a rheostat are arranged in the car and a series of sliding rails corresponding to the floors are located in the shaft, each rail having a projection adapted to cut out the motor.

681,603. MECHANICAL INTERCOMMUNICATION BETWEEN TELEPHONE SWITCHBOARDS; G. M. Yorke, New York, N. Y. App. filed March 20, 1901. An endless belt for conveying a ticket or paper containing certain information from one board to another.

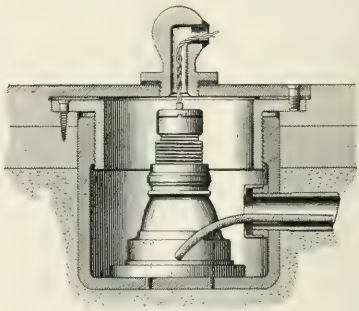
681,604. FEEDER CABLEHOLDER FOR ELECTRIC RAILWAY SYSTEMS; W. D. Young, Baltimore, Md. App. filed Feb. 1, 1901. The cable is confined in a space between the flange of the rail and a loop or bracket embracing the rail.

681,605. CROSS-OVER SWITCH FOR ELECTRIC RAILWAY SYSTEM; W. D. Young, Baltimore, Md. App. filed Feb. 12, 1901. A plurality of separated main conductor rails, one of which is shiftable into the plane of another, and an auxiliary rail separated from the main rails and arranged to span a gap between the main rails.

681,617. TELEGRAPHIC APPARATUS; S. G. Brown, Bournemouth, England. App. filed March 29, 1900. Details.

681,621. FUSE HOLDER; W. R. Cook, Pittsburg, Pa. App. filed Dec. 21, 1900. A magazine fuse-block.

681,625. AUTOMATIC PNEUMATIC REGULATOR FOR MOTORS; W. B.



681,416. Outlet for Electric Conductors.

Cowles, Cleveland, Ohio. App. filed May 28, 1901. Details of a system for cutting the pumping motor in and out automatically as the pressure reaches either limit.

681,637. EXPLOSIVE FIRE ALARM; S. C. Guthrie, Findlay, Ohio. App. filed Dec. 8, 1900. Details.

681,660. PRIMARY BATTERY; O. A. Spahr, Millersburg, Ohio. App. filed June 9, 1900. Details of devices for preventing polarization of the negative plate.

681,664. ELECTRIC PROSPECTING APPARATUS; A. F. McClatchey, Aurora, Ill. App. filed April 20, 1900. The electrodes to be inserted in the earth are provided with means for protecting them from the effects of electrolytic action.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, SEPTEMBER 14, 1901. No. 11.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, . . . President and General Manager

CHICAGO OFFICE, ... 1139 Monadnock Block.
PHILADELPHIA OFFICE. . . . . 929 Chestnut Street.

EUROPEAN OFFICE, ... A. C. SHAW, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER. . . . . Editors.
T. R. TALTAVALL. . . . . Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, ... per year, $3.00
Foreign Countries, within the Postal Union, ... 6.00
Single Copies, ...10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, SEPTEMBER 14, 1901.

CONTENTS.

	PAGE
Editorial	413
The Attempted Assassination of President McKinley	416
Electrical Engineers of the Day—XI. Gano S. Dunn	416
A Brief History of Luminous Fountain Development, by Luther Stieringer	417
High Speed Electric Railway Car of the Allgemeine Electricitats Gesellschaft, Berlin—I; by O. Lasche	424
The Induction Motor for Electric Railways—I	427
Extension of the Snoqualmie Falls Plant	429
The History of a Municipal Enterprise in Toledo, Ohio	430
Independent Telephony in Ohio	430
Convention of International Association of Municipal Electricians	431
Origin of "Mother of Pearl" Clouds	431
The Pittsburg Exposition	432
Current News and Notes	433
LETTER TO THE EDITORS:	
Elevating Presidents and Kings, by D. B. Clinton	434
Digest of Current Electrical Literature	435
A New Quick Break Switch	439
American Electro-Therapeutic Association	440
Electrical Test Instruments	440
A Novelty in Electric Signs	441
Exhibits at the Municipal Convention	441
DEPARTMENTS:	
Financial Intelligence	442
Commercial Intelligence	443
General News	445
Trade Notes	451
Record of Electrical Patents	451

PRESIDENT MCKINLEY.

It has been pathetically interesting to electrical people to note how closely President McKinley came in touch last week with electricity in some one or other of its many manifestations. In the broad-minded speech which he made the day before the attempt to assassinate him, he alluded at some length to the great work of telegraphy and telephony in the transmission of intelligence, and he closed by saying: "The construction of a Pacific cable cannot be longer postponed." Then he saw and admired the lighting of the Pan-American that night. Next day he went to Niagara, where he found the Municipal Electricians in session, and visited the great power plant. A few hours later, struck down by the bullets of an assassin, he needed the cooling breath of the fan motor in his agony; and by long-distance telephone the best Röntgen ray outfit that could be secured had been ordered 500 miles away, to be in readiness to locate one of the bullets.

As Mr. McKinley remarked in his speech, "The same important news is read, though in different languages, the same day in all Christendom," but he little thought that the attempt on his life would be the next great event to which this would literally and exactly apply. It is by such inventions and innovations that much of the world's real advance comes, and it certainly never comes by any effort of anarchist or murderer. The Frenchman, Mitre, has asserted that the worst of governments is preferable to the best of revolutions, a phase which merely marks the extent of the recoil from the extreme atrocities of the Mountain and the Commune. But when all is said and done, the influence of the printing press, the telegraph, the steam engine, the trolley car and the telephone, if they could be fully determined would be found far more effectual in promoting the world's welfare than most political movements or all the revolutionary slaughter, directed to the same object.

ELECTRIC FOUNTAINS.

Once again we are indebted to Mr. Luther Stieringer for a very interesting article, and this week we publish a contribution from him, profusely illustrated, on the subject of electric fountains, supplementing the two previous articles on exhibition ground lighting and electric towers. Such articles as these bring out strikingly the fact that exposition electrical work is an art by itself, but we doubt if all the conditions had been publicly discussed before, or at least by an expert and in this suggestive manner. It will be noted that Mr. Stieringer appears, from the evidence in his own articles, to have been studying these special subjects continuously for over 15 years. In this country no one else has a like experience, and probably no one in Europe has enjoyed equal opportunities. His brilliant success, culminating for the present in the Pan-American, has been seen and admired of all men.

It is in the closing sentences of the article that Mr. Stieringer reveals most as to the conditions that exposition experts, such as he, must always be studying. There seems to us no gainsaying his contention that the original exposition idea of public instruction is largely outworn and is overshadowed by the sensational or the amusement feature. It is increasingly difficult to show any really new thing at an exhibition, and in this respect, Professor Sever, superintendent of electrical exhibits, had a much more onerous task before

him at Buffalo than that encountered by either Mr. Stieringer, as consulting electrical engineer, or his accomplished associate at the construction end, Mr. Henry Rustin. As for electrics, it is true there is the Nernst lamp and the Edison storage battery; but the former was seen at Paris last year, and the latter was shown in this city early in the summer and elaborately described; so that neither is in any true sense a novelty. The same criticism would apply all through the Pan-American. It is not putting the case too strongly to say that any modern department store, like Siegel-Cooper's, or Stern's, is a Pan-American in itself; in fact, we believe that the new Macy's will have more floor show space than can be measured at Buffalo; while the goods represent all that is latest and best in a wonderfully wide range of human necessity and comfort.

Hence Mr. Stieringer's claim that the exhibition of the future must for its own sake continue to develop unduly its spectacular and amusement features, to succeed, appears well founded. It might be added that the later shows become more and more a night festival, in sharp contradistinction to the earlier ones, which closed at night; and it is here that electricity has its chance. As an agency, electricity is so protean and flexible, there is hardly any limit to what can be done with it, and we may boldly count on electrical novelties at future exhibitions surpassing anything now on record. Indeed, it is safe to predict that Mr. Stieringer and the St. Louis authorities have already forecast electrical spectacles of an unheard-of order of brilliancy and novelty. At the same time, they will never be able to efface from the memory the beauty and majesty of the spectacle presented by the Pan-American illuminated by energy from Niagara and seen in all its marvelous glory against the darkness of the night.

Discharge from High-Tension Transmission Lines.

This subject formed an interesting topic for discussion at the recent Buffalo convention of the A. I. E. E., and several matters of practical importance were reviewed. The discharges which may take place at the receiving end of a long aerial transmission line are various, and may be variously produced. Their common feature is an undue rise of pressure at the end of the line. The simplest of these is the disturbance of free oscillation in the transmission circuit, capable of being produced by a sudden change of any kind, such as a change of load, or a change of generator speed. All such departures from the steady condition of transmission necessarily give rise to temporary surgings that may have sufficient magnitude to produce a discharge from the line. Then there is the effect of high-frequency harmonic components in the generator e. m. f., which may develop a steady resonant rise of potential at the distant end of the line. Then there is the charging of the line-wires by electricity carried past them in moving air. The air is electrically charged or ionized, and a wind-movement of this air past the wires has the effect of handing over to the wires a portion of the charge. This is more frequently a cause of disturbance when a portion of the transmission line runs over a mountain range, since the difference of level between different parts of the line is usually accompanied by a difference in the potential of the air enveloping the wires.

Finally, there are disturbances due to lightning. The lesser of these are purely inductive disturbances. The greater are occasioned by the lightning flash passing directly over the wire or some portion thereof. The most serious and troublesome disturbances are those occasioned by lightning. In the Eastern States such disturbances are nearly all confined to the summer months; but in some localities they occur perennially. One preventive that has long been in use is a galvanized iron wire supported from the tops of the poles and grounded at frequent intervals. This wire, which is frequently barbed, not only offers special inducements to the selective passage of a direct lightning discharge, but it also affords a screening and sheltering influence against inductive disturbances to the working wires below it. To troubles which come from overhead, the overhead ground-wire gives relief. It affords, when barbed, a partial protection against charges by wind movement of electrified air. The only disturbances from which it grants no relief are those of resonance or surgings, developed from within the circuit. The galvanized iron wire also acts in some instances as a guard wire against wires falling from above. Its disadvantage is its extra cost, its liability to come into accidental contact with a working wire, and inconvenience in being handled or erected when barbed.

The International Engineering Congress.

An International Engineering Congress has recently been held in Glasgow, Scotland, under the auspices of the Glasgow International Exhibition. One of the features of interest visited is a 27-hp "Newcomen" engine, stated to have been steadily operated at Rutherglen Colliery since 1809. Its boiler pressure is 3 lbs. per square inch, above that of the atmosphere, and the mean effective pressure 7.35 lbs. per square inch. Such an engine is a curiosity in these days of high and increasing boiler pressures. It is said that no part of this engine has been renewed, with the exception of one or two accidentally broken spur-wheels. The consumption of coal per ihp-hour is not stated, but for a small engine at the mouth of a colliery pit there is probably "coal to burn." There ought not to be any great danger from explosion at a boiler pressure of 3 lbs. per square inch. It is described as being operated by hand. A man admits steam into the vertical cylinder below the piston by turning a handle, and then cutting off the steam, admits water to condense the steam, the atmospheric pressure forcing the piston down. This, if primitive, is at least simple. The engine, still in service, hoisting coal to the surface, is said to be the oldest engine at work in Scotland, and the only "atmospheric" engine in use in Gerat Britain. This engine's active career down to the present time is another evidence of our British cousins' aversion to the scrapheap.

Burning by Becquerel Rays.

It has been recently announced in the *Comptes Rendus* that the invisible rays emitted by radium have an active effect upon the human skin. It is well known that X-rays, if sufficiently intense and in sufficiently long duration of action, exercise a destructive action upon the skin, which peels off and leaves an open sore that is slow to heal. Recently Walkoff and Giesel observed a similar action exerted by radium. Mr. H. Becquerel now describes the effects noted by him on his own person. He carried a few decigrammes of radiferous radium-chloride, inside a small sealed tube, in his waistcoat pocket for a total length of time amounting to about six hours. In ten days a red mark, corresponding in position to the location of the tube, developed on his skin. It was followed by peeling and suppuration, and the sore did not heal for a month. This will add one more to the cheerful list of possible skin diseases that civilization enables us to classify, develop and diagnose. In addition to the ordinary sun-burning which is prevalent in the northern hemisphere about this time of year, and is sought by giddy girls or callow boys, we have arc-light burns, X-ray burns and Becquerel-ray burns. It seems likely that the action in each of these cases is similar, but a careful comparative investigation into the differences of action would probably be both useful and interesting. While the sun burns at a distance of ninety-odd millions of miles, the arc light and Crookes tube act at a few centimeters, and radium at a few millimeters.

High-Tension Switching.

The question of switches for high-tension circuits has been an ever present one for the past five years. As voltages have been steadily increased from five to fifteen, twenty, thirty and forty thousand volts, high-tension switches have hardly been developed rapidly enough to keep up with the voltages in use. Up to 12,000 volts the ordinary oil switch is now in daily use giving satisfactory results, and its perfection for higher voltages is promised. Indeed, from the experiments described in the Institute convention paper by E. W. Rice, Jr., which paper appeared in our last issue, there is every hope that an oil switch will soon be commercially available for circuits of 40,000 volts. In the majority of transmission plants using voltages from 20,000 to 40,000, it is hard to find an engineer who is satisfied with the present high-tension switching facilities in his plant. The last convention of the Pacific Coast Electric Transmission Association devoted a large portion of its time to a discussion of high-voltage switching. When a body of such veteran high-voltage men as those on the Pacific Coast discuss the subject at great length, it shows the importance of a solution to the problem with which they have been confronted. The paper by Mr. Rice just spoken of describes some experiments on opening high-voltage circuits in open free air, which make it seem not strange that present open-air switches are somewhat uncertain in operation. When a 40,000-volt circuit can produce a 30-ft. arc upon the breaking of a short circuit, there is reason for wondering why some of the present devices work as well as they do. The reason for such long arcs upon the breaking of high-voltage short circuits is fully taken up in Mr. Steinmetz's Institute convention paper, which we published in abstract and commented upon recently. Both theory and practice show that the surgings which take place upon the opening of short circuits on high voltage lines may give rise to a voltage much above the normal operating voltage.

The consensus of opinion among those who have to deal with high-tension lines is something like the answer to the conundrum, "Where would you rather have a boil?" Answer, "On the other fellow." The best way to do high-voltage switching is to do it on the low-voltage side of the transformers, and as little of that as possible. The great bulk of the switching under load on a high-voltage plant can be done exactly as well and even better on the low-voltage sides of the transformers. Indeed, in case of short circuits it is in some plants customary to go even further back when it is necessary to kill the line, and open the field circuits of the generators. An analysis of all the conditions under which it is necessary to open transmission circuits shows that the number of times that it is absolutely essential to open such circuits under load is very small. For example, the most common switching operation is that of cutting out a bank of transformers. This can be done on the low-tension side first, leaving only the exciting current of the transformers to be broken on the high-tension side. Some even advocate leaving the transformers in rather than open the high-tension side under no load. In case of a prolonged short-circuit on the high-tension line, it is again not only possible but best to open the low-tension circuits first. There is really only one case which arises where an interruption to the service would be prevented by the opening of high-tension switches, and where the same end could not be accomplished by opening low-tension switches. This is where a transformer is burning out and it is desired to cut it out without interrupting the service. Here it is necessary to open the high-voltage circuit under a very heavy current, and it is for such rare emergencies that high-tension switches are most needed. The almost incredibly long arcs which are drawn out by a long air-brake switch, as previously mentioned, make its performance a matter of considerable uncertainty under the various conditions that occur in practice, and it is seldom that enough room is allowed for this. The simplest device yet proposed is the horn switch used at Los Angeles and in Continental Europe, in which the arc is drawn between two horns, travels up in an ever-increasing length, and is finally broken by being drawn out by the air currents. Unfortunately the use of this simple device is not sufficiently widespread so that the results it gives under all conditions are known, and it is a question how far it can be depended on.

Polyphase Railway Motors.

The papers of Messrs. Berg and Armstrong at the Buffalo meeting of the A. I. E. E. with the ensuing discussion, formed a well directed and concerted attack on schism and heresy in electric traction. We are disposed to take a conservative position in such matters, fully realizing that the art of electric traction has suffered in the past through the frequent changes in apparatus. But we are hardly prepared to hold that polyphase motors are altogether good and desirable for ordinary purposes, and entirely worthless and reprehensible for traction. We run mentally back over a decade or so and recall the whole-souled unanimity with which the direct-current contingent, armed with unassailable data and panoplied in commercial cock-sureness, fell upon and smote the venturesome wight who whispered "drehstrom." They showed that he was intrinsically anathema, and insinuated that drehstrom implied cerebral wheels. It is a long reach from those days to the Buffalo convention, and the world has moved meanwhile. Now, the polyphase motor seems so glorious a vision that to learn its fatal weakness for electric traction almost gives a cold shiver. It makes us think of the scorn and contumely that ten years ago greeted the impudent proposal to use a series-parallel connection on electric cars. It was proved beyond controversion to be an impractical scheme conjured up by some of those theoretical fellows who thought they could work laboratory appliances off on practical engineers who alone understood commercial conditions.

With all levity aside, we do not think that there have yet been made, in this country at least, attempts at fitting induction motors for traction service of a sufficiently persistent and serious character to justify the abandonment of further efforts, or the prediction of definite limits to their usefulness. Messrs. Berg and Armstrong showed very clearly and fully that in some of the common cases of heavy electric traction, induction motors with the means for speed regulation just now available, were at a very serious disadvantage. So far, so good; but we do not think the conclusion justified that even very modest improvements might not swing the balance the other way. Rheostatic control is unmistakably inefficient when it has to be used to the extent assumed by Mr. Berg; and the concatenated control, adding as it does the reactances in two motors, is notoriously bad in the matter of power factor. But if Mr. John Smith, of Nova Zembla, had basic patents on the series-parallel control fully sustained against all comers in the Circuit Court of Appeals, we would be willing to wager a neat sum that Mr. Berg and his talented colleagues could, and would, devise a practical and efficient scheme for using induction motors within 90 days after the date of Mr. Smith's permanent injunction against them. We should much dislike to see the present economical and well standardized apparatus for electric traction disorganized by the introduction of half-baked experimental apparatus of half-a-dozen degrees of impracticability, but we have learned to go slow in predicating finality of any current electrical apparatus. The time will come when for some well defined purpose it will prove advisable to use induction motors for traction; and when the problem is attacked with a direct necessity spurring American engineers to action, we are not inclined to predict their failure. Until the whole matter is submitted to the touchstone of persistent experiment, we cannot be sure whether the subject of dispute is gold or dross. The facts brought out at the Buffalo meeting apply to conditions as they are here and now, not elsewhere or to-morrow.

The Attempted Assassination of President McKinley.

Late on Friday afternoon, Sept. 6, the country was thrown into a state of consternation and indignation by the news that while holding a public reception in the Music Hall at the Pan-American Exposition, President McKinley had been twice shot with a revolver by an anarchist. As soon as possible, the president was removed from the Exposition hospital to the residence of Mr. Milburn, where he had been staying with Mrs. McKinley, and the wires of the Western Union, Postal Telegraph and Bell Telephone Companies, with police and messenger alarm systems were immediately run to the Milburn property and a force of operators was installed. An enormous amount of private and press matter was immediately thrown on the telegraph wires, and the telephone long-distance service into Buffalo was also soon overloaded. The news was quickly known around the world, and cable messages have kept the submarine cable companies also very busy ever since.

On Saturday the physicians decided that Mr. McKinley's room ought to be kept cooler, and Mr. Charles R. Huntley, general manager of the Buffalo General Electric Company, took the matter in hand personally and spent the morning running the necessary wires, putting in fan motor equipment for the comfort of both Mr. and Mrs. McKinley, the latter being also, as is well known, in a most critical condition of health. Such work was never done with greater celerity.

At the same time, Mr. Cortelyou, private secretary to the President, telephoned over the long-distance wires to Mr. Edison at Orange for the best Röntgen ray outfit he could send, in order to help the doctors in finding and removing the second bullet, still in the President's stomach. Mr. W. E. Gilmore, general manager of the Edison shops, complied promptly with the unexpected requisition, and dispatched the outfit the same night, so that it reached Buffalo on Sunday morning and was at once installed ready for use. Dr. Knoll, of New York, and Messrs. Luhr and Dollie, from the Edison laboratory, went with it. At this writing the time of its use is not settled.

It is interesting to electrical people to know that in his address at the Pan-American, delivered just before the attempt at assassination, Mr. McKinley dwelt on the remarkable achievements of telegraphy, and insisted that one of the things that this country must do soon was to lay a Pacific cable. On Friday, just prior to the foul deed, he made a trip to Niagara Falls, and in company with Secretary W. B. Rankine, of the Niagara Power Company, spent some time inspecting the great power plant, with which he expressed himself delighted. On his return from this trip he went to the Music Hall at the Pan-American.

It will be remembered that when President Garfield was shot the "induction balance" was suggested and used with the object of locating the bullet. Although Mr. McKinley is a man of very sturdy build and solid frame, it is believed by experts that a successful location of the stray bullet can easily be made. It would seem that the bullet has probably lodged in the muscles of the back, where the rays can readily detect its exact location. Fortunately, up to this time of writing (Tuesday), there are no symptoms of blood poisoning or peritonitis to complicate matters.

Electrical Engineers of the Day—XI

GANO S. DUNN.

Gano Sillick Dunn, though not yet thirty-one years of age, has been connected with the electrical profession for more than 15 years. Like so many other prominent electrical engineers of to-day, he began his active career as a telegraph operator, having been compelled, owing to financial reverses in his family, to abandon preparation for Yale and begin to earn his living before he was fifteen years of age. For six years he was employed as an operator by the Western Union Telegraph Company, filling afternoon and night positions, and during the whole of this period he was attending college, supporting himself and helping support his family out of his earnings.

He graduated in 1889 from the New York City College, standing close to the head of his class, in spite of the fact that his long hours of work outside of the college made it almost impossible for him to find proper time for study. In 1891 he graduated from the newly established post-graduate Electrical Course of Columbia University, receiving the first degree in electrical engineering ever given by that University. In 1897 he received the degree of Master of Science from the New York City College. Immediately upon his graduation, Mr. Dunn was given temporary employment by the Crocker-Wheeler Electric Company to do some special experimental work. His ability, however, was so quickly evident that he was retained in the employ of the company, and has been with them ever since, most of the time as chief engineer.

It is but seldom that one who is peculiarly successful in executive and commercial lines, is at the same time possessed of ability to design apparatus when that designing means the most exhaustive study of abstract theoretical considerations. For many years Mr. Dunn has been the responsible and active designer of the Crocker-Wheeler machinery, and so thorough has been the preliminary study of the electrical and mechanical design that changes after the drawings are made are almost unknown, except when after a period of several years the general advance of the art and change of conditions may call for the development of a new line of machine. Space conception, æsthetic feeling for harmony of outline, the tendency to adhere to lines of simplicity and strength—in short, the ideal qualifications of the mechanical designer—are, as a rule, not found associated in a mind that can readily comprehend the intricacies of wave forms, and the highly complex reactions associated therewith; but Mr. Dunn has shown remarkable strength in both lines.

Perhaps the most striking thing about Mr. Dunn's career is the confidence which he inspires in those with whom he has business or

social relations. No greater evidence of genuine ability could be presented than the way in which he has stepped promptly into the front rank, and been given important executive responsibility in every organization with which he has been connected. He was made a director of the Crocker-Wheeler Company at twenty-five, several years later a member of the executive committee, and is now acting vice-president. He became vice-president of the New York Electrical Society at twenty-five, and its president at tweny-seven, and after serving as manager was elected vice-president of the American Institute of Electrical Engineers at twenty-eight.

Under Mr. Dunn's administration as president of the New York Electrical Society the membership was greatly increased, its finances improved and new life put into the organization, the high standing of which at the present day is, to a large degree, the result of his efforts. Mr. Dunn has been too hard a worker from early boyhood to find much time for writing, but the few articles which he has published have taken high rank and are considered authoritative by those best informed on the subjects on which he has written. One of his lectures delivered in 1896 on dynamo and motor design was referred to editorially in one of the prominent electrical papers as the "clearest exposition of the subject in hand that has ever been given in the language." This lecture was printed and several thousands of copies were sold. Mr. Dunn has also delivered lectures before the Franklin Institute and various engineering societies.

A Brief History of Luminous Fountain Development.

By Luther Stieringer, A. I. E. E.

THE origin of the illuminated fountain is veiled in obscurity. Admitting this fact at the start, it is evident then that any paper or survey designed to be an historical record can be such only so far as our light or knowledge penetrates. We may, however, concede that the principle was without doubt crudely applied long before the Christian era. The sources of light were, in all probability, originally fagots, candles, or oil, supplemented possibly by reflectors. Later on gas and the calcium light were used, and color was added to further embellish the display made and create the effect sought for.

We know, however, that the principle governing the luminous fountain was first stated by Professor Colladon, in a communication to the French Academy of Arts and Sciences in 1842. M. de Bovet also mentions having seen a small luminous fountain in 1879 or 1880 at Ouro Preto, the capital of one of the provinces of Brazil. This fountain was exhibited at the City Theater by a traveling showman. It embraced a reservoir placed on the roof of the building, a few tin pipes and a Drummond light.

It was Sir Francis Bolton, of England, who first employed electricity in the luminous fountain, the year being 1884. The perfected result of his labors was exhibited at the Healtheries Exposition. This fountain (Fig. 1) was installed in the center of a lake at the Exposition grounds, London. It consisted of a hollow mound of timber, in which the piping and the necessary apparatus for operating the light and color, as well as the water effects, were concealed. The level of the water in the basin was maintained within the fountain chamber, and as the deck or roof was less than 6 ft. from the bottom of the basin level, there was not enough head room to allow of the construction of platforms or raised flooring, and so the operators were forced to wear high rubber boots. In the roof of the chamber there were glass-enclosed light shafts, each having various forms of water jets issuing from their surfaces. The color effect was secured by the use of sliding frames of colored glass, to the number desired, interposed between the light and the streams of water. There was one set to each lamp and light shaft, and 30 ampere hand-feed lamps were used. Fresnel lenses of the lighthouse order were employed to parallel the rays. The water supply

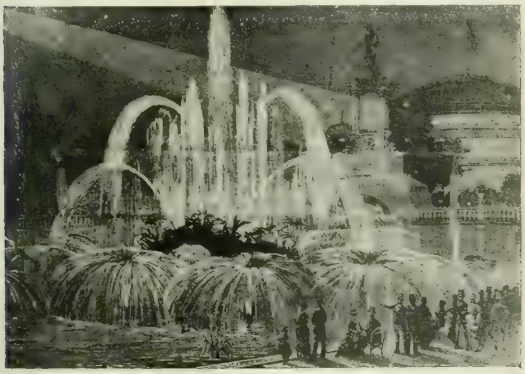


FIG. 1.—FOUNTAIN, HEALTH EXPOSITION, LONDON.

was regulated and manipulated by quick-acting valves. When in operation, signals were transmitted from an observation tower to the attendants in the operating chamber of the fountain, who had charge of the light, water and color effects. This fountain was the first spectacular fountain strictly operated as such, by being continuously in play, and never exceeding 15 minutes' display at any given performance, this being the limit of the effective changes possible with the number of combinations afforded in the design. It may be remarked that this fountain in its construction was a combination of the geyser and figure types.

Inspired by the success of this fountain, Mr. Erastus Wiman arranged with Sir Francis Bolton to design an electric fountain for the St. George's Amusement Company, of Staten Island, N. Y. The fountain so erected was installed and publicly operated in 1885, and it bears the distinction of having been the first luminous fountain seen in the United States. (For particulars, see *Electrical World*, Nov. 8, 1885). The original design of this fountain showed a square masonry basin holding water to a depth of 4 ft. (Fig. 2). In this basin there were arranged 16 light shafts, while in the chamber beneath the color screens and other necessary apparatus were installed. Fresnel lenses similar to those in the London fountain men-

FIG. 2.—ST. GEORGE, STATEN ISLAND, FOUNTAIN.

tioned were designed to be used. Mr. Wiman became quite interested in fountain work, and bought a patent from Sir Francis Bolton of a floating fountain capable of being sent to different harbors, or to river towns, there to be displayed as an attraction. However, no fountain embodying the ideas of the patent has ever been built.

In 1884 the Franklin Institute installed an electric fountain in their exposition building. Owing to the large amount of illumination in the building, it proved a failure. (See *Electrical World*, Sept. 13, 1884.)

Acting under the advice of the writer, retained as consulting engineer, the Staten Island fountain basin was reduced in height to admit of a better view. The wheatsheaf water effect was also introduced, this marking the first instance in which it was employed. The majority of the other streams of the fountain were horizontal, and were directed to the center of the basin. There was delay in securing the Fresnel lenses, which, together with their great cost, led the writer to recommend the use of the ordinary locomotive headlight, or parabola reflector. The recommendation was adopted, and the preliminary trial proved very satisfactory. This method of reflection has since been employed in all fountain work, the only exceptions being where intense beams of light are required externally, and at the Paris Exposition of 1889, where some plain mirrors were used. The final report, however, admitted that these mirrors were inferior to the parabola.

After 1886 the Staten Island fountain was put out of commission, and was finally sold to Mr. Yerkes, of Chicago, and by him erected in 1892 in Lincoln Park, of that city, it having been presented to Chicago as a permanent attraction. The site selected for this fountain is on rising ground, the surroundings enabling a dark environment during its operation. This fountain has been in operation every season since 1892. The water pressure is only 40 lbs., and the lamps are comparatively small, 30 amperes. Even with these drawbacks its location secures other advantages. (Fig. 3.) The design in rectangular form within a circular basin does not harmonize as well as in the square basin setting of the original design at Staten Island.

The electrically luminous fountain at the Paris Exposition in 1889 was the largest and most elaborate ever constructed up to that date, and was a decided feature of the Exposition. It consisted of two parts, one of French the other of English design, and embraced plans similar to those embodied in the fountains previously shown at Manchester, Glasgow and other places. This Paris fountain was without doubt one of the main features and attractions of the Exposition. It was of the combination order, consisting of an em-

blematical section and a geyser fountain built and operated by the English firm of Galloway. Some of the streams in the French section of the fountain are worthy of note because they were arranged to descend from orifices intensely illuminated, producing an effect of solid, luminous liquid streams. Their height, however, was restricted to a 7-ft. fall. This is an effect that has not since been repeated. The Staten Island fountain transferred to Lincoln Park, and there installed in 1892, was the immediate successor of the Paris fountain of 1889 (Fig. 4). (For particulars see *Electrical World*, June 26, 1886.)

With the conception and creation of the World's Columbian Exposition, of Chicago, there came a natural desire to excel not only the Paris Exposition fountain display, but everything of the kind

FIG. 3.—LINCOLN PARK, CHICAGO.

ever attempted. It was recognized that the spectacular effects of the beautiful luminous fountains delighted people, and so an early consideration of the subject was enforced. Owing to the difficulty in securing tenders for complete installations for two electrically luminous fountains, little progress was made. Strange to say, the only tender offered was from abroad, and exceeded by 50 per cent the contract price finally agreed upon. This tender included only the necessary apparatus for the operation of the fountains independent of such construction as was contemplated by the Exposition management. The difficulty of securing a suitable and at the same time practical site for the fountains and the consequent delay in maturing any specific plans, deferred the initial construction until a very late date. Finally, it was decided, as a matter of necessity, to place the fountains in the Grand Basin, on either side of the McMonnies Columbian fountain. Thus they had the Administration Building as a background, and were flanked by the Electricity, Machinery and Liberal Arts buildings. The great size of these edifices, whose cornice lines were from 60 to 70 ft. above the fountain terraces, and the proximity of the immense structural McMonnies fountain, made it imperative that the electric fountain should be of such proportions as not to be dwarfed by the magnitude of

FIG. 4.—PARIS EXPOSITION, 1889.

the setting which formed one of the principal conditions under which they must operate. The whiteness of the buildings, together with their strong interior illumination, made necessary the employment of very powerful lamps in the fountains in order that their spectacular effect should not be impaired. Due recognition was given all these difficulties by the writer, as consulting electrical engineer of the Exposition, to whom the task of preparing the plans that were finally adopted fell. These plans developed many new features (Fig. 5), the entire installation being on a larger and more comprehensive scale, in every respect, than ever before or since attempted, with the additional feature of a marked economy in construction and operation over all previous fountains of similar character. (For particulars, see the *Electrical Engineer*, May 3, 1893.)

In the construction many natural obstacles were encountered. Excavations had to be made in sandy ground and a water-tight chamber built 8 or 9 ft. below the lake water level. The projected use of an iron caisson was abandoned in the face of many difficulties which presented themselves, and a special construction was adopted. Piles were sunk into the ground, and upon the shorter ones a floor of interlacing beams was laid, upon which concrete was run to form the floor proper of the chamber. Longer piles served as columns for the support of the wooden water deck, and also for the framing against which the Wakefield sheet piling, in three layers, three inches thick, 12 in width and 20 ft. long, lap-jointed, was allowed to rest, the same being sand-jetted in, thereby securing a water-tight chamber, entrance to which was gained through a water-tight passage. Within each of these subaqueous chambers the projector lamps, the color screens, the switchboards, the signal indicators and ventilating apparatus were located. In each chamber there were 19 special, 90 ampere arc lamps, estimated to give a beam of light of 250,000 candle-power each.

In prior fountains, color screens were laboriously slid in and out like lantern slides. In this instance the umbrella screens were so geared together that they could all be revolved together easily by a single attendant and at a higher rate of speed. The signaling apparatus was both efficient and complete, and embraced the color, valve and other signals in each fountain. When operated to full capacity, each fountain required 22,000 gallons of water per minute. There were 19 composite groups of jets in each fountain with a total of 1710 jets. Each of these fountains had a greater number of water orifices, electric lights and water supply than had been before or has been since installed, of similar type. The Paris fountain had only 17 light shafts, while the Chicago fountains each had 19, or a total of 38. When the lights on the Exposition grounds and the exterior of the adjacent buildings were extinguished, and when high winds, which served to disturb the sprays, were not prevalent, the results were highly satisfactory. The *Chicago Herald* of June 16, 1893, had this to say of this fountain construction:

"Suddenly the lights vanished. In their places rose, though not to a great height, two streams of water, sparkling as in the brightest sunlight. When those two artificial geysers spouted high up above the domes of surrounding buildings, a mighty and involuntary exclamation of gladdened surprise rose from the multitude that saw them. The spouting columns danced and sparkled above the great parabolic reflectors, whose surfaces concentrated upon them the light

FIG. 5.—CHICAGO, 1893.

of many thousand candles. From pure white they were changed with the rapidity of kaleidoscopic transformations into all the colors of the prism. They were shaded one into another, bringing delight with every change, little ones about it fairly bubbled over the surface of its apparent source. Then more power was turned on, and every little jet rose until it reached the height of the central one, and all fell in one dense mass in spray. The people cheered the changes. They clapped their hands and shouted until palms ached and voices grew hoarse. With the successful operation of the foun-

FIG. 6.—SAN FRANCISCO.

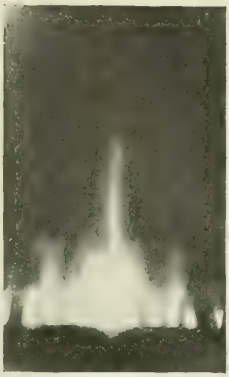


FIG. 9.—TWIN LUMINOUS FOUNTAINS, ATLANTA.

FIG. 8.—ATLANTA, WITH UNFINISHED TOP, SHOWING LIGHT SHAFT AND PIPE.

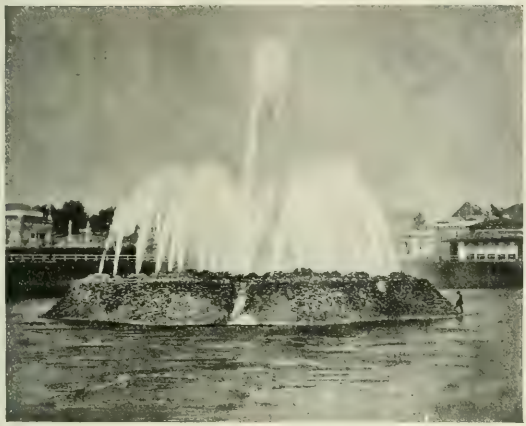
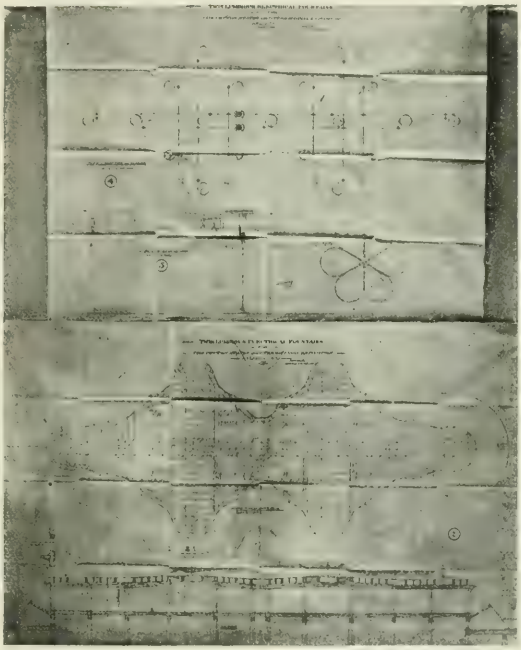


FIG. 8A.—ATLANTA FOUNTAIN.



FIGS. 10 AND 11.—COLOR SCREEN PLAN AND TIMBER PLAN, ATLANTA.

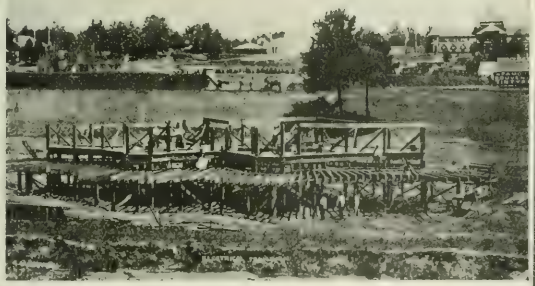


FIG. 7.—ATLANTA FOUNTAIN IN COURSE OF CONSTRUCTION.

THE DEVELOPMENT OF ELECTRIC FOUNTAINS.

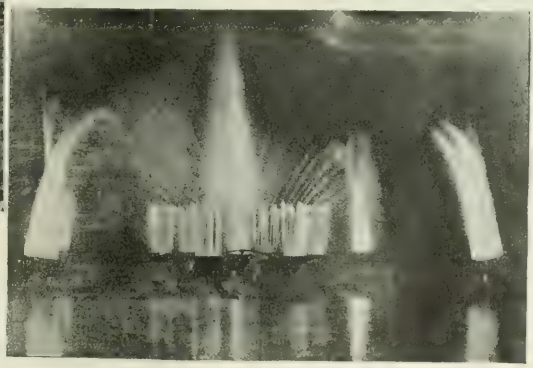


FIG. 12.—SCHENLY PARK, PITTSBURG.

tains their cup of happiness was full, but ere their surprised senses had taken in the first effects of the beauties unfolded to their view by combinations of light and water another display was before them."

One of the Columbian World's Fair fountains was removed to the Midwinter Fair in San Francisco, and operated during 1894. (See *Electrical Engineer,* May 9, 1894.) The only change made was in the fountain basin, as shown in the illustration. (Fig. 6.) At the Atlanta Exposition of 1895 a new departure in electric fountain work was demanded. The writer, as consulting engineer of the Exposition, reported on all plans submitted. The objection to the cost of previous forms necessitated a special design involving simplicity and economy. To meet these conditions the consulting engineer was authorized himself to prepare plans, which were finally accepted, and a fountain was installed under his supervision. This fountain consisted of a rocky mound constructed of timber covered with rockwork, as shown in the illustration (Fig. 8). This formed a hollow chamber and was built on a framework in the center of an artificial lake. All supporting timber of the structure was concealed when the lake was filled to the proper level (Figs. 7, 8, 8*a* and 9). Within the fountain chamber sufficient room was provided to place and operate all the electrical, water and color screens and apparatus In this fountain, special 60-ampere lamps were used, also four searchlights placed on Machinery Hall, about 400 ft. distant from the fountain. These served to illumine the high streams. A 24-inch water main attached to powerful exhibit pumps, located in Machinery Hall, furnished 16,000 gallons of water per minute at a pressure of 110 lbs. Some of the plans of the fountains as installed are shown in Figs. 10 and 11. This fountain was known as the "Twin Luminous Fountain Atlantis," and proved very successful. So impressive was it that music was written for it, while the newspaper articles were very elaborate.

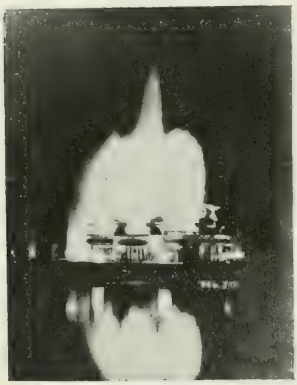


FIG. 13.—WILLOW GROVE FOUNTAIN, PHILADELPHIA.

One of the Atlanta papers had this to say: "The electric fountain is another triumph of the Exposition. Here again a new fairyland is opened. The wheat sheaves might be the ones that Joseph dreamed of, for somehow they have got mixed with the coat of many colors. First, there is the golden grain, tall and waving, and bending under its bearded load as at harvest, then the field is turned to green as if Joseph's bad brothers had taken part in the dream, then comes a dull red as of bloody thoughts, and then a violet is succeeded by another of pearl, as if dreams were fading into morning. Water is a wizard in making colors, and when the fire artist adds this element to his palette he makes pictures which surpass description. They give the observer a kind of intellectual feast which may be enjoyed and remembered, but may never be hung in cold type." This popular eulogy was supplemented, it may perhaps be fitting to note, by a medal of St. Gaudens' design.

At Schenly Park, Pittsburg, Pa., in 1894, a fountain of the geyser type (Fig. 12) was installed under favorable conditions as to site, and has been operated every season since with successful results. At Willow Grove, a pleasure resort near Philadelphia, a structural fountain was installed in 1896. It has been operated right along. (For particulars, see *Electrical Engineer,* Oct. 31, 1896.) This fountain (Fig. 13) possesses the characteristics of the Atlanta fountain in not having a submerged chamber, the structure being of considerable height above the water basin, as portrayed in the accompanying illustration of it. The environment of this fountain has an excess of light, thus neutralizing the advantages of a dark setting, which would enhance the effect many fold.

In 1896 a fountain of the structural order and modified geyser type, electrically luminous, was erected in Budapest. A picture plan and daylight view are shown herewith in Figs. 14 and 15. (For particulars, see *Electrical Engineer,* Oct. 31, 1896.)

At Prospect Park, Brooklyn, in 1897, a fountain of the World's Fair type was installed (Fig. 16). It had 19 light shafts. The site selected was a poor one, an excess of extraneous light, disturbing

FIG. 14.—BUDAPEST FOUNTAIN, DAY VIEW.

street car traffic and other objectionable features neutralizing the best effects obtainable.

At Washington Park, a pleasure resort on the Delaware River a few miles below Philadelphia, a spectacular fountain has been in operation since 1898. This (Fig. 17) is the first outdoor fountain display of the stage order. It introduces living figures in prearranged poses, and while seemingly enveloped in jets of water, the figures are only veiled with water curtains of various designs. This fountain is the largest of this type and is badly located, being in the midst of too much light. Possessing novelty, however, it has proved satisfactory to the people visiting this resort. A number of fountains of this type, on a small scale, are now installed at different resorts in the United States.

In 1900 a fountain was erected in Crystal Palace, London. It was of the Chicago World's Fair type (Fig. 18), and has a beautiful setting, the surroundings enabling the best results to be obtained during its performance.

The Omaha fountain (Figs. 19 and 20) was named "Nautilus," and was the result of experiments made in one of the lakes at Atlanta in 1895 by the writer. It was of the exteriorly illuminated type, a combination of incandescent embellishment and arc projectors. (See *Electrical Engineer* of May 19, 1898.) When the water was at fixed flow and designed to harmonize with the surroundings, pleasing effects were obtained at small cost. It may be remarked, how-

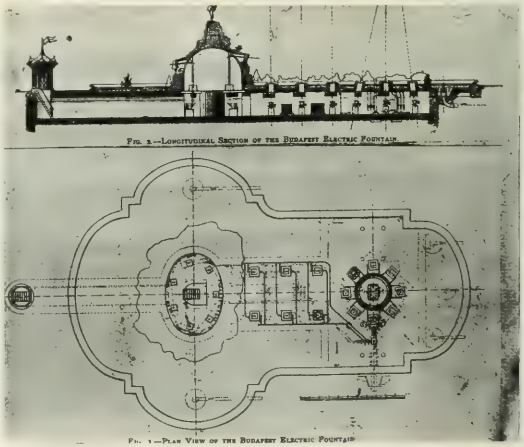


FIG. 15.—SECTION AND PLAN OF BUDAPEST FOUNTAIN.

FIG. 16.—FOUNTAIN, PROSPECT PARK, BROOKLYN.

FIG. 17.—WASHINGTON PARK FOUNTAIN.

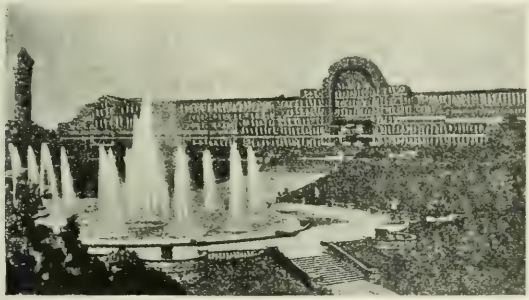


FIG. 18.—CRYSTAL PALACE, LONDON.

FIG. 19.—PAN-AMERICAN, LUMINOUS FOUNTAIN, OMAHA TYPE.

FIG. 20.—OMAHA EXPOSITION, NEPTUNE FOUNTAIN.

FIG. 21.—CHATEAU D'EAU, PARIS EXPOSITION, 1900.

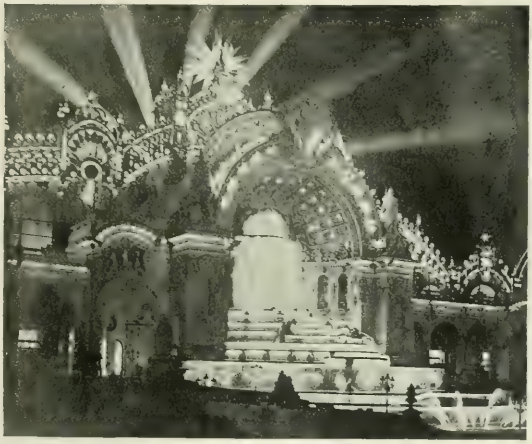


FIG. 22.—PARIS EXPOSITION, 1900.

FIG. 20.—PAN-AMERICAN LUMINOUS FOUNTAIN BY DAYLIGHT.

THE DEVELOPMENT OF ELECTRIC FOUNTAINS.

ever, that exposition settings are generally on a large scale, and require the largest fountain creations. Many small fountains of a permanent character have been illumined by various methods of lighting. The floating lights were first introduced at Atlanta, later

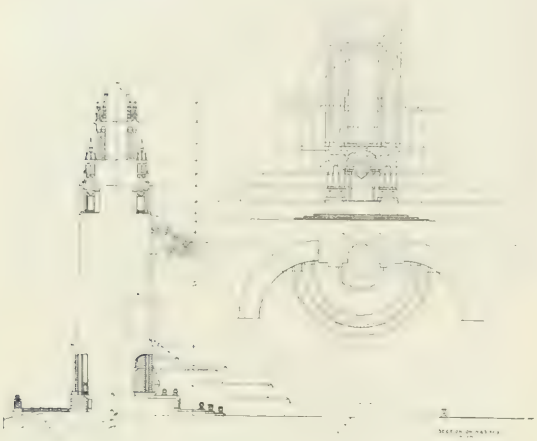


FIG. 23.—COMPARISON OF PARIS AND PAN-AMERICAN.

at Omaha, and still later at the Pan-American Exposition in Buffalo, in the Main Court Fountain basin.

The Paris Exposition management of 1900 early projected to make their electric fountain and cascades the main feature of the exposition. The Chateau de Eau is shown in Figs. 21 and 22. (See details in ELECTRICAL WORLD AND ENGINEER, Sept. 1, 1900.) For comprehensiveness, elaboration and completeness of design this conception excelled all prior efforts. The writer, as consulting engineer of the Pan-American Exposition, appreciating the magnitude of the Paris fountain and cascades, and realizing that the proposed Howard Tower fountain conception for Buffalo had many things of similar character, secured some time before the operation of the Paris fountains, through the courtesy of M. Paulin, full detail plans

FIG. 24.—PAN-AMERICAN, GRAND COURT FOUNTAINS.

of this most important installation. A study of the plans revealed much in comon between the Howard Tower and the Paris fountains. The writer prepared for comparison a plan to scale of the elevation, and a cross section of both these organizations for the purpose of creating out of the proposed Howard Tower water display some original effects or improvements on the Paris display. (See diagram, Fig. 23, which shows to scale the relative proportions, more particularly in the two niche spills.) This was, however, only partially carried out, the limitations of structural conditions preventing. Provision was made for the illumination of the water display incidentally. Owing to changes that were introduced and lack of apparatus, the results were not attained that had been intended. The results attained (Fig. 24) do not show the capabilities conceived and planned for this work. However, the work now possesses more character than on earlier operation. Notwithstanding recommendations to avoid vertical streams in the tower basin, they were introduced, thus proving that design must sometimes give way to utility. The vertical streams were abandoned, owing to the drifting spray becoming a nuisance to surrounding walks. All the streams were finally turned inward. With the ultimate increase of water, they now possess more character and are more effective than heretofore. The detailed description of the Pan-American fountains will form the subject of a special article.

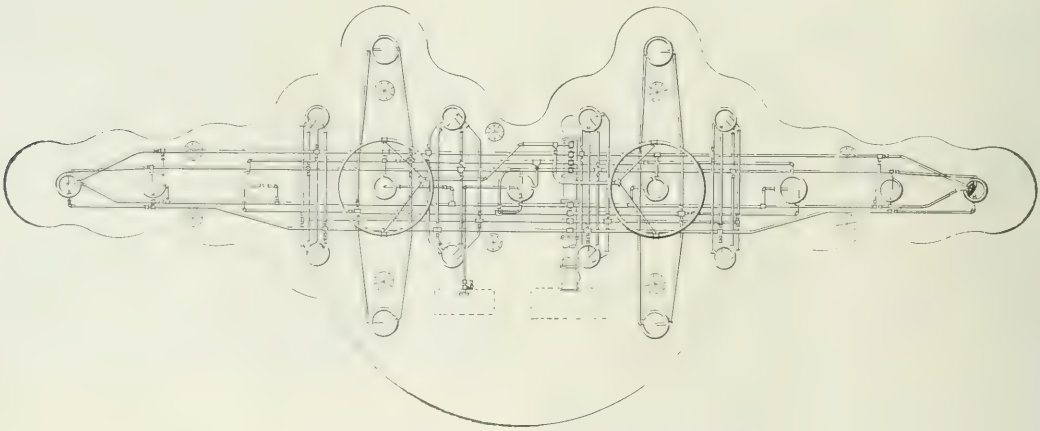


FIG. 25.—PAN-AMERICAN FOUNTAIN PIPING PLAN.
(From Designs of Luther Stieringer, Consulting Engineer.)

The main flow of water at Paris issued from the ornamental niche into a basin and was intended to be of large volume. In its fall it assumed a cataract form. From the cataract basin it descended over a series of cascades. In the basin of the foreground a large number of fountain jets were placed. These were illuminated at night from chambers beneath. There were some 6000 incandescent lamps used in color and with commutating devices. The cataract, or main fall,

as originally planned, was destined to become a failure. The plans were changed from having the water spill over the basin ledge in a solid sheet to a series of internal terraces within the orifice or opening over which the water flowed; by this means creating an appearance of being expelled in great quantity. The same defect of cataract form would have resulted for the Pan-American Howard Tower niche, but fortunately the need of rearrangement was early indicated by a kindergarten model, which sufficed to suggest the changes finally made and the provision of more water than originally conceded to be necessary to fill out the orifice or opening to produce the effect of a surging and active release of a large volume of water. This was attained as now operated by a steel shield of a dustpan form, the handle end downwards, a header placed at the bottom from which a large number of streams are directed against the hollow of the pan or shield, which deflects the water outward through the semi-circular orifice. The vertical streams are provided with shut-offs to regulate the flow of water.

The motive assigned for the Pan-American Electric Tower water display was to convey the idea of majesty and abundance associated with Niagara Falls. Although the Paris design preceded the Pan-American arrangement, no motive was assigned of a source of water. The source was the River Seine, and the water in this instance was not alone offered for display, but was utilized in condensing steam.

The luminous fountain of the Pan-American Exposition shown in Figs. 25 and 26, is a duplicate of the Atlanta fountain, and by the same designer. The changes consist of two additional light shafts on the longitudinal axis, a motor and pumps located within the fountain chamber, the pressure being at best but 35 lbs. on all but the center stream, where 100 lbs. pressure is claimed. The electric generators that supply current to the motors driving the pumps are located in a small structure on the bank of the bay. The fountain has a superior setting in the center of this bay, the banks of which are well covered with trees and slope gently to the water, forming a natural amphitheater. These conditions make the surroundings appropriate for an acceptable performance. If the designs of this fountain could have been carried out in full, its inherent capabilities were expected to make it one of the features of the Exposition. The delays in material and other limitations have prevented the realization of the original conception. In being operated over an hour at a time, it has lost its novelty as an effect. As such it could not be operated successfully for a period of more than 12 or 15 minutes, and give a perfect entertainment. Fountains, like many other things, require rehearsals. This fountain was never thoroughly rehearsed and adjusted, but is still experimental. Even as operated, however, it is received with favor.

In considering the illumination of the world-famed Whirlpool Rapids of Niagara, one cannot but remark its resemblance to fountain work. The rapids form a natural wonder, and have a volume of water that no artificial source can ever mimic. These wild, fascinating, tossing waters were first illumined by the writer in 1897, during the meeting of the Edison convention at that place. More recently an installation of a more permanent character has been made for illuminating displays during the summer months. The display approaches closely to an electric fountain display, the water being continually in action, no repetition of form being produced, the effectiveness of the display depending only on the treatment by light in the illumination.

From the experience of this and other expositions, it is clearly evident that the success of an elecric luminous fountain, considered largely from the point of a spectacular display, depends chiefly on a suitable site and a dark environment, two conditions which are absolutely essential to success. And in conclusion, it may be incidentally remarked that the operation of an electric fountain in a location such as that described for the one at Prospect Park, Brooklyn, is not unlike an attempt to play a symphony on Broadway, New York, during heavy traffic hours. No matter what a fountain in such a location might be or is, the spectators, whom it is desired to please, lose the benefit of desirable surroundings. If the audience is not gratified, the chances are that the fountain will be scored a failure.

It will be evident from the above brief recapitulation of leading features in the history of electric fountains, that the development has been quite evolutional, but any one who has had to deal with exposition work must realize that to satisfy future requirements something absolutely new is required. After 100 years of expositions and at least 50 years of well-nigh uninterrupted attempts in that kind of advertising, it is evident that they no longer meet a want in the way of enabling the public to become acquainted with what is latest and best in any art or industry. This work is now done very satisfactorily by the daily and the technical press, as well as by the magazines, while each city of any size is itself likely to contain as good a display in any line as can be brought within the four walls of an exposition building.

There was extremely little that was new, industrially or technically, at Paris in 1900, and it might be questioned whether there was a single new thing of first-class merit at Buffalo that could in anywise compare with the faint whisper of the telephone at the Centennial in 1876 or the gleams there of the first successful arc lighting. Thus expositions tend more and more to the development of the spectacular and are becoming, unfortunately, over-ridden by the Midway feature. There will doubtless be great expositions in the future, but if the above statements be conceded to be true, as they must, it will be seen that the public will look for a greater accentuation than ever of spectacular displays such as are secured in electric fountains, electric towers and the like. It would hardly lie in the writer's mouth to claim that when the Pan-American has passed away it will be chiefly remembered for its nocturnal pageantry of light, but if those who have written about the show and described it are to be believed this will undoubtedly be the case. Possibly such expositions as that projected for St. Louis will present striking attractions during the daytime, but it is safe to say that special stress will be laid upon illumination and all that may be considered under that generic head. Electricity will certainly be adequate to this new task, for the resources of that inexhaustible and protean art have as yet been barely grasped even by those who have made it the study and work of a lifetime.

Novel Church Lighting.

A few Sunday mornings ago it was so dark at Stratford, Conn., that light was needed for the service in the old Congregational Church. Unfortunately, there is only a day circuit, and so the incandescents could not be used, and it was proposed to fall back on kerosene. At this juncture F. C. Beach, editor of the *Scientific American,* rode up to the edifice in his automobile and offered his services to help the commitee out of their dilemma. Mr. Beach placed his carriage near a window of the church, connected the Gould storage batteries to the circuit and soon had the darkened interior of the church brilliantly illuminated. At the conclusion of the service the wires were disconnected, and, mounting the seat of the vehicle, Mr. Beach ran it around to the front of the edifice and conveyed his family to their home. But few of the members in attendance at the service were aware of the unusual conditions, believing that the current which lighted the church was furnished by the Bridgeport company, as usual.

Trolley Network on Long Island.

Articles incorporating the Northport Traction Company, Long Island, have been filed with the Secretary of State. It is proposed to build and operate a street surface electric road three miles long, between East Northport station, on the Long Island Railroad, and Northport harbor, in the village of Northport, Suffolk County. The capital stock is $50,000, consisting of shares of $100 each. Directors for the first year are: William H. Baldwin, Jr., William F. Brown, and William J. Kelly, of Brooklyn; Frank E. Haff, of Long Island City; John Wolf Hiltman, Edward Pidgeon and Edward Thompson, of Northport; William E. Potter, of Flushing, and Frederic C. Scudder, of Babylon.

The incorporators include executive officers of the Lond Island Railroad, its president, secretary, general superintendent, solicitor, etc., and the organization of this company is a development of President Baldwin's policy of meeting competition from electric lines, which at one time promised to cut heavily into the passenger traffic of the Long Island Railroad. To anticipate this possibility Mr. Baldwin has adopted the plan of organizing electric companies at strategic points, and building short lines from stations on the Long Island Railroad to towns not on the line, where the business to be developed justifies the action. Thus the company owns an electric road at Huntington and at Far Rockaway, and will add to these lines from time to time. Experience in their operation will be useful also in anticipation of the introduction of electricity on the main line and divisions in the suburban zone about New York.

High-Speed Electric Railway Car of the Allgemeine Elektricitats Gesellschaft, Berlin—I.

By O. Lasche.

(*Chief Engineer Allgemeine Electricitats Gesellschaft.*)

THE high-speed electric railway car of the Allgemeine Elektricitats Gesellschaft, Berlin, is now ready to be placed upon the track and subjected to actual running trials. A stationary test of the car upon rollers in the factory has been made, and the operation of it under these conditions has fully answered all expectations.

The studies and experiments of the association for studying electrical high-speed railways have, up to the present, assumed but a general character, and do not refer to the equipment of any particular line. It is intended to begin within a short time the trials on the military railway track Berlin-Zossen, which has been kindly placed at the disposal of the association by the Imperial Railway Military Board of Administration.

The speed of 125 miles per hour has been assumed as the maximum velocity because of the present construction of the car, but it must not be inferred that the main object consists in the attainment of that speed or that there will not be any possibility of making the trials at a still higher speed. The trials, however, have for their special object the establishment of a sure basis for projecting, constructing and working *electrically* lines at speeds which are common at the present day, or still higher. In technical journals and newspapers the speed of 125 miles per hour has been ridiculed as impossible of attainment; on the other hand, it has been often asserted that this speed can be reached by steam locomotives, Americans claiming, as is known, to be able to travel at a still greater rate. In view of the present requirements of traffic, efforts must, of course, be made to travel faster, but especially must traveling be made more convenient for the public, and for this purpose electricity is best adapted. Of course, the object of the present trials and of the operations during the next few years will be to ascertain the economy of an electric system of working as compared with the present steam working system. It must be ascertained in what proportion the total costs stand at different velocities and especially at the higher velocities. Cost was not considered the main point when electric light and electric power were introduced, and even up to the present day the electric light is often much more expensive than other forms of illumination, yet electric lighting occupies a very wide field of activity. In the same manner cost will not be the first consideration in the introduction of an electric system of working existing railways, but rather the convenience afforded by such a system. From this beginning the introduction of electric long-distance traffic will be easily developed and become universal.

A rapid succession of separate motor cars is one of the most obvious advantages of an electric system of railways, and this method of working is proposed both for suburban and long-distance lines. For this reason, therefore, the trial cars of the association have been built as passenger cars and not as locomotives. This quick service system is already needed for the convenience of the public and will be gladly paid for by them.

Lines with an increasing traffic will appreciate the advantage of introducing an electric system of working, as with such a system it will not be necessary for them to strengthen either their tracks or their bridges, since instead of meeting the increasing traffic with heavier locomotives and longer trains, a quick service system of light and separate motor cars can be introduced, with the additional advantage of freedom from smoke annoyances.

The track and its maintenance are, of course, very important points in a high-speed electric system of railways, and many considerable improvements will be necessary, although the trials shortly to be made will prove the comparative requirements of electric motor cars and steam-driven trains.

The coming experiments are expected to establish a basis for the calculation of the working expenses of electric main lines, the outputs of motors for the various speeds with the increasing influence of the air resistance, and for the size of the necessary power station. Of the limit of the minimum speed at which the electric system may be more economical than the steam locomotive system, about as little is known as the limit of the maximum speed. It is only known that with steam locomotives the consumption of steam and especially the consumption of coal is largely increased as the speed grows. By centralizing the generation of power the case will, of course, be entirely different. The best large steam engines may be used, and boilers with superheating and feed-water heating apparatus. This centralization is possible for very long distance lines, and consequently also the attainment of a practically uniform load.

Electric energy may be economically transmitted to very long distances by three-phase alternating current at 40,000 to 50,000 volts and further extensive railway systems can be supplied with energy from a central station placed in the most favorable situation.

CHOICE OF THE SYSTEM.

Owing to the long distances through which it may be necessary to operate, the system to be adopted is three-phase alternating current of high potential. For the present experiments a voltage of only 10,000 to 12,000 is necessary. The current is supplied by the Oberspree Central Station of the Berlin Electricity Works, the distance from the station to the point at which the overhead line is fed being about 15 km. Transformers are mounted in the car by which the voltage impressed upon the motors is reduced to 435 volts.

As to further constructions, it remains an open question whether it is advisable to keep the heavy weight of the transformers within the car. It may be preferable to reduce the high tension of 50,000 volts by transformers placed in houses alongside the track to a medium tension of about 3000 volts and to wind the motors for this voltage.

The transformation of three-phase currents into direct current is not practicable for feeding long-distance railways, since it necessitates the use of motor-generators or rotary converters which require attention. Furthermore, the direct-current system can be used only at low voltages and therefore transformer stations are required at frequent intervals along the line to avoid excessive losses. It may prove necessary to use direct current where the long-distance motor cars pass through cities. The overhead wires required by the three-phase system are inconvenient for branches and switches, and therefore it may be necessary in such cases to shunt a low-speed locomotive operated by direct current in front of the car.

The problem set to the Allgemeine Elektricitats Gesellschaft was to construct a motor car for a speed of 125 miles per hour, and to accommodate 50 persons. The car has two bogey trucks with three axles each, and the motors are designed for a total normal output of 1100 horse-power and 3000 horse-power maximum. The electric current provided is three-phase, at a tension of 12,000 volts, and with a frequency of 50 cycles per second. The weight of the cars was required to be as small as possible, and by no means to exceed eight tons per wheel; and the cars were required to conform to certain dimensions to pass over the lines of the State railway.

The car cannot be compared in any way with the ordinary tram car or low-speed locomotive, its electrical equipment including the motors, transformers, and the starting and regulating arrangements, being of an entirely new and novel construction. It has been built, however, in such a fashion that after the experiments on it have been carried out it can be put into actual working use.

In order to obtain the lightest construction of car and of the electrical equipment a long series of experiments and designs were made before the final form was adopted. In view of the desired high speed the A. E. G. thought it necessary to find means to relieve the axles from the heavy weights of the motors, or at least of preventing the axle from being directly burdened by this weight.

The starting and regulating apparatus for 3000 horse-power could not be constructed according to the types of the usual car controllers having to deal with an output of hardly 100 horse-power. Elaborate and costly experiments were necessary for testing the entirely new constructions which were designed.

The braking at a speed of 125 miles per hour by means of friction brakes, that is, at a friction speed of 56 meters (183 ft.) per second, was found impracticable, and it appeared necessary to provide means for braking electrically as well.

Quite a number of further new details had to be designed. The motor bearings have to work at a speed of about 14 meters (46 ft.) per second, the slip rings of the armatures at a speed of 40 meters (157.5 ft.). The trolleys constitute another new detail, which may be considered as one of the most difficult problems to be solved.

WEIGHT OF THE ELECTRICAL EQUIPMENT.

As to the arrangement and especially the designs of the body of the car, at first it was proposed in view of the conditions of running in both directions, forwards and backwards, to construct at

each end of the car a driver's cab, in which the necessary starting apparatus was provided. The construction was so arranged as to enable the driver to control the entire electrical equipment of the car from the front starting device. This arrangement, however, proved impracticable, owing to the quantity of cable required, considering that 3000 horse-power had to be controlled. Matters were facilitated by dividing the electrical apparatus into two circuits and operating the rear starting device at a distance, either by an electric motor, compressed air, or water pressure.

In one design considered, the working compartment was of two stories, the lower one for the necessary apparatus and machinery,

FIG. 1.—ZOSSEN A. E. G. CAR.

and the upper one for the driver and the starting and regulating apparatus. These arrangements prevented the driver from inspecting the track within 30 meters (98.4 ft.) of the front of the car, and although such inspection is of no great use in consideration of the high speed at which the car is to travel, yet the design was altered and a driver's cab provided at each end. It is especially desirable in consideration of the high speed of the car, which would make a side lookout very trying to the eyes, that the public should be provided with a lookout at the ends of its body, and therefore, although there is a cab at each end, it is so arranged that lookout windows are left. These conditions led to the design of car shown in Figs. 1, 2, 13 and 14.

All apparatus, cable and safety devices are arranged in the space in the middle of the car. This room, and also the transformers built below it, are separated from the passengers' compartments by air shafts having double iron walls. The driver always stands at the front of the car, apart from the passengers, in a room containing no parts under high voltage. The controlling is effected from the cab by a system of mechanical transmission.

It has already been stated that the transformers had to be mounted in the car, although their weight is extremely inconvenient and considerably increases the total weight of the motor car.

In the calculation of the transformer windings and the cross sections of the iron, the question of the heating of these parts and its dissipation is of the greatest importance.

The cooling of the transformers by air taken from below the car is impossible, on account of the great accumulaion of dust when traveling at a high speed. On the other hand, the designs showed the great difference in the weights when air is passing *through* the cores of the transformers in contrast with the insignificant cooling obtained when only *over* the surface of the casing. Two air shafts are led from the roof of the car to the transformers in such a manner that the front shaft is used for admitting fresh air and the rear shaft as an outlet for the heated air. Special care has been taken for shielding the motor from the air in rainy weather and for drying and filtering it before it enters the channels of the transformers, although actual contact of the cooling air with live circuits is avoided.

Further economy in weight resulted from the use of a liquid starting device of an entirely new construction, instead of a metal starting device with coils or strip resistance material, such as was at first provided.

The following brief summary shows how the weights varied in the different investigations:

Weights.	I. Pounds.	II. Pounds.	III. Pounds.
Four motors	37,274	35,274	28,218
(a) Two transformers	28,660	28,660	14,330
(b) Starting resistance with casing	19,841	19,841	10,471
(c) Two controllers with driving mechanism			
(d) Braking and lighting batteries	5,732	5,732	5,732
(e) Motor with compressor	1,763	1,763	1,763
(f) Oil pump	441	441	....
(g) Oil tank	1,322	1,322	....
Total weight of cable	8,818	2,204	2,204
Collector bows	3,086	3,086	3,086
Summary	104,939	98,322	65,808

The final weight of the transformers was 6.5 kg. (14.3 lbs.) per kilowatt, and of the motors 13 kg. (28.6 lbs.) per horse-power of the normal output and 4⅓ kg. (9.47 lbs.) per horse-power of the maximum output. The table also shows the economy which resulted from the construction of the motors (Fig. 3), without a closed casing. As with the new types of alternating-current dynamos and stationary motors, the iron of the magnetic circuit is not covered by the usual casing, but is directly exposed to the air, the cooling surface of the motors being enlarged by the provision of ribs. The surface cooling is therefore very excellent and fully sufficient for the continuous running of the motor. There is no provision made for the admission of air into the motor, as on account of the dust it is not possible to take the air from below the car, and the supply of air from above could only be arranged in a very inconvenient manner.

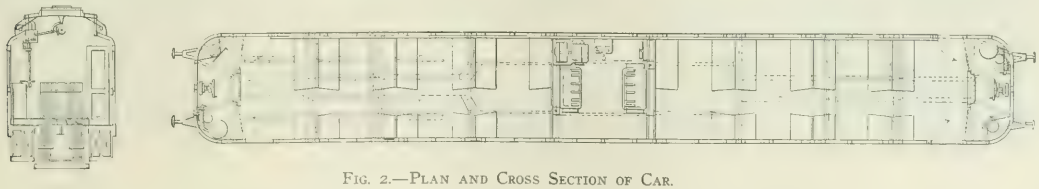


FIG. 2.—PLAN AND CROSS SECTION OF CAR.

STARTING DEVICES.

In the remarks concerning the main division of the car and arrangement of the electrical apparatus having regard to the attainment of the smallest weights, it was mentioned that the starting ap-

paratus was mounted in the middle of the car so as to shorten the cables as much as possible. The primary circuit of the motors is provided with a switch for reversing the direction of running, for cutting out and for braking the motors by counter current, or by connecting the circuit of the field frame to a storage battery.

The problem of the starting resistance for 3000 horse-power was finally solved by a liquid starting device on quite a new principle. Fig. 4 shows the corresponding experimental arrangement. A three-phase motor of 200-400 horse-power is coupled direct to a very heavy flywheel. For making this run up to full speed in 15 seconds a torque corresponding to an output of 400 horse-power must be attained. With the same output, another heavier flywheel is made to run up to full speed in 1½ to 2 minutes. The former meets the requirements of a hauling engine, the latter the requirements of the high-speed car. The high-tension switchboard is arranged in the background, wherefrom the winding of the motor is connected for backward and forward motion. A combination of these connections with the starting device proper was omitted in this experimental arrangement.

The cut shows in the foreground a small centrifugal pump driven by an electric motor, which withdraws the liquid from a tank located in the basement and continually delivers it into the superposed tank in which the electrodes, i. e., the terminal or end plates of the opened armature circuits, are located. The pump operates continuously, hence a continuous renewing and mixing of the liquid takes place, the electrodes are thus suspended, not in stationary, but in moving water. By shifting the somewhat primitively arranged vertical rod to the right, a valve located in the bottom is closed, through which, when open, the water is continuously discharged. The liquid now begins to rise in the tank, i. e., the armature circuits are closed, whereby a considerable resistance remains switched in. The motor starts, as the liquid rises further the interposed resistance decreases and the motor runs quicker. Consequently, for a certain load of the motor each height of the liquid level represents a certain speed. By means of a regulable overflow in the electrode vessel, the level of the liquid, and consequently the speed of the motor can easily be adjusted.

The electrode plates are at the lower end, very wide apart, and made with prongs of different lengths. The arrangement is such that the longest prong of the first plate is situated diagonally opposite to the longest prong of the other electrode. Thus at the beginning, not only is the dipping surface small, but especially the distance or the path of the current through the liquid, is very long. The immersed surface of the plates can therefore be considerably larger on account of the great distance than might be the case for the passage of the same quantity of current through a short path, i. e., the specific passage from one plate to the other of the current through the liquid is reduced. In consequence thereof a flashing of the points or tips such as occurs with the old construction has become impossible. On the other hand, the electrode plates are put very close to each other at the top, and besides, more plates are used in order to keep the current conducting surface very large, thereby reducing to a minimum the resistance set up by the liquid to the passage of the current. It is thus not necessary to use metallic short-circuiting contacts.

The essential difference between the new starting device and the previous ones consists in keeping the liquid in constant motion, and this fact alone ensures its success. The heated liquid does not remain at the part where heat is generated, but is constantly moved and mixed afresh. It can be easily calculated what amount of heat is delivered to the liquid by the resistance at a certain load and a certain decrease of the normal speed. On the other hand, water in motion renders it possible to conduct away the troublesome heat in a very simple manner. The cooling surface necessary to do this may be calculated. For instance, according to the present construction in the high-speed car, a copper coil of small diameter is provided, through which the heated water has to pass after its exit from the electrode vessel, and before it is used afresh. Consequently, the new liquid starting device enables any suitable large resistance to be introducd into the circuit permanently, i. e., the motor can continuously run at any desirable slow speed.

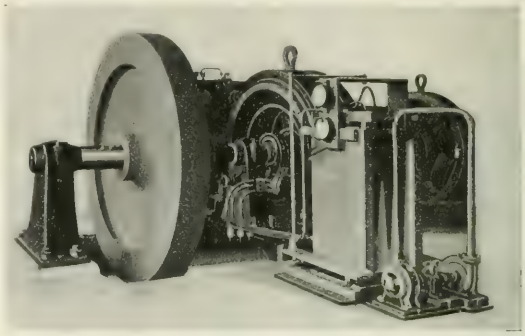


FIG. 3.—EXPERIMENTAL FORM OF STARTING DEVICE.

The starting time of the motor, viz., the time up to which the resistance is entirely cut out, is determined by the speed at which the liquid flows to the electrode vessel. By inserting an adjustable cut-off device in the pipe leading from the centrifugal pump, the speed at which the liquid is delivered and consequently the starting time can be regulated at will. By this construction it is therefore rendered possible to prevent the driver from reducing the time of the starting; hence the acceleration and consequently the momentum of inertia can never prove greater than the overloading capacity of the motor permits. On the other hand, the driver can, by a correspondingly slow or incomplete closing of the foot valve, decrease the speed for starting and braking, to any desired extent. In a similar manner, the driver can run the car at any desired slow speed by keeping the foot valve partially opened. Consequently, he can al-

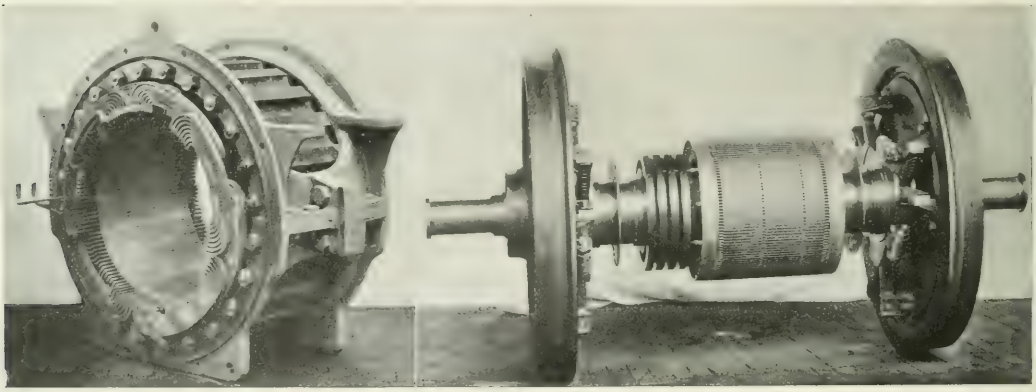


FIG. 4.—MOTOR FIELD AND ARMATURE.

ways regulate the speed. This new construction, when compared with metallic starting devices, also shows the great advantage of a gradual and perfectly regular switching out of the resistance over the intermittent action of the latter. In other words, the starting and braking are effected softly and not by jerks. Any one who has experienced the jerking motion in tramway cars can realize how the above arrangement will be appreciated by the passengers.

Owing to the great simplicity of the apparatus, it can always be readily operated from remote points, as the power required is very small. Consequently, the provision of compressed air or electricity in the car as means for operating the reversing mechanism is obviated. It has only been necessary to provide a connecting shaft operated by a hand wheel from each or both drivers' cabs.

By employing this new system of liquid starting apparatus, metallic resistance was no longer needed. Several hundred contacts and connecting cables were dispensed with, and as regards maintenance, all fear is needless, since the maintenance of plates immersed in a soda solution, and therefore not liable to get rusty, cannot be compared with the maintenance of many and large controller cylinders, contacts, contact brushes, cable connections and pieces of resistance material.

BRAKES.

With the same experimental arrangement constructed for testing the starting apparatus, the system of electrical braking by the motors was also tested.

The car is equipped with a Westinghouse compressed air brake, which is divided into two parts for each of the two trucks. The compressed air cylinders are operated from the front driver's cab. The brake pressure is assumed as very high, 170 per cent, because the friction coefficient between brake block and wheel at the high speed of over 50 meters (164 ft.) per second is materially different from the friction coefficient at the usual lower speeds. In consequence of investigations made, an appliance has been devised for decreasing the brake pressure at a gradual slow speed. Notwithstanding the fact that in a certain degree the brake device of the one forms the reserve for the other bogey, it was not considered admissible to dispense with a second brake device. This additional braking action was imparted by the motors themselves, and not by special rail brakes or similar less proved apparatus.

The braking or retarding action can be effected by means of an electric motor in two different ways: First, by eddy current, namely, energizing the field of the motor with direct current and short circuiting the armature; and, second, by reversing the direction of the current in the rotary field.

Both kinds of brakes are used in the high-speed car. After the armature circuit is opened by opening the outlet valve on the liquid starting device, the field is cut out and switched on to a storage battery built within the car, or is reversed to opposed current in that two of the three phases are reversed, the series arrangement of the phases being changed from 1, 2, 3 to 1, 3, 2 and 3, 2, 1, respectively.

After the switching has been effected in either way, the armature circuit is gradually closed again, i. e., the inflowing liquid connects the phases through very great resistance; and according to the desired intensity of the braking action, the level of the liquid is raised or lowered.

The braking with counter current alone did not appear to be sufficient, because the current was liable to fail for some reason or other, for instance, by the blowing of a safety-fuse in the very moment when the brake is applied. The use of counter current has a further disadvantage. In conformity with the electric dimensions of the motor and the potential of about 430 volts selected for the field, the armature has a tension of about 325 volts with open circuit. After the reversal of the field, the tension in the armature increases at the full speed of the latter, to almost double the amount, viz., to about 650 volts. Although the liquid starting device is constructed for this voltage and the motor armature also fully sustains the same —it was tested at 4000 volts—yet it does not appear proper during the braking action, when there is a possibility of direct danger, to make the safety of the braking action dependent on an unusually higher voltage.

These were the reasons which led to the provision of an eddy current braking system, and for this purpose there were also used, analogous to the two separate air receptacles for the Westinghouse brake, two entirely separate storage batteries. It is here assumed that motor braking must be made use of in the event of the high speeds, whereas the air brake is only applied at the end of the run. For shunting service a hand brake is provided, which acts on the front bogey.

The Induction Motor for Electric Railways—I.

THE paper read at the recent Buffalo Convention of the American Institute of Electrical Engineers by Mr. Ernst J. Berg, entitled "Electric Railway Apparatus," and another by Mr. Albert H. Armstrong, entitled "Notes on Modern Electric Railway Practice," are of particular interest for the discussions contained of the status of the induction motor in electric railway work.

The paper by Mr. Armstrong discusses the best accepted practice for several classes of railway systems from the direct-current standpoint, and then takes up the subject of alternating generation and transmission, with induction motors on the cars.

This system is briefly defined as consisting of a polyphase generating station supplying transmission wires extending along the line of travel, feeding at frequent intervals into step-down transformers which reduce the transmission potential to a still considerable pressure for the overhead trolleys. Induction motors receive their power directly from these trolleys and are geared to the car axles by the standard method.

A principal advantage of the induction motor system lies in the reduction of the labor account due to the elimination of attendance at the sub-stations, the step-down transformers being self-cooled and requiring no more than casual inspection. Where the train service is infrequent and does not justify the expense of sub-station attendance every 12 or 15 miles, the induction motor system offers a substitute to the converter system worthy of very careful consideration. As the induction motor system introduces several features which are new, viewed from a direct current standpoint, a few of its characteristics are touched upon.

The induction motor, while not a synchronous piece of apparatus, is such so far as its behavior in railway work is concerned. A car equipped with such motors will run at practically constant speed up grade and down, or on level, thus making the car speed nearly independent of the profile of the road. The speed of the induction motor, depending upon the frequency of the source of supply, is not affected by the voltage, provided the voltage is sufficiently high to provide the torque required. This constant speed quality of the induction motor at first sight appears to be a desirable feature, as it would seem to ensure the maintenance of a constant schedule speed not influenced by grades. The greatest objection, however, is that the practically constant speed of the induction motor car up the severest grades calls for a very large motor output and produces much more violent fluctuations upon the distributing and generating system than is the case with the d. c. series motor, which falls off considerably in speed on heavy grades. The system, being alternating throughout, provides no means of introducing storage batteries to smooth over these excessive fluctuations, and they are more liable to reach the generating station and produce an irregular load curve with its greater coal consumption than is the case with direct current series motors and rotary converter sub-stations, even though this may be used without storage battery auxiliaries. Where the system is so extensive that each individual car or train is a small increment of the total load, this objection of fluctuations upon the generating station will, of course, not hold true. The motive power, however, must provide for the running of the car or train up the steepest grade at practically the same speed at which the car operates upon a level, and the motors must therefore be designed to stand a greater output for the same service performed than the direct current series motor.

The induction motor can give only a certain maximum torque with a given impressed line voltage, and as this torque decreases with the square of the impressed voltage, it will be necessary to carefully determine the operating conditions of the motor and of the distributing system in order that the motor may be able to start its car or train upon the heaviest grade with the minimum line potential met with in operation. The direct current series motor can give a torque much in excess of any service demand, without sacrificing its running qualities at light loads. Railway service calls for a large overload capacity of its motive power, and the induction motor can meet these infrequent demands only by a design which sacrifices some of its advantages for normal operation. For example, a motor car to be successful must be able to operate through snowstorms, oc-

casionally haul a trailer, or push in a disabled motor car over the irregular profile of the road. An induction motor car designed to provide just sufficient torque to operate itself alone, would fail to give the commercial satisfaction which is given by the direct current series motor car with its capability of standing enormous overloads for a short time. It is evident that the practically synchronous operation and limited torque of induction motors introduce a number of problems into high-speed interurban work not met with in direct current distribution, and that the motive power, transformer sub-stations, distributing system and generating system must all be designed very liberally in order to take care of the violent and large fluctuations inherent in the operation of the railway induction motor.

The induction motor, like any piece of alternating apparatus, demands a magnetizing current, and this current is much larger than that met with in stationary motors, due to the larger air-gaps demanded in traction work. Stationary motors can run at air-gaps of but three or four-thousandths of an inch, but the railway man would decline to assume the responsibility of keeping up his bearings for any such air-gap. Increasing the air-gap will raise the magnetizing current, lower the power factor of the system, and hence increases the size and cost of the distributing and generating apparatus. The necessity of designing the railway induction motor to meet unusual demands occurring very unfrequently further increases this magnetizing current, due to the high density required in the iron circuit with a reasonable motor weight. Even with a liberal air-gap, viewed from an induction motor standpoint, such a motor demands a clearance between field and armature nearly 50 per cent less than is common practice with d. c. motors. The maintenance of linings with a small gap is a matter for consideration, particularly when it is remembered that when the armature of an induction motor strikes its field, it may destroy two sets of windings as the field is a duplication of the armature winding. We are therefore confronted with the maintenance of an air-gap of half the width and double the expense of repair with the induction motor to offset the small commutator maintenance of the d. c. motor.

The installation of high-speed interurban roads in this country has been brought about by the financial success of the earlier roads of this character. Because a system is operative is no reason for its adoption unless there is sufficient promise of its superiority over present methods. Our interurban and suburban roads possess a very strong advantage in being able to traverse city streets en route and at their termini. All the large cities in this country, and most of the smaller ones, have direct-current railway systems in operation, and the direct-current interurban and suburban system can therefore run its cars over existing city systems without in any way conflicting with the operation of such roads. The induction motor interurban system, on the other hand, would necessitate the changing of cars at the outskirts of the termini cities, running around the cities passed en route, or else the equipment of unused streets with double trolley and alternating current; or as an alternative, changing over the generating and distributing system and motive power of all cities entered, to alternating current. There are a number of engineering difficulties to overcome before such a change would be commercially practical.

A chief advantage of the induction motor system lies in the ability of running motors from trolley potentials far in excess of 600 volts universally used with direct-current series motors. Not having any commutator, the induction motor can use trolley potentials of several thousand volts, and proper line insulation and safety in operating are the only limits placed upon the trolley voltage. Owing to the large lagging currents demanded by induction motor roads which operate at power factors ranging from 50 to 75 per cent, it is desirable to use as high a potential as possible in order to eliminate the excessive feeder copper or frequent transformer sub-stations required with low voltage distribution. A trolley potential, therefore, of 2000 or 3000 volts offers advantages in interurban distribution well worth the extra expense and development needed to insulate trolley and car wiring at this comparative high potential. In order that the motive power will be reasonably cheap, and bearing in mind that such motive power must stand maximum demands considerably in excess of the direct-current motor, it is advisable to wind the motors directly for the trolley potential rather than introduce the expense and provide space for step-down transformers. We are therefore confronted with the difficulty of running a 3000-volt trolley through small cities along the route and into large cities at the termini, even assuming that the cost of changing over such systems to alternating current would be justified.

Step-down transformers installed upon the car, reducing from 3000 to 600 volts, open the possibility of running motors without step-down transformers on city streets, and with step-down transformers when the trolley potential is 3000 volts in the open country. The double trolley, however, complicates the city system and adds additional expense to the already expensive motor equipment. The induction motor, moreover, is not adapted to city street running, calling as it does for constant acceleration and efficient operation at fractional speeds. Instead of efficiencies of acceleration in the seventies obtained with direct-current motors, the induction motor would give an efficiency of only 40 to 45 per cent during acceleration with a corresponding increase in coal consumption, making it compare very unfavorably with the direct-current motor for city work. The adoption of the induction motor for interurban work seems limited, therefore, to those roads running on private right of way throughout, and having no connection with existing city systems at their termini or en route. Even in this class of roads, if the service is at all frequent and profile very irregular, the direct converter system with its third-rail distribution may prove cheaper to install and operate. The reduction in operating expenses which the induction motor effects by dispensing with rotary converter sub-station attendants may be more than offset by introducing apparatus whose volt-ampere capacity may be double the kilowatt capacity required, and which furthermore may operate with a very irregular and inefficient load curve as compared with the load curve produced with d. c. series motors.

The above are stated to be a few of the obstacles in the way of the success of the induction motor for general interurban work. There are, of course, special instances where the roadbed is practically level, grades and curves being eliminated and the conditions ideal for the installation of induction railway motors. It is unfortunate, however, that all interurban roads cannot pick out a level country, or have unlimited capital at the back of them in order to provide ideal conditions for the motive power; in fact, the motive power must accommodate itself to the physical limitations of the road, and it is just here that the direct-current series motor shows its superiority to the induction motor where the profile is irregular and where the service consists of mixed city, suburban and interurban high-speed work. As before stated, interurban high-speed roads are being rapidly extended in this country owing to their economic success, and in a large number of cases coming under the writer's observation, the induction motor could not compete in first cost of installation, nor in expense of operating with the d. c. motor, operated from rotary converter sub-stations and high-tension alternating transmission. The expense of the few men required to operate sub-stations is a very small item in the total operating expenses of the road, and as our interurban roads more nearly approach steam practice, they require attendants every 10 or 15 miles to serve as ticket agents, train dispatchers, etc., so that with a well-organized interurban system, the item of sub-station attendance can be largely charged to the general operation of the road and not to the cost of producing power.

The ideal conditions for the operation of induction railway motors seems to be a regular profile, either level or a uniform up-grade, private right of way with no city or suburban running, infrequent service, and freedom from unexpected and fluctuating demands upon the motive power. Electric railway work up to the present has demanded considerable of the motive power in the way of meeting large momentary overloads, running at different speed, line voltage, etc., and the direct-current series motor has shown itself well equipped to meet these requirements. The induction motor is more adapted for operation under predetermined conditions, and its design does not lend itself to the same broad field of usefulness now covered by the direct-current series motor.

In a service calling for frequent stopping where the demand upon the motors is largely acceleration work, the induction motor must dissipate considerably more energy for the same service performed than the direct-current motor, and hence must be correspondingly heavier and more expensive. For constant speed running, the induction motor, however, must dissipate but little more energy than the d. c. motor, and from the nature of its design may dissipate that energy more rapidly.

This brings up a new class of railroad work just being considered, and that is mountain railroading, and long-distance cross-country roads for either high-speed passenger or freight work. The condi-

tions governing both these classes of work are practically the same in that they demand a constant sustained output of the motive power, and it is in this class of work that the induction motor is being seriously considered.

Direct-current motors fed from a system of rotary converters connected to a high-potential transmission distribution system are open to the objection that a trolley or third-rail potential under 1000 volts must be used, necessitating the collection of very large currents and an undesirable frequency of converter stations, or prohibitive expense of third-rail and feeder construction. The power consumed by a freight train of 2000 tons or more may reach 3000 horse-power on the grades encountered in steam railway mountain work, and the ability of the induction motor to collect this large amount of energy at a trolley potential of 3000 volts or more, gives it a distinctive advantage in first cost of installation and expense of operation compared to direct-current distribution. High-potential alternating trolley systems present certain difficulties in the way of insulation, but after several years' experience with high-potential transmission lines, these difficulties should be easily surmounted. Such systems also employ locomotives and not individual motor cars, so that the high-potential apparatus is localized, and more space is provided to properly insulate all high-tension wiring.

The operation of heavy freight trains, or high-speed passenger trains on trunk lines is the work of the future, and will be undertaken as soon as it is evident that a saving will result in operating expenses by the substitution of electricity for the steam locomotive. Trunk lines having local passenger traffic could very well equip their tracks with both high-potential overhead trolley for the operation of heavy through trains and freight work, and also use a third-rail construction to operate direct-current 600-volt d. c. motors for the short haul work. Both these systems could be fed from the same generator and transmission lines, operating 25-cycle rotary converters to feed the third rail system at intervals, and step-down transformers to reduce the potential to the 3000 volts or more required for the overhead high-tension trolley line. This mixed system provides for the maintenance of a steady load on the generating station, while it permits the local and short haul traffic to benefit from the advantages of the d. c. motor for this class of work.

The electrical equipping of trunk line steam roads is a very large engineering proposition, involving such radical changes in the operation of such roads that its commercial success must be undoubted before the work is undertaken. It is possible that such a movement will be brought about by the equipping of some of the new high-speed third-rail interurban systems with overhead trolley operating at 3000 volts alternating current. These systems are rapidly being extended and interconnected, and will soon be able to take care of long-distance work when the systems are sufficiently joined together. The management of such roads, owing to their experience with electric traction, may be reasonably supposed to be more open to the advantages of electric haulage, while the establishment of a line of generating stations, all operating at the standard frequency of 25 cycles, will offer the means of feeding such a system with a comparatively small cost for equipping. The various sub-stations, however, and the d. c. copper distribution are not adapted to the operation of large heavy units, although the transmission lines and generating stations could well feed these trains with a reasonable outlay for high-tension overhead trolley construction.

It is along such lines that Mr. Armstrong looks for the introduction of the induction motor as a railway factor in this country, and there are several propositions in view where the introduction of the induction motor seems justified and preferable to the steam locomotive now in operation.

An abstract of Mr. Berg's paper will appear in next week's issue.

A German Interurban Railway.

Consul Warner reports from Leipzig that work has been begun on the electric railroad between Halle and Merseburg, permission for the construction of which was granted by the Prussian Government several months ago. It is expected that the Halle-Ammendorf section will be completed before the beginning of winter. The total length will be 10 miles. Power will be obtained from the River Saale. The consul also states that the projected electric railroad between Leipzig and Halle has been abandoned, the Prussian and Saxon governments having refused to grant the necessary franchises.

Extension of the Snoqualmie Falls Plant.

The Snoqualmie Falls Power Company, transmitting to Seattle and Tacoma, is preparing to increase from 8000 horse-power to 20,000 horse-power. At present there are four 2000-hp units at the Falls. The transmission voltage is 30,000. The Abner Doble Company, of San Francisco, which furnished the waterwheel equipment for the initial installation, is figuring upon placing its wheels in the new extension, and an engineer of another waterwheel concern is likewise looking into the matter. The waterwheel contract will not be let for 60 days yet. If an impact wheel is used there will be a single wheel on each end of each 3000-kw generator shaft, and each wheel will be driven by a single jet of water 14 inches in diameter, the two jets combined being sufficient under the existing head of 270 ft. to give the requisite power. The two waterwheels and the generator between will be built on a single hollow shaft of oil-tempered nickel steel.

The present underground generating station, which is 200 ft. long, is to be lengthened out 150 ft. up stream, to make room for the new installation. A new penstock is to be built, which will carry 50 per cent more water than the old one. The transmission line that is to parallel the old line, will require 125 tons of aluminum wire, and the order for it has already been placed. At Tacoma a large and commodious brick and stone sub-station is now being erected. The entire cost of these improvements will be in the neighborhood of $400,000. The work is to be vigorously prosecuted, and it is expected that the first of the new generators will be delivering current into Seattle and Tacoma within the next nine months.

The generating machinery will consist of three 3000-kw rotating field generators of the two bearing type, generating a three-phase current at 1100 volts and 60 cycles. The speed is to be 100 r. p. m. Each generator will require an exciting current of 320 amperes approximately, at 125 volts. For exciting these three generators a 220-kw, eight-pole, direct-current generator of the two-bearing type is to be used. At 175 r. p. m. it is to deliver under normal load a current of 1600 amperes at 125 volts.

The current which is generated at 1100 volts is to be raised to a line potential of 30,000 volts by nine 1000-kw, oil-insulated, water-cooled transformers. These are to be delta-connected on both the primary and secondary sides. It is estimated that each transformer will weight 11,000 lbs., and require 500 gallons of oil. The switchboard that is to be installed is to consist of 14 panels of white marble and is to be of the special type that was furnished for the original installation. Instead of the Niagara type single-phase indicating wattmeter that is in use on the present switchboard a polyphase long scale indicating wattmeter is to be used. Where formerly a field plug switch was used a double-pole field switch is to be employed. The standard equipment of synchronizing lamps is to be replaced by a single-pole plug switch mounted on the generating panel and connected to a synchroscope, which will be mounted on the multiplying panel. The increased capacity of the generators will necesitate placing three single-pole main switches instead of one three-pole main switch. The circuit breakers which are to be non-automatic will be placed on an extension panel above the main instrument panel.

Each of the three generator panels is to be furnished with the following instruments: One 3000-ampere, non-automatic, double-pole circuit breaker; three 3000-ampere, single-pole, double-throw, main switches; three 3000-ampere, long scale, alternating-current ammeters; one 400-ampere Westinghouse round pattern, dead-beat, direct-current ammeter for field circuit; one 400-ampere, double-pole, single-throw, quick break, field switch, with shunt resistance and discharge attachment; three series transformers, two shunt transformers, etc., etc.

The multiplying panel, which is to carry the necessary instruments for multiplying the duplicate sets of three-phase bus-bars, will be furnished with the following apparatus: One 3000-ampere, double-pole, non-automatic circuit breaker; three 3000-ampere, single-pole, single-throw multiplying switches; one synchroscope; one three-pole, double-throw switch for throwing the above specified synchroscope onto either one of the three sets of two-phase bus-bars, etc., etc.

For each group of three raising transformers there will be three switchboard panels similar to those at present installed in the generating station. Each of these panels will have mounted upon it the following apparatus: One 1500-ampere, single-pole, 1000-volt, automatic overload circuit breakers, with time limit relays; one 1600-ampere, long scale ammeter; one 1600-ampere, double-pole, double-throw main switch, etc., etc. For each set of three panels which con-

trols a group of transformers there will be needed: One polyphase, integrating wattmeter and two shunt transformers.

All the electrical apparatus is to be furnished by the Westinghouse Electric & Manufacturing Company. The installation and rapid increase of this plant is due to the energy of President Charles H. Baker, of the Snoqualmie Falls Power Company. It is certainly one of the finest and most reliable water power properties in the United States.

The History of a Municipal Enterprise in Toledo, Ohio.

The story of the manner in which at Toledo, Ohio, a municipal plant has once again proved a hollow fraud is given in the following special dispatch of Sept. 6 from that city:

Municipal ownership of a public utility has been tried in Toledo and found wanting. The city natural gas plant, which has cost the municipality about $1,500,000 so far, has just been turned over to the Toledo Gas Light & Coke Company, a corporation which has a monopoly of illuminating gas in this city. The company's bid for the plant, which the Council accepted, proposed a 20-year lease of the property, the city to receive $6,500 per annum in cash as rental; that illuminating gas shall be furnished at 95 cents a thousand cubic feet, and that fuel gas shall be paid for at the rate of 70 cents a thousand cubic feet.

The City Council refused to consider a second bid, which was supposed to come from Standard Oil interests, and which offered $7,000 in cash each year for 20 years for a lease of the plant, illuminating gas at 85 cents and fuel gas at 65 cents a thousand feet. The principal objection to this bid was that it was made by a local lawyer as trustee and that he refused to disclose the names of the persons for whom he was acting. Mayor Jones, who is known to be a stanch advocate of municipal ownership, neither signed nor vetoed the ordinance leasing the plant. The legislation was permitted to become operative under the State law which provides that municipal measures that are neither vetoed nor approved by the Mayor have the effect of law in 10 days after their passage by Council.

The city gas plant has had the stormiest career of any public utility in this part of the country. It was established in 1890, when a group of politicians made the people of Toledo believe that by the judicious expenditure of a million or so in building a municipal natural gas plant the people would not only get fuel gas dirt cheap for themselves, but could sell enough of it to manufacturers and others to pay the cost of the plant and also, in practically no time, pay off the city debt. So the people voted to issue bonds to the amount of $750,000 and went into the natural gas business.

Altogether since May, 1890, the city has issued $1,050,000 natural gas bonds, and has paid, or will have paid by Oct. 1 of this year, $449,500 interest on the bonds. And the interest account will keep up for many years to come.

The legislation which enabled the city to issue the gas bonds was passed only after the bitterest conflicts in the General Assembly and the City Council.

Failing to check the preliminary establishment of the plant, the opponents of the city line bent their energies toward preventing the city from marketing the bonds, and with partial success. The city next had difficulty in securing profitable gas territory. The gas supply which the municipality secured began to fail. Customers who had put up with cold meals in cold weather were loud in their grumbling; and presently it was not considered civic treason to condemn the city gas plant.

Pumps to re-enforce the pressure of gas were installed, and would have worked satisfactorily had there not been a constant dwindling of the supply in the city's gas wells. Within the last three years patrons dropped away from the line to such an extent that it no longer paid expenses; and when 18 months ago, an ordinance was introduced in the Council to invite bids for the property, there was little popular opposition.

One of the recent financial reports made by the trustees showed that there was but $30 in the city gas fund. As fast as the opposition company could put in connecting lines for them, former patrons of the city line went over to the private concern, until the city line's customers could be counted on the fingers of both hands. Now the former stanch supporters of the municipal gas line are willing to admit that it was one of the most disastrous undertakings the city ever assumed.

Independent Telephony in Ohio.

While Ohio is admittedly the stronghold of the independent telephone movement, and the development has reached a higher plane than in any other State, the territory is far from being fully developed. Although over 1200 towns, villages and hamlets are reached by the independent lines, new exchanges are being built as rapidly as ever before, and at the present rate it seems probable that it is only a question of a year or two before every citizen of the State will be accessible by the independent lines. Just at present the movement is especially progressive and within the next two or three months a number of important exchanges, giving service to thousands of new subscribers, will be cut into the main system. It might be added that some of the companies which have commenced business within the past year have made some astonishing gains. Here are a few of the latest developments in the State: Ground has been broken at Dayton for a system which will cover the whole of Montgomery County, the original investment for which will be $750,000. The business section of the city system will be all underground, and work has started on an exchange building which will cost $50,000. A contract has been placed for a Kellogg multiple central energy switchboard of 10,000 capacity. Rates will be $24 for residences and $40 for business. Since June 1, 2200 contracts have been closed. Practically the same condition exists at Toledo where 400 men are at work on the new system. Inside of three months, it is claimed, 5500 subscribers have been secured, and the exchange will probably open with 6000. At present the Bell company is said to have 2695 names in its Toledo directory. About Oct. 1, the following large exchanges will be opened for business: Canton, 1500 subscribers, ultimate capacity of board, 2000; Alliance, 450 subscribers, ultimate capacity, 600, both exchanges having Kellogg boards; Mansfield, 1200 subscribers, ultimate capacity 2000; Zanesville, 1200 subscribers, ultimate capacity 2000, both with American Electric Telephone boards. At Lima a new company has recently bought up the old independent exchange, and is rebuilding it, installing a Sterling board. The exchange will open in the near future with 1200 subscribers in the county, this being one of the best farming sections of the State. It is stated that the opposition has 694 subscribers in that district. At Bowling Green, a town of 5000 inhabitants, the independent company, has made an increase since Dec. 1, from 128 subscribers to 512. Within the next 30 days the Massillon Telephone Company will be consolidated with the Stark County Telephone Company, one of the properties of the Federal Telephone Company. The Massillon company has 800 subscribers against 325 for the opposition, and subexchanges are to be built in the neighboring towns of Canal Fulton, Dalton and Navarre, which are to be included in the deal. The Columbiana County Telephone Company will soon open exchanges at Toronto and New Cumberland. This company has 2500 subscribers against 793 for the opposition, and it has increased the number from 1400 since December.

It is a surprising fact that while Cleveland has the largest independent exchange in Ohio, and, it is claimed, in the country, it is, with the exception of Cincinnati, which is not developed, the only large city in the State in which the opposition has the advantage. A year ago the Cleveland Telephone Company (Bell) had about 12,000 subscribers, while the Cuyahoga Telephone Company had about 6000. General Manager Mark Davis, of the latter company, claims that on Sept. 1 a comparison of the two directories shows that the Bell company has 9500 subscribers and the independent 8500; and he adds that Jan. 1 will see the conditions reversed.

It is stated by the officials of the Federal Telephone Company that it is now only a matter of a year or so before there will be a powerful independent exchange in Cincinnati connecting with the surrounding towns. It is stated that while the Federal Company will not control the new situation, it will lend its support to the work, since an exchange at this point is much needed to increase the efficiency of the long-distance wires throughout the State.

Electricity for the Trunk Roads.

It is stated that a general conference of the operating officers of the railroads operated between New York and Chicago will be held to consider suggestions for operating suburban passenger trains by electricity. Propositions have been submitted by electricians to substitute electrical power for steam with guarantees that heavy trains can be moved with regularity and safety at the rate of 70 miles per hour.

Convention of the International Association of Municipal Electricians.

MR. MORRIS W. MEAD, the president of the International Association of Municipal Electricians called the meeting to order at 2 p. m. on Monday, Sept. 2, at the International Hotel, Niagara Falls, N. Y., nearly 150 members being present. The Rev. A. S. Bacon offered the opening prayer, following which Mayor M. B. Butler delivered the address of welcome. He referred to the great power development, and noted how closely allied to it were the interests of the members of the association. Captain William Brophy, of Boston, responded to the Mayor's address in behalf of the association.

The address of President Mead was then delivered. Its import was that the members were there for business. His remarks, which were of a thoughtful character, contained many excellent suggestions, and were replete with valuable information. He believes in progressive electricity, and desired every member to keep fully abreast of the times.

When President Mead finished his address, which was listened to with close attention, Frank C. Mason, of Brooklyn, stepped to the front and, on behalf of the association, presented to Morris W. Mead, Jr., the latest member of the Mead household, a solitaire diamond ring and a Niagara souvenir spoon. Three cheers were given for Master Mead, and he was made an adopted son of the association.

Various letters and invitations were read, and then W. Y. Ellett, of Elmira, N. Y., was appointed sergeant-at-arms. W. M. Petty, superintendent of telegraph of the Rutherford, N. J., fire department, read a paper on "The Protection of Fire and Police Telegraph Wires from High-Tension Currents and Lightning." He thought the term "lightning arrester" was a misnomer, that the apparatus should more properly be known as a "diverter." He also advised the abandonment, except for testing purposes of the ground wire now found in general use in the fire-alarm boxes. Mr. Petty's paper was warmly discussed by all the members, the debate consuming the entire remainder of the day's session. Before adjournment, President Mead announced that Friday, Sept. 6, had been bulletined as Municipal Electrician Day by the managers of the Pan-American Exposition at Buffalo.

During the session the ladies of the party were entertained by a local committee with a carriage drive through the park, a visit to the Natural Food Conservatory, and other points of interest. In the evening there was a ride down the gorge electric road to the Whirlpool Rapids and return, with electric searchlight effects.

The convention reassembled on Tuesday morning at 9.30. Mr. Guy Owen, a delegate from Honolulu, Sandwich Islands, was introduced. He stated that he would be glad to explain the fire-alarm system in use in Honolulu to any of the members.

Mr. H. W. Pope, general manager of the Bell Telephone Company, of Buffalo, N. Y., was next introduced, and addressed the convention at some length. Mr. Pope, in his preliminary remarks, mentioned the fact that in 1870 he called a convention of American district telegraph superintendents which included the fire alarm people of those days. He then explained the availability of the telephone in fire and police telegraph service, and stated that the company of which he is manager had a record of giving local telephone connection in the average time of three seconds.

In the discussion that followed, Mr. F. C. Mason, of Brooklyn, described his telephone system which he said was a very efficient one, and gave general satisfaction to all of the city departments. Mr. H. W. Pope was voted the thanks of the association for his address, and was elected an honorary member of the organization. It was decided that a certificate of membership should be issued to all members, and the matter was referred to the executive committee. The report of the committee on statistics was next received, and the commitee was ordered to continue its work and to report further at the next convention.

Next in the order of exercises was a paper entitled "Municipal Control vs. Municipal Ownership," which was read by the author, E. F. Schurig, city electrician of Omaha, Neb. Mr. Schurig in summing up his argument expressed himself as not in favor of municipal ownership, but approving municipal control. This paper was freely discussed, together with the paper following, written and read by Captain William Brophy, of Boston, on "Inadvisability of Placing High and Low-Potential Wires Through the Same Series of Conduits, or Through the Same Manholes."

Secretary Frank P. Foster then read a paper entitled "Improved Storage Battery for Municipal Purposes," contributed by J. W. Aydon, of Wilmington, Del.

Mr. H. C. Bundy, of Watertown, N. Y., explained the make-up of his storage battery.

At the afternoon session Secretary Foster read a paper from the pen of Mr. P. H. Trout, Jr., of Lynchburg, Va., on the "Need and Value of a Set of Rules for Outside Construction."

On Wednesday, Sept. 5, the meeting was called to order at 8.30 a. m. by President Mead, who introduced P. H. Alexander, of New York. Mr. Alexander read an interesting paper on "Magneto Electric Car Brakes." This received the close attention of all present, and a vote of thanks was given to the author for his contribution.

Dr. L. E. Niles, president of the Magneto Electric Company, of New York, was introduced and asked to explain his magneto system for fire and police telegraph. This system was described and illustrated in Electrical World and Engineer, Dec. 1, 1900. A committee of five was appointed to examine and report upon the magneto system at the next meeting of the association. This committee consists of F. C. Mason, R. E. Moran, of Memphis, Tenn.; Captain William Brophy, of Boston, Mass.; E. F. Schurig, of Omaha, Neb., and J. Murphy, of Cleveland, Ohio.

Richmond, Va., was selected as the next place of meeting, the date thereof to be named by the executive committee. The following officers were then chosen for the ensuing year:

A. S. Hatch, president, of Detroit, Mich.
W. M. Petty, first vice-president, of Rutherford, N. J.
A. G. Farrand, second vice-president, of Atlantic City, N. J.
William Crane, third vice-president, of Erie, Pa.
William A. Barnes, fourth vice-president, of Bridgeport, Conn.
F. P. Foster, secretary, of Corning, N. Y.
Adam Bosch, treasurer, of Newark, N. J.

Captain Brophy, in a few well chosen remarks, eulogized the efficient work performed by Frank C. Mason, of Brooklyn, in organizing the association. By a unanimous vote of those present Mr. Mason was elected a life member of the association, a well-deserved compliment for faithful service.

Origin of "Mother of Pearl" Clouds.

The daylight effect of the aurora borealis would appear to be that of "mother-of-pearl" clouds. The last Danish expedition which was sent to the Polar regions to study the aurora borealis observed these so-called "mother-of-pearl clouds," which are described in the reports of the Danish Academy of Sciences. These clouds resemble the so-called "shining clouds," and were given their name by the Norwegian meteorologist, Professor Mohn. The Danish scientists twice had an opportunity of seeing such celestial phenomena. Once they succeeded in measuring the distance of these clouds above the earth, which was found to be about 40 kilometers. The second time measuring was not possible because all the members of the expedition were in one place, but they were able to make some observations about the movement of the cloud. At first it looked like a horizontal band in the southwestern horizon at a height of 30 or 35 degs. Then it moved slowly toward the east, stopped, and finally returned to its original position. During its retrograde motion a part of the cloud was torn off, the fragment assuming a circular shape, and floating alone with a rapidity of 1 deg. in 4 seconds toward the south. Having passed through 7 degs. of the firmament, this small cloud was dissolved.

It is evident that these motions are peculiar to the "mother-of-pearl clouds," because another cloud which was in the same tract of sky at the same time remained motionless. The color of these formations at the edge was mostly red, but toward the middle it changed from rose color to green. The clouds were visible in broad daylight about noon. An observation through the spectroscope gave only the lines of the common spectrum of the sky at daylight, together with some absorption lines, which indicate a great quantity of vapor. It was perhaps the strong sunlight which prevented the observation of any peculiarities in the spectrum of these clouds.

Their motion cannot be caused by any wind. Professor Poulsen, the head of the expedition, is rather of the opinion that the "mother-of-pearl clouds" are moved by other forces, partly, perhaps, by electricity. Poulsen explains the formation of such a cloud by currents of negative electricity, by virtue of which the atmospheric vapor is condensed. The clouds probably move in the direction of the electric currents.

The Pittsburg Exposition.

The thirteenth annual exposition was opened in Pittsburg on the evening of Sept. 4, and it is the general verdict that this year's show is a worthy successor to its predecessors.

The exposition was organized for the purpose of giving every year an exhibition of the goods made by local manufacturers. Among the exhibitors are locomotive builders, steam engine makers, gas engine manufacturers, etc. In the electrical field the Westinghouse Company, of course, takes the lead. It has a number of its generators, motors and switchboard appliances in its space. An exhibit is also made of the Nernst lamp, which is attracting a great deal of attention, because it is the first time the local public has had an opportunity of seeing this new lamp.

The exposition building is brilliantly illuminated by several thousand incandescent and arc lamps, furnished by the Allegheny County Light Company and the Westinghouse Company. It will close Oct. 31.

The New York-Buffalo Automobile Test.

A most interesting start was made on Monday morning at 8 o'clock of the New York-Buffalo endurance test of the Automobile Club of America, for which at the close of the prescribed time there were no fewer than 85 entries, not one of which, however, was electric. The distance to be traversed this week is about 465 miles, including some of the worst roads in creation running through the oldest and most civilized and densely populated portions of New York State. In fact, part of the route had to be changed before starting on account of a "washout" near Albany. The rules of the contest were published in full in the ELECTRICAL WORLD AND ENGINEER of Aug. 3, all based on the idea of maintaining an average speed rather than making a high rate at any time, the limits being 8 and 15 miles per hour. The vehicles are divided in three classes: A, under 1000 lbs.; B, 1000 to 2000 lbs.; C, 2000 lbs. and over; D, motor cycle class, and E a special class for public delivery wagons. In addition to the three classes of certificates to be awarded there will be three cups, one for each class, A, B and C, from Messrs. Shattuck, Whipple & Scarritt, for a hill-climbing contest at Nelson Hill on the first day.

Among the starters on Monday morning were Messrs. A. L. Riker and wife, in a handsome 16-hp Electric Vehicle Company's Riker gasoline touring car; H. Ward Leonard in his 5-hp gasoline, and C. J. Field in a De Dion-Bouton gasoline motorette. There were several gasoline Electric Vehicle automobiles in the line. Of the 80 vehicles listed in the printed schedule issued before starting no fewer than 53 were gasoline. Several of the vehicles were of foreign make, chiefly, if not wholly, French, and many of them Panhard-Levassor, one of which was occupied by President Shattuck.

CURRENT NEWS AND NOTES.

A MAGNETIC OBSERVATORY is to be built by the United States Government at Sitka, Alaska. Dr. H. W. M. Edmonds, of the Coast Survey, is in charge of the work.

THE CZAR IN FRANCE.—During his visit to France the Czar of Russia is to visit the famous chateau of Compiegne, so closely associated with the Napoleonic regime. The most difficult problem in connection with making the chateau ready for the Czar has been fitting it with electric light. The difficulty has been overcome by passing a cable up to the roof and thence distributing wires through the windows. The chateau will be provided with 1600 lamps of 16 candle-power for the apartments and 600 for the theater. Motive power is provided by four 75-hp engines placed in the confines of the park. The power house and cable connections will be carefully guarded by troops.

REFLECTING INCANDESCENT LAMP.—A patent granted Sept. 3 to P. A. Gibbins describes an incandescent lamp in which the filament is in proximity to a prismatic reflector. Several forms of reflectors are shown, one being in the form of a cylinder with a star prismatic section, another in the form of a corrugated ellipsoid—in both of these cases the filament being arranged spirally about the reflector. Two other forms are shown for use when the light is to be cast downward, in this case the prismatic reflector having a corrugated spherical surface. The interior of the reflector is coated with any suitable substance to make a reflecting surface. It is claimed that there is an advantage from having the exterior surface in the shape of a series of prisims.

WATTMETER BRAKE.—The usual method of braking employed in electric meters is based upon the application of a Foucault disk rigid with the indicating device. A disadvantage of this method is that it renders the moving parts very heavy, whereby the sensitiveness of the apparatus is greatly diminished, the pivots wear quickly and a special arrangement is necessary to prevent breakage of the pivot stone when transporting the apparatus. In a patent granted Sept. 3 to Felipe Saldana, the ordinary movable solid disk is replaced by a ring which moves through a highly concentrated magnetic field having only the width of the ring. By this means the weight of the moving part is stated to be very greatly reduced.

PROTECTING THE CHILDREN.—President Jacob L. Greatsinger, of the Brooklyn Rapid Transit Company, has had an interview with Deputy Police Commissioner York, in which he suggested that the police aid in preventing trolley accidents in the future. President Greatsinger believes that the danger may, to some extent, be obviated if very young children are not permitted to play in the streets where the cars run. It was pointed out to Mr. York that of the deaths reported from trolley accidents during the last eight months 17 of those killed were little children. The plan of segregating the children in the quiet streets is not regarded as feasible by the Deputy Commissioner. He, however, promised to do all in his power to assist the railroad officials. Instructions have been sent to the police of every precinct in the Borough directing them to look carefully after the children. If any are found playing in the middle of the street along trolley routes they are to be turned back to the sidewalk.

BRITISH PACIFIC CABLE.—An interesting report, showing the progress of the work on the British Transpacific cable—to be the longest cable ever laid—has been received at the State Department from Consular Agent Robinson, at Norfolk Island. The report states that on the passage across to Norfolk Island from Brisbane, Australia, soundings were taken every 10 miles by the British cable steamer "Britannia," which is being used to mark out a track for the cable. About 100 miles from the coast an obstruction was met with in the shape of a range of submarine mountains lying directly in the track, and a deviation to the south had to be made to clear it. The greatest depth obtained was 2800 fathoms, and the most shallow 237 fathoms, the latter being the depth recorded when the ship was right above the tops of the mountains. It has been decided to land the cable at Anson Bay, on the west side of Norfolk Island, and a cable house is to be built there. Norfolk Island will be one of the most important stations of this cable route, as all messages to Australia and New Zealand will converge there to be repeated.

ILLUMINATION FROM ARC LAMPS.—In the discussion at the recent convention of the Ohio Electric Light Association it was stated that alternating-current enclosed arc lamps had been found to make mahogany furniture appear to be covered with a bluish-white fine dust, and a remedy was asked. One of the audience said that a reduction in the size of the carbon, or an increase in the current, or both, would be beneficial, though a careful selection of globes would do much in the right direction. Globes of a greater opalescence filter more of the violet light and have a tendency to make a more perfect balance of the spectrum, thus approaching the daylight effect. Another member advised the use of a 7 or 7½-ampere lamp, and said that he had observed that the quality of the light from an alternating-current enclosed arc lamp is materially improved by raising the voltage. It is not only the increase in the quantity of light that causes the improvement, which is also due to the increase of current at the arc, whereby the carbons are heated to a high degree and become to a certain extent luminous members, and assist the steadiness of the illumination at the moment the arc changes its polarity. Shortening of the arc will also help to overcome the difficulty mentioned, but an increase in current will remedy the defect to a greater extent.

THE ELECTRICAL EXHIBITORS' CLUB at the Pan-American has elected as honorary members Messrs. Moore, assistant chief of the machinery section, etc.; L. Stieringer, consulting electrical engineer; H. Rustin, chief of mechanical and electrical construction, and Professor G. F. Sever, superintendent of electrical exhibits.

TRANSPORTATION DAY will be celebrated Sept. 14, all being well, at the Pan-American Exposition, and should draw crowds. Senator Depew, formerly president of the New York Central Railroad, is to make the oration in the Temple of Music. A pageant is proposed illustrative of the evolution of the arts of transportation.

PIKE'S PEAK ELECTRIC ROAD.—A newspaper dispatch reports that Colorado Springs capitalists have organized a company to build an electric railway to the top of Pike's Peak, an altitude of 14,143 ft. The road will cost $500,000 or more. It will start from Colorado Springs, or from some station on the Cripple Creek Short Line. Work will begin immediately.

DRAWBAUGH IN WIRELESS TELEPHONY.—It is stated that Mr. Daniel Drawbaugh, of telephone invention fame, has developed a system of wireless telephony and telegraphy. He uses the "strong electric currents in the earth" as the medium of communication. The newspaper containing this information refers to Mr. Dawbaugh as "the aged farmer of Eberly's Mills."

A PROTECTIVE PHONOGRAPH.—Dr. S. H. Albeneius, of Central Avenue, Jersey City, has recently put in operation a large concert phonograph in opposition to the Salvation Army meetings, which are held nightly at Central Avenue and Charles Street. The phonograph, it is said, has completely routed the singers, who have been making life a burden by their intolerable noise.

COLORADO SOUTHERN TO USE ELECTRICITY.—President Frank Trumbull, of the Colorado & Southern Railroad, who is now in New York, says that the directors of his company are considering a plan to use electric motors on the suburban service in Denver territory. This change is regarded as practically certain, and believed to insure a marked saving in operating expenses.

SUPERSEDING STEAM LOCOMOTIVES.—It is stated that President James J. Hill, of the Great Northern Railroad, has ordered that steam locomotives be superseded by electric motors on the Cascade division of the Great Northern. If this change works out satisfactorily the electric motors will be introduced into other divisions of the Great Northern system. The gases in the Cascade tunnel have already overcome several of the engineers.

READING METERS.—At the recent meeting of the Ohio Electric Light Association Mr. Alexander Dow remarked that the best practice now is not to use dial blanks for indicating positions of the hands, but to allow the inspector to put down the figures as he reads them. Electric light companies have in this respect profited by the experience of the gas companies, the practice of which is now to record the reading in figures without showing the dial position.

TELEGRAPH LINES TO STRAITS OF BELLE ISLE.—The Dominion Government telegraphs have been extended to Chateau Bay in the Straits of Belle Isle, and stations have been established at Pointe du Maurier, Harington, Mutton Bay, St. Augustin, Bonne Esperance, Blanc Sablon, Red Bay, and Chauteau Bay. From the latter place a cable will be laid to Belle Isle, and a signal station established. It is the intention of the Government to test the Marconi wireless system between the same points. The completion of this work will be of assistance to the shipping using the Straits route.

METER REPAIRS.—In a discussion on the subject of wattmeters at the recent meeting of the Ohio Electric Light Association, one of the speakers said that whenever a jewel is changed in a meter the pivot should also be changed, as in 90 per cent of the cases the pivot will be found defective as well as the jewel. Referring to a statement that in one plant 261 jewels had been renewed, and but 33 pivots, the prediction was made that the meters would on the next test show a still more alarming condition than in the first instance, owing to the retention of pivots that were probably inferior and defective.

ARC LAMP FOR LUPUS CURE.—A dispatch from Copenhagen, Denmark, says that Dr. Sophus Bang, manager of the laboratory belonging to Professor Finsen, inventor of the light cure for lupus, has constructed a special electric lamp, giving a feeble light, but which is extremely rich in chemical rays. The dispatch adds that Dr. Bang used metal instead of carbon "points." The bacteria-killing power of this lamp is 10 times as great as that of an ordinary arc lamp, and a lupus patient requiring 75 minutes' treatment with the arc lamp will require only from three to five minutes' treatment with the new one.

END OF PIGEON POST.—A special dispatch from London of Sept. 7 says: Lord Roberts has once more openly shown his contempt of some of the methods of Lord Wolseley, his predecessor in the office of Commander-in-Chief. He has ordered the discontinuance of the experimental pigeon post service for war purposes at Aldershot, which was instituted by Wolseley. The pigeon loft is now being removed and the birds disposed of. Several hundred young birds had been already trained up to 20 miles, and the officer in charge stated as his opinion that the experiment had more than justified itself. About $6,000 has been spent on the scheme.

WOES OF THE ENGLISH TELEGRAPH GIRL.—A cable dispatch from London of August 31 says: The Central Telegraph office has been a scene of embittered strife between the controller and 2000 women telegraphers. The controller, who is a man of severe mind, trained in the north, ordered the closing, during working hours, of the dressing rooms where looking glasses are kept. The girls petitioned against this, and protested against his tyranny. The controller replied by accusing them of squandering the time of the Government. Despite angry appeals over the controller's head, he still refuses to unlock the door, and the girls have to take messages for eight hours without having a look at themselves in the glasses.

RUBBER IN FRENCH AFRICA.—A consular report says that explorations in connection with the production of rubber began in Madagascar in 1851, and have of late years increased to a notable extent. M. Jamelle recently called attention to the "piralahy," a new shrub of the genus *Landolphia*, which is found in the forests of Bueni, in Majunga, in Andriba, and in the valley of Betisbooka. In the French Kongo, also, a few apocyneous plants of the genus *Landolphia* are met with, which yield a quantity of india rubber. The amount produced is estimated at 500 tons per annum. The whole country, says M. Savorgnan, is literally covered with rubber trees. The yield in Senegal is small at present. The aborigines are just beginning to bring into the market a clear substance called kurussa, whose commercial value approximates that of the rubber of Para.

CANADIAN LONG-DISTANCE TRANSMISSION PLANTS.—In view of the increasing number of transmission enterprises in Canada, the following data on such plants now in operation and in course of development will be of interest: Chambly Manufacturing Company, Chambly, Que., 20,000 horse-power, 17 miles to Montreal, 25,000 volts; Hamilton Electric Light & Cataract Power Company, De Cew's Falls, Ont., 10,000 horse-power, 33 miles to Hamilton, 22,500 volts; West Kootenay Electric Power Company, West Kootenay, British Columbia, 4000 horse-power, 30 miles, 20,000 volts; Dominion Government, Soulanges Canal, Que., 700 horse-power, 14 miles, 2400 volts; Light, Heat & Power Company, Lindsay, Ont., 535 horse-power, 17 miles, 11,000 volts; Trenton Electric Company, Trenton, Ont., 735 horse-power, 12 miles, 11,000 volts; British Columbia Electric Company, Victoria-Goldstream, B. C., 1000 horse-power, 12½ miles, 10,000 volts; Shawinigan Water & Power Company, Shawinigan Falls, Que., 10,000 horse-power, 80 miles to Montreal, 33,000 volts (projected transmission); Canadian Niagara Falls Power Company, Niagara Falls, Ont., 15,000 horse-power, 90 miles to Toronto, 44,000 to 66,000 volts (projected transmission); Lachine Rapids Hydraulic & Land Company, Lachine Rapids, Que., 12,000 horse-power, 6 miles to Montreal, 4400 volts; Canadian Electric Light Company, Chaudiere Falls, Que., 2000 horse-power, 9 miles to Quebec, 6000 volts; St. Lawrence Power Company, Mille Roches, Que., 4000 horse-power, 6 miles to Cornwall, Ont., and 73 miles to Montreal, 11,000 volts on Cornwall line.

HORSE CARS have now entirely disappeared from Massachusetts, except in museums, where they are placed alongside Indian arrow heads and flintlock muskets.

LIGHTS AND LIFTS FOR THE KING.—A very large sum is being spent in getting Buckingham Palace in readiness for the reception of the royal guests at the coronation of King Edward. Hitherto it has been lit by gas, but electric light is now being installed, the antiquated and faded furniture is being replaced by suits of more modern pattern, and the principal apartments are being newly decorated and fitted with luxurious, up-to-date appointments. As already noted in these columns, one of the innovations is a fine equipment of American electric elevators.

AN AUTOMOBILE SAVINGS BANK.—The authorities of Mezieres, France, wishing to encourage thrift, have had built to specifications, an electric motor car bank containing four seats, one for the driver and three in the rear arranged around a small table. Folding shelves make a desk for a person standing beside the vehicle. Under the table is a small safe. The passengers are two clerks from the local treasury department and a cashier. The car travels about the country making short stops in the villages on prearranged days, and receiving such sums as the citizens or farmers of the neighborhood may wish to deposit. Riches have been known to take wings, but this is the first time they took an automobile.

EXTRACTION OF PRECIOUS METALS BY ELECTROLYSIS.—An electrolytic amalgamator recently patented by Charles P. Tatro and George Delius, of Seattle, Wash., comprises a covered cylindrical tub in the bottom of which is a copper pan containing a body of mercury serving as the cathode to collect the precipitated metal. The anodes, of carbon, are suspended from the cover, while a bladed propeller, likewise hung from the cover, revolves beneath them and above the cathode, keeping the ore in suspension in the electrolyte. The device is thus a modification of the well-known Pelatan-Clerici cell, possessing the advantage that the attachment of the revolving blades to the cover permits the latter, and with it the anodes, to be lowered readily into a heavy pulp. An additional and novel feature is the provision of a small supplemental anode in the side of the tank, electrically connected to insure that a light current shall at all times flow to the surface of the mercury and thus prevent flouring or sickening when the main circuit is broken.

RAILWAY DEALS IN OHIO.—An important step was taken on Aug. 29 in the amalgamation of the Everett-Moore properties into the Lake Shore Electric Railway, when the directors of the Lorain & Cleveland, the Sandusky & Interurban, the Sandusky, Norwalk & Southern and the Toledo, Fremont & Norwalk companies met at Cleveland, Ohio, and unanimously voted to consolidate. Formal notices to the stockholders to meet Sept. 19, to vote on the proposition, were authorized and temporary officers of the consolidated company were elected as follows: President, Barney Mahler; vice-presidents, J. B. Hanna, W. H. Price; secretary, F. W. Coen; treasurer, C. H. Stewart. Directors: B. Mahler, J. B. Hanna, H. A. Everett, E. W. Moore, C. H. Stewart, J. B. Hoge, W. H. Gawne, H. W. Price and J. H. Harding. The consolidation will give a total mileage of about 159 miles. The Lorain & Cleveland has 22 miles, the Sandusky & Interurban, 53 miles; the Toledo, Fremont & Norwalk 52 miles, and the Sandusky, Norwalk & Southern 32 miles. The new company will be known as the Lake Shore Electric Railway Company. Reference to this new deal was made in these columns Aug. 31 last.

AN INDUCTION FURNACE.—An electric furnace in which conductive charges may be melted by currents of electricity induced within them has been patented (Sept. 3) in this country by the Swedish engineer, Fredrik Adolf Kjellin. The construction is extremely simple, the charge, which must be a conductor of electricity, being so packed within an annular groove in a body of refractory material as to form a closed circuit which constitutes the secondary of a step-down transformer, whose primary, a cored coil of insulated wire, is placed within the annulus, and connected to a source of alternating currents. In operation the current induced in the charge is found sufficient for such metallurgical operations as admit of a closed metallic circuit within the annular furnace chamber. The furnace would seem to be especially adapted for the melting of platinum and other metals which, particularly at high temperatures, possess such power of occluding hydrogen and other gases as to render it extremely difficult to obtain perfect castings by the use of the oxyhydrogen flame, or similar combustion methods. A furnace of the same general type has been heretofore patented in this country and abroad by Edward A. Colby, and in England by De Ferranti. Kjellin's construction differs from these in that compactness and an increased efficiency are gained by placing the primary within the secondary, and thus, for a furnace of given size, very materially reducing the space between these elements.

MAGNETIC SPEED INDICATOR.—Magnetic speed indicators have been devised depending upon the pull which moving permanent magnets exert on a copper disk, but one objection to this type has been that owing to the energizing magnets being movable, a speed indicator has to be made very large in order to produce an appreciable effect. Mr. Simon P. Storer in a patent dated Aug. 20 describes a magnetic speed indicator in which the magnet is stationary and having concentric annular poles adapted to give the most powerful effects. Within the field of this permanent magnet is mounted a soft iron keep or armature which is movable, being in the form of a cylinder moving in the space between the poles. The armature is furthermore toothed so as to cause a bunching or tufting of the lines of force in the magnetic field within which it moves. Concentric with the cylindrical armature is a copper cylinder which can be made the movable part, or the soft iron armature may be made movable. In either case, one part or the other when in motion exerts a pull which is in proportion to the speed of revolution, the pull being counteracted by a spring connected with the part upon which it is exerted. The latter part thus will be displaced from its normal position by an amount which is proportionate to the speed of the moving part. A copper shield may be placed in a fixed position close to the soft iron armature so as to act as a damper against any sudden acceleration of the armature, the instrument thus becoming dead-beat.

A NEW ARC LAMP.—A patent granted Sept. 3 to Daniel Higham relates to a direct-current, constant-potential arc lamp, and provides for a regulating series magnet having one portion of the winding fine and of high resistance, the other portion coarse and of low resistance, and a coil of high self-induction of low resistance in parallel with the fine wire portion of the magnet. The result of this arrangement is that the current entering the lamp divides between the inductance coil and the fine-wire winding, about 10 per cent of the current flowing normally through the latter. Upon an increase of the voltage in the mains or of a current in the arc, the inductance coil resists the increase of current in it and compels it to flow through the fine-wire winding. This effect is only momentary, however, since the inductance coil quickly adjusts itself to the new voltage, but results in strengthening the magnetism of the fine-wire coil, thereby lifting the carbon and lengthening the arc, which takes place before the arc can be seriously affected by the change in the current intensity. A dash-pot prevents the carbon from too violent or excessive movements, or from getting into a condition of rhythmic oscillation. Conversely, upon a decrease of current the magnetism of the fine winding is suddenly lessened and the carbon is dropped. One practical advantage claimed for a lamp thus constructed is that it automatically adjusts itself to any voltage, so that the same lamp can be connected to any circuits carrying, for example, anywhere from 90 to 120 volts without requiring any adjustment or change of parts. Another advantage from this consequent use of a long arc is the greater percentage of watts at the arc and therefore a higher efficiency, while the wide separation of the carbons largely prevents the shadow of the lower carbon from becoming objectionable.

LETTER TO THE EDITORS.

Elevating Presidents and Kings.

To the Editors of Electrical World and Engineer:

Sirs.—On page 38 of your issue of Sept. 7 you have a little squib entitled, "To elevate the King." One would imagine from reading this notice that there was something new about the automatic house elevator. Five years ago the Sprague Company contracted to install an electric one in the White House in lieu of the hydraulic one in

use there. It was installed by Mr. B. N. Jones, electrical engineer, then in the employ of the company. It has been used by the President, Mrs. McKinley, the visitors, the servants and whoever saw fit to utilize it. It performs every function described in your notice, and it is my conviction that were some one to compare it with the one you describe he would find them to be one and the same thing.

It would gratify me very much to see in your columns next week a little note indicating that the President, as well as the King, can be elevated automatically and electrically, and that the precedent was established by an American engineer. And if anybody asks you who that man was, you can say it was Frank J. Sprague. His work in developing the great trolley system of to-day is not the only thing of his that now enjoys world-wide repute and usefulness.

NEW YORK CITY. D. B. CLINTON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Artificial Loading of Alternating-Current Apparatus.—GOLDSCHMIDT.—An illustrated description of a method which often simplifies the heat test of large alternating-current apparatus. The machine which is tested is run unloaded at full voltage and the copper wires are heated by a current of normal intensity, but sent into the winding from an external source, especially from a direct-current machine. This requires, of course, that the direct-current machine supplies current to the winding of the alternating-current apparatus, without getting current from the latter. This can easily be done, for instance, with armature winding of three-phase generators connected in ring, as shown in the adjoining diagram. The winding is

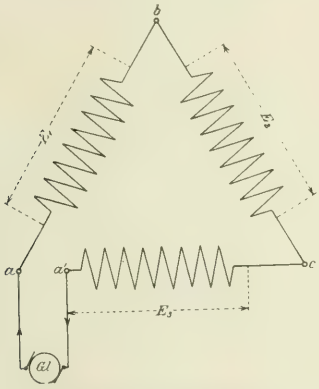


DIAGRAM OF ARMATURE WINDING.

cut at a point *a a'*, and a direct-current machine *Gl* is connected to *a* and *a'*. The geometrical sum of the three voltages E_1, E_2 E_3 is zero. It is true that the sum of the third harmonics does not disappear, so that at open circuit there is a considerable tension between *a* and *a'*. At closed circuit, however, the currents due to this tension are practically zero, because the reactances of the three-phases, connected in series, represent a very great reactance for the triple frequency. The direct-current dynamo is therefore to be connected before the three-phase machine is excited. The direct current in the three-phase armature does not produce a reaction upon the field magnets. Only local magnetic fluxes can occur. They do not cause large eddy currents in the pole shoes. As there is no armature reaction, one works, of course, with too small an exciting current and certain deformations of the field do not occur. The exciting current in our case is practically not different from that for non-induction full load. When the armature wires of the three-phase generator are heated, their resistance increases, so that to get the normal current, the direct-current voltage must continually increase. This increase of voltage, therefore, measures directly the increase of temperature of the armature winding. He then discusses how to apply this method to three-phase alternators with star connection, and to tests of transformers. It is not possible to apply this method to tests of three-phase induction motors.—*Elek. Zeit.*, Aug. 22.

Large Direct-Current Generators.—H. M. HOBART.—An article referring to the paper of Rothert, abstracted in the Digest, March 23, and discussing several general points of the design of large direct-current generators. He discusses in detail the design of a 1000-kw, 500-volt tramway generator. He remarks that the requirements in the United States differ from those in Europe. In the United States it is generally required that an overload of 50 per cent for two hours does not cause detrimental sparking or heating, that for continuous operation at normal load the increase of the temperature over that of the room, measured by a thermometer, is not more than 35 degs. C., that a momentary overload of 100 per cent does not cause detrimental sparking or heating. The corresponding requirements, usually made in Europe, are that an overload of 25 per cent during half an hour does not cause detrimental sparking or heating, that for continuous operation at normal load, the increase of temperature over that of the room, measured by the thermometer, is not more than 50 degs. C., and that a momentary overload of 50 per cent does not cause detrimental sparking or heating. He is of the opinion that the design of a direct-current machine should be based upon the conditions of good commutation. He thinks that Rothert's choice of the same number of poles for 500, 250 and 125-volt machines is not good. For the same power these three machines should be designed differently. For a 500-volt, 1000-kw machine, running at 90 revolutions, he would choose 16 poles, for a 250 machine of the same power and speed, 20 poles. He discusses several general points of the design, and, among other things, he remarks that one should not hesitate to use a high number of revolutions, if this gives a sufficient advantage. He discusses in detail the merits of three different designs of a 1000-kw, 500-volt machine. One design is due to Siemens & Halske, of Vienna, the second to the General Electric Company, of this country, and the third to the author. The latter design he considers a modification and improvement of that of the Gen. Elec. Co. All the details of construction of the three machines are given in comparative tables, and the merits of the three designs are discussed.—*Elek. Zeit.*, Aug. 15.

REFERENCES.

Construction of Alternators.—LASCHE.—A continuation of his well illustrated serial on the construction and systematic manufacture of alternators. He describes the stiffened cast-iron casing, and the stiffening of the armature ring by ties.—*Eng'ing*, Aug. 23.

Slotted Armature.—ROTHERT.—An illustrated translation of his German article on modern windings for direct-current slotted armatures, recently noticed in the Digest.—Lond. *Elec. Eng.*, Aug. 23.

Automobile Motors.—GASNIER.—An illustrated description of quite a number of motors, made by Postel-Vinay for use on automobiles. The construction of the motors is described and illustrated and characteristic curves of the behavior of the motor are given.—*L'Ind. Elec.*, Aug. 10.

POWER

Choice of an Electric Power Distribution System in Factories.—MOSES.—A discussion of the relative merits of the direct-current and polyphase alternating-current systems and of the best choice of voltage for power distribution in factories. The alternating current two or three-phase system at 500 to 220 volts is slightly simpler and more durable and more free from breakdowns than the direct-current system, on account of the simple construction of the induction motor and the absence of a commutator. But in all other regards the direct-current system is said to be preferable. The alternating-current system is not yet fully standardized. It is not applicable yet to charging storage batteries, to railroad work, or to hoisting. The starting currents under load are large, causing more or less fluctuation in lights, and the first cost of dynamos and motors is between 25 per

cent and 35 per cent higher than that of direct-current apparatus of the same capacity. Therefore, unless these disadvantages are balanced by the possibility of commutator troubles, the direct-current system is at present preferable and advisable for ordinary cases of factory transmission. Regarding the best pressure, he says that the advantages of a high transmitting pressure, such as 440 to 500 volts, are low first cost and small bulk of wiring, switches and controlling apparatus. The disadvantages are increased liability to ground, danger of shock, increased number and decreased size of field armature wires and of commutator bars. For small motors, 5 to 50 horsepower, for transmission over short distances, such as 200 to 400 ft., and for fluctuating work, such as elevators, presses, cranes, punches, etc., the 125-volt two-wire system seems preferable. For large motors, transmission over comparatively long distances, or for steady work, where mechanical strength is not essential and where the motor will receive attention, as in silk mills, carpet works, etc., or for work where minimum weight and size are important, the 240-volt system, or one of higher pressure, is usually the best fitted for the purpose. The lighting also has an important bearing on the choice of pressure. He recommends to use 110 to 125 volts for lighting, no matter what pressure is used on the motors. Where the motors operate at 220 to 240 volts, a three-wire system may be used, either with two 120-volt dynamos in series, or a 240-volt dynamo with a small motor-dynamo as balancer, or a 240-volt Dobrowolski dynamo with three brushes. The latter method has recently been adopted for the first time in the United States in the South Station of Boston, and he thinks it will be largely used in future (regarding the Dobrowolski dynamo with three brushes, see for instance, the papers of Sengel, Digest, Sept. 3, 1898, and June 23, 1900). His general conclusion is "that at present prices the 125-volt direct-current two-wire system is the preferable one in most instances, and little or no trouble with the motors or dynamos is experienced at this voltage. Where the distance through which the power is to be transmitted is such as to make the cost of wires for carrying the current too great, the 240-volt direct-current three-wire system should be used. Where there are special features, or where the power is transmitted a distance too great for the 240-volt direct-current system, the three-phase alternating-current system, 60 to 70 cycles per minute, becomes necessary and gives thoroughly satisfactory results. The greatest drawback to the alternating current system to-day is its excessive cost which brings no equivalent advantage."—*Eng. Mag.*, Sept.

Printing Machine.—An illustrated article on "Spence's electric motors for the Hoe four-roll printing machine." At the Glasgow exhibition it prints and folds a daily journal at the following speed: 4, 6 or 8-page papers at 48,000 per hour, 20, 24, 28 or 32-page papers at 12,000 per hour. The mechanical construction of the machine is described. The machine is fitted with a complete electric motor driving equipment. There is a 50-hp, 500-volt compound-wound motor, running at 400 r. p. m. For preparation of the printing rolls and for leading in the paper, a speed of only 16 revolutions is required. This is accomplished by means of a motor-generator, which reduces the voltage. Most of the switching is done automatically.—Lond. *Eng'ing*, Aug. 23.

Electric Power in Factory.—An illustrated description of the electric installation of a billiard table factory in Chicago. There is a steam-driven 150-kw, direct-current generator delivering current at 220 volts. The factory is wired on the two-wire, 220-volt system, the lights and motors both taking 220 volts. There are 11,500 incandescent lamps of 16 candle-power, and six enclosed, constant-potential arc lights. There are 11 multipolar, 220-volt motors in the different departments. They are supported on overhead platforms, and are belted to line shafting for operating the wood-working machinery.—*West. Elec.*, Aug. 31.

REFERENCE.

Electric Percussion Rock Drills.—An illustrated description of the Durkee, Gardner and Hercules drills.—*Eng. News*, Aug. 29.

TRACTION.

High-Speed Electric Traction on Trunk Railroads.—SCHIEMANN.—A paper giving a review of the attempts which have been made in recent years to introduce electric operation on the existing trunk railroads. It is evident that on account of the long distances transmission by polyphase currents is necessary. The following four systems are briefly discussed: First, the polyphase currents are tranformed in converter sub-stations into direct current, which is supplied to the cars; second, the high-tension polyphase currents are transformed in transformer stations along the line into low-tension polyphase currents, the cars being supplied with induction motors; third, the high-tension polyphase currents are directly supplied to the cars, are transformed to low tension in transformers, placed on the cars, and then supplied to the low-tension induction motors, this system being used on a trial line of Siemens & Halske in Lichterfelde (see Digest, last week); fourth, the high-tension polyphase currents are directly supplied to high-tension induction motors on the cars, so that there is no transformation at all. Experiments with this system have been made by Ganz & Co. on a line near Budapest, three-phase current at 3000 volts being used. These experiments have been so successful that this system is to be used on an Italian road of 120 miles in length. Advantages, hoped for from electric operation, are higher speed, greater safety at high speed, and greater simplicity of the signals. If on the present trunk railroads the electric system is introduced, while the old schedule of the trains and in general the old methods of operation are continued, no great advantages would probably follow from electric traction. Such advantages would be obtained only by a change in the method of operation—more trains, shorter trains, higher speed.—*Elek. Zeit.*, July 25.

Large Generating Station Suggested for London Tramways.—G. WESTINGHOUSE.—A communication in which he suggests the formation of a "mutual supply and equipment company," which should supply current to the different tramway companies. The current should be generated in the large power house of the supply company. This would reduce to a minimum the required amount of apparatus and the inconvenience resulting to the public from the installation of such great undertakings. He recommends to use trains of three carriages, two being fitted with motors and controllers, the third being interposed, "unit control" being used. He strongly speaks in favor of large gas engines, supplied by producer gas, in the power house.—Lond. *Times*, Aug. 19; reprinted in Lond. *Elec.*, Aug. 23.

Automobile.—A long illustrated description of the "Electricia" automobile, built by Contal. The motor is enclosed, of light weight and good efficiency. The exciting field current can be varied in wide limits and there are two armature windings connected to two commutators. The combination of variation of the field strength with series parallel control of the two armature windings enables one to vary the speed at will, without changing the connection of the battery cells. The battery is of the Faure type. The grid is formed of two beveled plates, which are mechanically filled with the active material. The composition of the active material is kept secret, but is claimed to be entirely different from those generally used. The following results of tests made by the Central Laboratory of Electricity with a 21 plate cell, are given: Total weight, 28.8 lbs.; capacity, 434 or 384 of 290 watt-hours when discharged with 14 or 33 or 49 amperes, respectively.—*L'Ind. Elec.*, June 25.

REFERENCES.

High-Speed Electric Railway.—A note stating that the contemplated express service between Berlin and Hamburg continues to attract much attention. It will have to be carried above or below all existing railways, streets, etc. Three sets of rails are proposed, so that there are always two lines available, while the third is being repaired. Some notes are given on the calculated costs and the proposed schedule. During the hours of main traffic trains will go every 10 minutes.—Lond. *Eng'ing*, Aug. 23.

Recent Practice in Electric Railway Construction and Operation.—A long article on modern track construction, and on dangers of accidents on suburban lines, on grade crossings, and on single-track lines when cars running in opposite directions may collide. To avoid dangers of the latter kind, two methods of operation are open, which are discussed. The dispatching system, and the block system, with either automatic signals or the train staff.—*Eng. News*, Aug. 29.

Interurban Railway.—An illustrated description of the Toledo & Monroe high-speed electric railway, with high-tension three-phase current transmission and converter sub-stations.—*Elec. Rev.*, Aug. 31.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Single-Phase System.—WARRILOW.—An article in which he advocates the single-phase system and says that, by reason of its simplicity, it can and will be worthy of introduction as a standard method of generation and distribution. The chief drawback to single-phase supply up to the present has been its unsuitability to operate tramways directly and to meet the demands for motors of

large power. He thinks that while the chief problem is that of the tramways, it will not be so in future, as tramways of all kinds may be superseded by the automobile. He does not think that it is a great drawback that single-phase alternating currents cannot be used directly for charging storage batteries, as it is a small matter to drive a direct-current dynamo with a single-phase motor. Three-phase generation and direct-current distribution is said to be a "very doubtful method of obtaining electricity," as it lacks reliability and occasions greater outlay and maintenance. The original single-phase motor difficulty has proved to be of temporary nature, as single-phase motors are now obtainable with a good starting torque, and of high efficiency. "The field, then, lies before the single-phase system, which may be so far improved to meet the necessary demands, with the greatest simplicity at the least cost, items which form important factors in methods of generation and distribution, which our experience will teach us should be adopted as a standard for all electrical work."—Lond. *Elec. Eng.*, Aug. 23.

REFERENCES.

British Lighting Plant.—An illustrated description of the electric lighting plant of Luton. There are three 85-kw steam dynamos, a 42-kw steam balancer, and two batteries, each of 140 cells of the Chloride type, each giving 160 or 100 amperes for two or four hours, respectively.—Lond. *Elec. Rev.*, Aug. 23.

Lightning Arresters.—Mueller.—An illustrated article on the charge of overhead lines with static electricity and on the construction and installation of lightning arresters.—*Elek. Zeit.*, July 25.

Wires, Wiring and Conduits.

India Rubber Strip for Insulation Purposes.—Terry.—The pure rubber strip which finds application either as the first coating of power and light cables, or which is used alone for jointing in house wiring, is of two distinct makes, known as "cut" and "spread." Whereas at one time cut sheet was more largely used than spread, the reverse is now the case. This is due to motives of economy. The raw material is the same in either case. It is only after the initial stages of washing and drying that the methods of manufacture of the cut and the spread sheet begin to differ. A brief review of these methods is given. The manufacture of the cut sheet requires a large amount of expensive machinery and great care in the technical details, and is also somewhat dependent upon the conditions of the weather. In recent years, in continental Europe, "the time-honored English process of using only fine Para rubber seems early to have been abandoned, the idea asserting itself that the adulterations which were customary in the bulk of rubber goods, might be introduced with advantage into fine cut sheet also." No systematic tests appear to have been made regarding the electrical constants of first, second and third quality of cut sheet. It is still an open question how far the mechanical treatment which the rubber undergoes in the cut sheet process effects its longevity. Raw rubber as imported is practically imperishable when it is kept away from the insiduous action of the solar rays. As far as his experiments in the matter have gone, there seems no doubt that the less the rubber is exposed to mechanical action, the greater is its longevity when exposed to the various deleterious influences with which it meets when put into use.—Lond. *Elec.*, Aug. 23.

REFERENCES.

Wiring Accessories.—Boenninghofen.—A paper on wiring accessories, used by the Gen. Elec. Co., of Berlin, for aerial wiring with copper or aluminum wires for pressures up to 1000 volts. He remarks that experience in practice has already proven that aluminum cables can be successfully used. At a specific gravity of 2.7 for aluminum the specific conductivities of aluminum and copper are in the ratio 1 to 1.7, so that to get the same resistance the cross-section of aluminum must be 1.7 times that of copper. With bare wires there is a saving of 35 to 40 per cent with the use of aluminum. Moreover, as the weight is decreased, the poles can be placed at larger distances. He describes a large number of joints, lugs, insulators, etc., used by his company. The paper is fully illustrated.—*Elek. Zeit.*, Aug. 8.

Underground Mains.—An illustrated description of a new system of electric underground cables, which has been devised by Highfield and Cater, and is now undergoing a practical trial at St. Helens. The principal claims are: Small space occupied in the ground; no surface drawing-in boxes required; cheapness and rapidity in making house connections; thorough protection of conductors from all kinds of mechanical damage; a perfectly symmetrical system of conductors for polyphase systems.—Lond. *Elec. Rev.*, Aug. 23.

Cable Manufacturing Plant.—In a continuation of the serial on the visit of the (Brit.) Inst. Elec. Eng. to Germany, a well illustrated description of the cable works of the General Electric Co., of Berlin, is given.—Lond. *Elec.*, Aug. 23.

Dangers from Electric Wires to Firemen.—Mead.—An abstract of a paper on the dangers of electric light and trolley wires to firemen when fighting fires and how to avoid these dangers.—*Eng. News*, Aug. 29.

Electro-Physics and Magnetism.

Coherers.—Eccles.—The first part of an account of what appears to have been a very extended series of experiments with filings coherers, the first object of which was to investigate the relative influences of oscillatory and of steady p. d.'s in promoting coherence in filings coherers. His first experiments showed that there can be no doubts as to the possibility of coherence by the application of absolutely non-oscillatory e. m. f.'s. Moreover, it was established that any electrical surgings produced by sudden connection with the source of e. m. f. had little or no influence in compelling coherence beyond that which their maximum voltage gives them; in other words, coherence was found to be an effect caused merely by p. d. There were great difficulties in his experiments regarding the relation between sensitiveness and cohering voltage, these difficulties being due to mechanical disturbances. He endeavored to make the degree of mechanical disturbance as uniform as possible. This was done by allowing the hammer of a trembler to strike uninterruptedly the coherers under examination. During each quiescent stage between the blows coherence takes place and a current passes through the galvanometer. Decoherence follows immediately, and is succeeded by another coherence, and so on. If uniformity of the vigor of the blows is ensured, each consecutive cycle of operations within the coherer, resembles accurately the preceding one. The galvanometer gives the mean value. This method was very successful. Several diagrams, showing the relation between the milliamperes obtained and the voltage applied, are given. The article is to be continued.—Lond. *Elec.*, Aug. 23.

Elements of Three-Phase Theory.—Russell.—A mathematical article, illustrated by diagrams, in which he discusses several fundamental theorems of three-phase theory, without making any assumption as to the shape of the wave form. The problems considered are the following: He shows how to calculate the magnitudes and the phase differences between the mains in three-phase systems, and gives a graphical representation of the voltages in the three arms of the load, with star connection. He gives a rule for finding the voltages across the arms of a star-box when the resistances of the arms are given, and an algebraical formula for finding the angles of the voltage triangle. "The voltages in a star box adjust themselves so that the energy expended in it is a minimum." He then discusses the potentials to earth of the mains. "If the fault resistances of the mains vary, then their potentials adjust themselves so that the energy expended in leakage currents is a minimum." He gives a simple rule for constructing the diagram of the currents in a mesh winding, and discusses the measurement of power in three-phase circuits. He finally discusses some special theorems, namely, to find the resistances of the arms of a star-box in order to get symmetrical three-phase currents, and, to find the ratio of the resistances in the star winding in order that the voltages to the center may be equal.—Lond. *Elec.*, Aug. 16.

Braun's Cathode Ray Tube as Electrometer.—Milham.—An account of experiments in which he used the Braun cathode ray tube for measuring electrostatic fields. His method is necesarily somewhat indirect, for when the tube is placed between the electrodes there is no deflection of the cathode ray beam; when, however, the field is suddenly commutated, the fluorescent spot jumps aside, and then returns to its normal position, quickly at first, and then more slowly. On repeating the commutation the throw is in the opposite direction, and the return is as before. The following explanation is suggested. The field traverses the tube, but the cathode rays within the tube render the gas conducting, and the charges on the walls are thus neutralized. That this is the true explanation, may be proved by interrupting the cathode rays during their returning motion by stopping the current. The luminous spot then disappears, and when the beam is restored the spot reappears, not in its normal

position, but at the point it had reached when the rays were cut off. The speed of return is proportional to the throw, and the latter is proportional to the field. Under favorable conditions he claims an accuracy within 1 per cent for the measurements.—*Phys. Zeit.*, Aug. 3; abstracted in Lond. *Elec.*, Aug. 23.

Discharge Current from a Surface of Large Curvature.—ALMY.—An account of an investigation in which he found that the current discharging from a fine wire to a concentric surrounding cylinder is proportional to the product of the length of the discharge wire, the potential difference between wire and cylinder, and the difference between this potential difference and the minimum potential necessary to produce a measurable discharge, and inversely proportional to the third power of the radius of the cylinder.—*Am. Jour. Sc.*, Sept.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison's Alkaline Storage Batteries.—WADE.—A description, taken from the patent specifications of Edison's cadmium-copper and iron-nickel cells. He also makes some general remarks on the latter cell. He says that Edison's claim that iron cannot decompose water is correct, as the e. m. f., corresponding to the oxidation of iron and calculated from the thermochemical value of the oxidation heat, is 1.47, while the minimum e. m. f. required to decompose water is 1.48. Edison has found that iron in a finely divided form, when prepared by the usual known methods, is practically unoxidizable. Kennelly has described this by saying that iron assumes the well-known passive state. The present author remarks that it is questionable whether this is not to confuse two phenomena which, while superficially alike, are really of a different or even opposing nature, for it is generally believed that the metal is protected from the acid by a thin skin of oxide on its surface; that is to say, the passive state of iron is the result of oxidation rather than of inability to oxidize. "The important fact whose discovery is the essence of Edison's invention is that, while most forms of iron cannot be oxidized and most salts of iron cannot be electrolytically reduced in an alkaline solution, there are a very few which will reduce to the metallic state and oxidize again with comparative facility."—Lond. *Elec.*, Aug. 23.

Max Storage Battery.—CASNIER.—An illustrated description of the Max storage battery, made by a French firm. The battery is of the Faure type. The electrodes consist of a series of cylinders of about ¼ inch diameter. Each cylinder has a lead core covered with active material, which is again covered with a layer of moist asbestos. "The asbestos used is blue asbestos, which gives results apparently much superior to the ordinary white asbestos." The construction of the electrodes in form of a series of cylinders is said to ensure a longer life than other types of light pasted batteries. The whole battery is manufactured mechanically by means of a special machine which is described and which turns out about 40 electrodes of 8.7 inches length and ¼ inch diameter per minute. Tests of the battery, made in the Central Laboratory of Electricity, have given the following results: The capacity in watt-hours is 290, 252, 211 for a discharge of 7¼ hours, 4¾ hours, 2¼ hours, respectively. This corresponds to 25.8, 22.2 and 18.6 watt-hours per kilogram, as the total weight of the tested battery was 11.35 kilograms, the weight of the electrodes alone being 7.11 kilogram.—*L'Ind. Elec.*, July 25.

REFERENCES.

Historical.—Some historical notes on the beginnings of electrochemistry. The suggestion to work chemical reactions by electricity is due to Cruikshank, but the first important application of the idea—the discovery of new metals—belongs to Davy. An account of Davy's experiments is given. Reference is made to the investigations of Faraday, Hittorf and Kohlrausch, and to the theories of Grotthus, Clausius and Arrhenius.—*The Elec. Chem and Met.*, Aug.

Persulphates.—PERKIN.—An article on the preparation by electrochemical methods, of persulphate and of persulphuric acid, and on their properties.—*The Elec. Chem. and Met.*, Aug.

UNITS. MEASUREMENTS AND INSTRUMENTS.

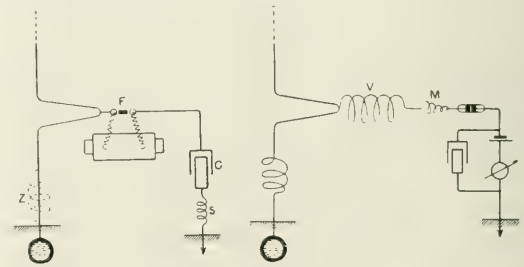
Eddy Current Brakes.—FEUSSNER.—A long illustrated paper read before the Electrotechnical Society, of Berlin, in which he describes the construction of several forms of eddy current brakes for testing machines, more especially of two made by the German Reichsanstalt. The principle of the eddy current brake is an old one, and has been used in many motormeters. A copper disk is revolved in a magnetic field. Eddy currents are induced in the copper disk, and a torque is produced which tends to revolve the system of magnet poles in the direction of the rotation of the copper disk. The copper disk is connected to the motor, the power of which is to be measured. The system of the magnet poles is so arranged that it can revolve by a small angle around the same axle in space as the copper disk. The force acting upon the system of the magnet poles is measured by balancing it by means of weights as in scales. The methods of artificially cooling the induced part are described. The main advantage of eddy current brakes over friction brakes is that the desired load can be exactly fixed, and that very delicate measurements can be made. He used battery current. The needles of the ammeter and voltmeter by which he measured the power consumed by the motor did not oscillate the least, so that exact readings to one or two thousandths could be made.—*Elek. Zeit.*, July 25.

REFERENCE.

Wattmeter.—CARMICHAEL.—An illustrated description of the Thomson recording wattmeter.—*Can. Elec. News*, Aug.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—SLABY.—An abstract of a paper on "The latest progress in spark telegraphy." The connections used in the transmitter and receiver by the Gen. Elec. Co., of Berlin, are given in the adjoining diagrams 1 and 2, respectively. The transmitter consists of the vertical wire fastened to the flagstaff of the building, which is led to earth and connected with the water main. A loop in this wire is led through the window into the room and is connected to an induction coil *F*, the other pole of the secondary winding being connected to earth through a tuned condenser *C*. The wave-length to be transmitted can be changed by adding a coil of wire *Z* in the earth wire, as indicated by the dotted line in the diagram. A whole set of such coils is at hand, so that a large number of different wave-lengths can be transmitted. In each case, however, it



DIAGRAMS OF CONNECTIONS.

is necessary to tune the oscillations produced on the circuit closed by the earth connection to the oscillation of the wire, in order to obtain the greatest effect. This is done in the simplest manner by adjusting an adjustable self-induction *S* or the condenser *C*. Diagram 2 shows the receiver. The pressure is at its maximum at the end of coil *V*, and "is strengthened by a tuned intensifying coil *M* which is connected directly to the coherer." It is also possible to replace the action of the two coils by a single coil with corresponding winding. The earth connection of the coherer contains the dry cell and the relay, which are bridged by a condenser in order not to disturb the oscillations. The General Electric Company, of Berlin, guarantees with this arrangement a tuning to the required wave-length "within certain limits," and a clear deciphering of signals at distances of 60 miles on the sea with masts 164 ft. high. He remarks that wireless telegraphy has left the condition of tentative experiment. It will become an indispensable means of communication on the coast and on the open sea, and "will also, in future, replace cable in many cases for submarine communications, although in this respect we must not place our hopes too high." "We can scarcely expect a transmission of signals of more than a few hundred kilometers even with more perfect development of the means at present at hand." He remarks that the future of wireless telegraphy "lies exclusively in the direction of producing higher electrical pressures. What we have used in this direction hitherto is very modest, if we compare it with what has been shown to only a few of the initiated, far from here on the other side of the ocean, on the high Rocky Mountains at the sources of the Colorado River, by an investigator who has shut himself off from the world—Nikola Tesla. . . . May his theoretical knowledge and his eminent technical ability

soon be placed at the practical service of spark telegraphy." A reproduction of a very peculiar photograph is given which shows Tesla sitting in his laboratory. There are cylinders of different heights, and a globe suspended near the roof. The whole is filled with heavy spark discharges starting from the cylinders and the globe.—Lond. *Elec.*, Aug. 23.

Multiplier.—BLONDEL.—A brief communication referring to Slaby's wireless telegraphy experiments, and the theory of Seibt on the action of the "multiplier" (Digest, Aug. 24), used by Slaby (the coil *M* in the above figure 2). He says that only the theory of Seibt is new, while the multiplier itself is well known in France to physicists and physiologists under the name of the Oudin resonator. —*Elek. Zeit.*, Aug. 22.

CAHEN.—A communication in which he corrects a slight mistake in the theory of Seibt, which, however, does not alter the final result. *Elek. Zeit.*, Aug. 8.

MISCELLANEOUS.

REFERENCES.

Electric Furnaces.—RICHARD.—An article giving brief illustrated descriptions of electric furnaces, devised by Borchers, Gin and Leleux, Roesler and Carlson, Contardo, Electro-Chemical Society Volta, the Machalske furnace for preparing phosphorus, the Hatch rotary furnace, and the Voelker and Luhne furnace for making glass. —*L'Eclairage Elec.*, Aug. 17.

Canadian Manufacturing Plant.—An illustrated article on the plant of the Canadian General Electric Company at Peterboro, Ont.—*Can. Elec. News*, Aug.

Manufacturing Plant.—An illustrated description of the works of the Westinghouse Electric & Manufacturing Company in Pittsburg. —*Sc. Amer.*, Aug. 31.

Glasgow Exhibition.—An illustrated description, by Wansbrough, of the electric light plant and an illustrated description by Horner, of the machine tools exhibited.—*Cassier's Mag.*, Sept.

KERR.—An illustrated article on engineering at the Glasgow exhibition, in which he deals with the salient points in the steam plant and machinery section.—*Eng. Mag.*, Sept.

Paris Exposition.—REYVAL.—Illustrated descriptions of alternating-current machinery, exhibited by the Oerlikon Company; a 650-kilovolt-ampere, 7500-volt, three-phase alternator, a 200-kw synchronous converter, several three-phase induction motors, and a 20-kilovolt-ampere, three-phase transformer.—*L'Eclairage Elec.*, July 20. Illustrated descriptions of direct-current dynamos of 65 kilowatts and 6 kilowatts, a 7-hp, three-phase induction motor, and a 3-kilovolt-ampere, three-phase transformer exhibited by Krizik, also of 200-kw, direct-current machines exhibited by Breguet.—*L'Eclairage Elec.*, Aug. 3. An illustrated description of a high-tension 180-kilovolt-ampere, single-phase alternator of the Societe L'Eclairage Elec. The voltage is 30,000. For a frequency of 50 p. p. s. the speed is 428 revolutions. The number of poles is 14.—*L'Eclairage Elec.*, Aug. 10.

New Books.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING. By Charles Proteus Steinmetz. New York: Electrical World and Engineer. 320 pages, 148 illustrations. Price, $2.50.

The preface states that the first part of this volume, entitled "General Theory," grew out of a series of University lectures which the author once upon a time promised to deliver. This section of the book may, in a sense, be considered as an introduction to the author's classical work on "The Theory and Calculation of Alternating-Current Phenomena," leading up gradually from the ordinary sine wave representation of the alternating current to the representation by polar co-ordinates, to the representation by polar vectors, and to the symbolic representation in terms of the rectangular components of these polar vectors. The section is, however, more than an introduction to the author's large work, inasmuch as it treats of the fundamental principles of both direct and alternating current.

The second section, entitled "Special Apparatus," is a series of monographs upon the more important types of alternating and direct-current apparatus. This part is to some extent supplementary to "Alternating-Current Phenomena," in which the author has presented the general theory of alternating-current machines, while the present work is devoted more especially to specific discussions of the particular features of individual machines. This section is, therefore, less theoretical and more descriptive than "Alternating-Current Phenomena," the characteristic features of structure and behavior being covered.

The work is restricted to those machines which experience has shown to be of practical importance, and to those theories and methods which are of practical utility. This is the more desirable inasmuch as electrical literature has been, especially of late years, haunted by so many theories which are either incorrect or too complicated for use.

The above statements as to the scope and character of the book will give an idea of the contents of a work which makes a distinct addition to the debt, already large, which electrical engineers owe to the talented author.

BOOKS RECEIVED.

ELECTROMAGNETS; THEIR DESIGN AND CONSTRUCTION. By A. N. Mansfield, S. B. New York: D. Van Nostrand Company. 155 pages, 36 figures. Price, 50 cents. (Science Series.)

DIE NEUSTEN FORTSCHRITTE AUF DEM GEBIETE DER FUNKENTELEGRAPHIE. Von A. Slaby. Berlin: Julius Springer. 30 pages, illustrated. Price, 80 pfennigs.

ORIGINAL PAPERS BY THE LATE JOHN HOPKINSON, D. Sc., F. R. S. Edited, with a Memoir, by B. Hopkinson, B. Sc. Two volumes. Vol. I., Technical Papers. Vol. II., Scientific Papers. Cambridge: University Press. Vol. I., 294 pages; Vol. II., 393 pages.

Directory of Electrical Societies, Etc.

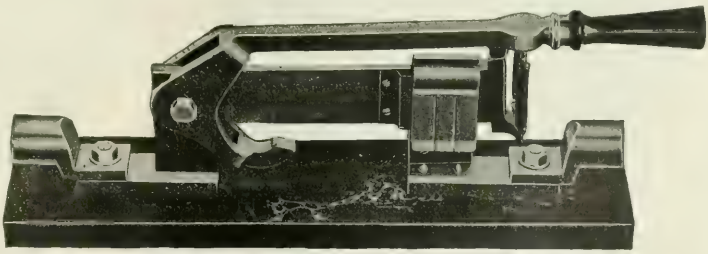
ILLINOIS STATE ELECTRIC ASSOCIATION. Next meeting, Rock Island, Ill., Sept. 24 and 25, 1901.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Owensboro, Ky., Oct. 8 and 9, 1901.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, Buffalo, N. Y., Sept. 24, 25 and 26, 1901.

A New Quick Break Switch.

We show herewith a new quick break switch now being made by Zimdars & Hunt, of New York City. It is claimed to be a strictly high grade switch, one that will meet the severe service to which this type of apparatus is so often subjected. The cut illustrates clearly the principal features of the design. The handle lever is connected with the blade by spiral springs. In the act of opening, these springs are fully elongated before the blade moves, but at that moment the blade is started by the finger on the lower end of the handle lever, and then under the action of the springs, flies out instantly and an instantaneous break is effected. There is no arcing at the main contacts, however, this being taken care of by auxiliary carbon contact blocks, which are supplied on all these switches. The switch



QUICK-BREAK SWITCH.

gives evidence of careful design, and the manufacturers state that owing to the liberal contact and sectional areas provided there is no possibility of undue heating even under a considerable overload.

American Electro-Therapeutic Association.

The eleventh annual meeting of the American Electro-Therapeutic Association will be held at Buffalo, N. Y., on Tuesday, Wednesday and Thursday, Sept. 24, 25 and 26.

Electrical Test Instruments.

The accompanying illustrations show several new types of testing instruments manufactured by Elmer G. Willyoung, 11 Frankfort Street, New York. Fig. 1 is known as "Model K" portable test set, and replaces the well-known "Aone" Test Set, of which it is a modified and improved form. It is claimed that the "Model K" is arranged for a larger variety of measurements than any other single instrument that has ever been offered. Among the possible measurements are resistances in general; very high resistances; very low resistances; insulation (as in cable testing) by the direct deflection method; internal resistance of batteries; the measurement of e. m. f.; calibration of ammeters and voltmeters; location of faults by the Varley or Murray loop method; the measurement of self-induction; detection of open and short circuits, etc., etc. Familiarity with testing methods will suggest many other possible tests. It is not claimed that any one of the above tests is better made with the "Model K" than with other type of instrument that might be named, but it is claimed that where only one or a few instruments is possible to an expert, the type mentioned can be the least easily dispensed with.

The set is really a highly developed form of Wheatstone bridge. There are 17 coils in all, arranged 1, 2, 3, 4, 10, 20, 30, etc., to 10,000 inclusive. The bridge arms proper are reversible, with ratio coils of 1, 10, 100, on one side, and 10, 100 and 1000 on the other. The maximum range of measurement is, therefore, from 0.001 ohm to 21 megohms. By using the "direct deflection" method, this maximum is extended up to about 200 megohms. The set is complete with its own galvanometer and battery. The former is a jeweled D'Arsonval instrument, absolutely unaffected by mechanical or electrical disturbances, and giving a deflection of one division per volt through from 1½ to 2 megohms. The galvanometer scale is long (1½ inches), zero in the center, and with 30 divisions on each side. Deflections are strictly proportional to current.

For the "Loop" tests, a special "ground" plug is used. For the "Direct Deflection" method, the set has its own galvanometer shunts. (See upper left-hand corner of Fig. 1.) These shunts are contained in a little nickeled box which attaches to the set proper by four screws—two of these screws making the connection. This shunt box is interchangeable in all sets, and may, therefore, be purchased with the set or not, as may be decided. This type is said to be the smallest (11 by 5¼ by 4½ inches deep) instrument of its kind ever put upon the market, as also the lightest (weighs 7 lbs.).

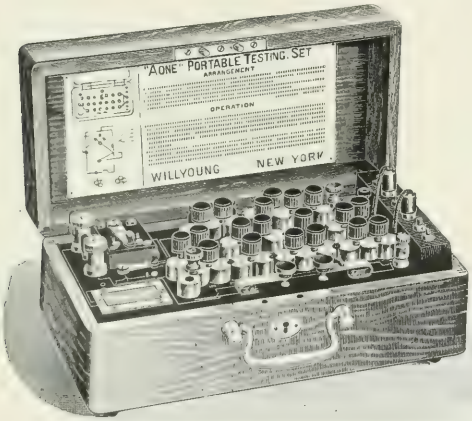


FIG. 1.—PORTABLE TESTING SET.

A photometer known as "No. 1 Station Photometer" is shown in Fig. 2. This instrument has been upon the market for the past four years, but the present model embodies a large number of minor improvements recently made. This photometer is essentially for accurate measurements either in the factory, central station, or scientific laboratory. The track is of cold rolled steel shafting supported by pillars at each end. It carries an engine divided scale reading direct in candle-power. Either a plain (for mean hemispherical candle-power) or a compound rotator (for spherical candle-power), is at one end and carries the lamp under test. At the other end is a support which will carry either an amyl-acetate standard or a standard incandescent lamp. The observing carriage is equipped, ordinarily, either with a Lummer-Brodhun or a Bunsen screen. This carriage has a quick-acting clamp below, by which it may be instantly clamped

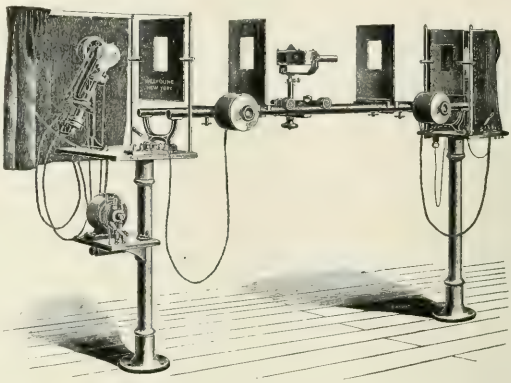


FIG. 2.—STATION PHOTOMETER.

to the track at any desired point; a ½-cp incandescent lamp (placed in series with an outside 110-volt, 16-cp lamp) illuminates the scale and permits it to be read when a button is depressed. There is a finely divided rheostat for each lamp, carrying current up to 1½ amperes and varying the voltage continuously for about 20 per cent on each side of the normal. These rheostats are attached to clamps which may be slipped along the track and fastened at any desired point. This permits the observer to regulate both lamps himself or allows him to use assistants at the ends of the track, as he may prefer.

Fig. 3 is a faradmeter for measuring electrostatic capacity. It is really a Wheatstone bridge arranged on the Varley slide scheme, and with its resistances free of capacity and inductance. An alternating current or an induction coil running at small spark length (1-16 to ⅛ inch) is the source of current, and a telephone is the detector. There are two switches, one giving the first and the other the second decimal place. They are set quickly, and are direct reading. This instrument is therefore a commercial instrument which any one may use, there being no galvanometer to keep in adjustment, and electrical and mechanical disturbances do not affect it—in short, it is a labor-saving device. It is claimed that a tyro can do 10 times the

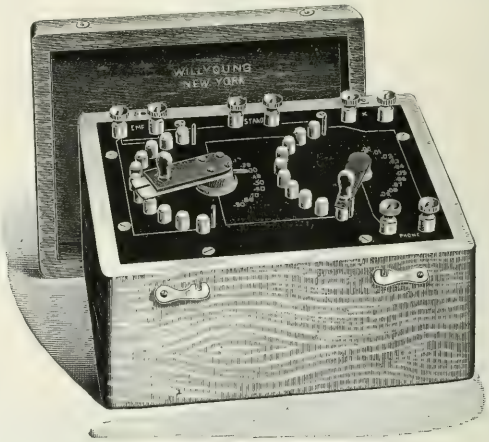


FIG. 3.—FARADMETER.

work with it that an expert can do with a ballistic galvanometer in the same time. Not the least of the advantages claimed for this instrument is that absorption and leakage are eliminated, i. e., the capacity is not a matter of defining exactly the time of change, discharge, etc., but is always the same for the same condenser.

A Novelty in Electric Signs.

The demand for electric signs appears to be very much on the increase, and there is a corresponding effort to fill it. As a general thing, such signs have been costly and elaborate, while many people want and are satisfied with methods involving only a moderate outlay. A recent successful effort to produce a cheap electrical advertising sign has been made by the American Miniature & Decorative Lamp Company, 436 Broome Street, New York, as illustrated herewith in Figs. 1, 2 and 3, which are reproduced from actual signs. It should be stated that the lamps are arranged in a circle of wood coated with fine white enamel in which a varying number of special 8-cp lamps are set. The sizes made at present, include 15, 12 or 8 lamps in multiple, and 16 or 8 in series. Each ring is furnished with cord and plug, and can be instantly connected up to any convenient socket. If the cost of running two ordinary 16-cp lamps for 5 hours nightly be taken at $2 per month, such a sign, which is far more effective for advertising purposes, should pay for itself in four months. We understand from the management that other shapes are now being built, embodying the same idea of encircling or enclosing the "ad" with a rim of powerful light. Of course, the textual sheet in the center can easily be changed at any time. The 8-cp lamps used are of a special design, and are, it is said, much smaller than anything of the kind previously attempted.

FIG. 1.—ELECTRIC SIGN.

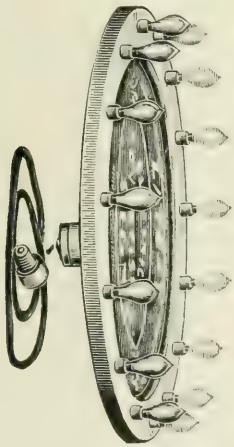


FIG. 2.—ELECTRIC SIGN.

FIG. 3.—ELECTRIC SIGN.

Exhibits at the Municipal Convention.

At the Niagara Falls Convention of the Association of Municipal Electricians, report of which appears elsewhere in this issue, a few exhibits were made, a room being set apart for the purpose:

The Circular Loom Company, of Boston, was represented by F. N. Ferrin.

The Okonite Company, of New York, was represented by George T. Manson.

The Gordon Battery Company, of New York, was represented by W. C. Banks.

J. Jones & Sons, of New York, were represented by Mr. J. Jones, and their exhibit was an elaborate one.

The Carborundum Company, of Niagara Falls, N. Y., distributed pocket knife sharpeners made of its product, which is a "keen" rival to the emery-wheel.

The Safety Insulated Wire and Cable Company, of New York, was represented by A. P. Eckert, who distributed leather-covered memorandum books.

The Gamewell Fire Alarm Telegraph Company, of New York, was represented by T. Torry, who gave away as a souvenir a silver matchbox of unique design.

The Edison Manufacturing Company, of Orange, N. J., was represented by W. S. Logue, of Chicago, the general manager of the Edison interests at that point.

Mr. Louis W. Miller, superintendent of fire-alarm telegraph at Rochester, N. Y., explained the merits of the Miller cut-out, which absolutely cuts out, when they are not in use, fire and police telegraph boxes. Mr. Miller's device is in use in many cities, and he is at present installing a full set of these instruments at Syracuse, N. Y.

The Montauk Fire Detecting Wire Company, of New York, was represented by Mr. F. S. Palmer, of the New York office. An interesting exhibit was given, showing the practical operation of the system in affording prompt fire alarm. The fire that was detected was effectually suppressed by the application of "Kilfyre." This exhibition was given in front of the hotel, and was witnessed by several hundred people.

The Sprague Electric Company, of New York, was represented by Alexander Henderson. The conduit exhibit was a very complete one and highly interesting. Greenfield flexible steel conduits and steel armored conductors were shown, and samples of these goods were distributed among the members. A large sample board originally built for the Pan-American Exposition attracted a good deal of attention. Mr. Henderson was the first chief of the electrical inspection bureau of the Fire Department of New York City, and is deservedly popular with municipal electricians as well as with other folk.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 4 per cent; time money, 5 per cent for 60 days. There was a violent break in prices on the stock market on Saturday as a consequence of the attempted assassination of President McKinley at Buffalo on Friday afternoon, and the market exhibited a feverish tendency, closing near the low, very weak opening prices. Part of the weakness at the close was, however, attributed to the heavy decrease in the bank return, which was $10,000,000 instead of $5,000,000, as previously estimated. The market up to Friday's close was irregular and sensitive about money conditions. Steel stocks showed some strength, notwithstanding the disappointment over the non-settlement of the steel strike. The industrial list, while not active, exhibited some features of interest. In the tractions, Brooklyn Rapid Transit developed weakness, owing to the fact that the July net earnings showed a falling off instead of an increase, as was predicted. Manhattan received support, owing to the excellent annual report and the increases in the earnings of the system for both July and August, but closed the week with a net loss of 6 points. In the outside market, the feature was the pressure to sell issues that have recently been most active. At Saturday's close the following results of the week's transactions in the principal traction and electric issues were recorded, all being affected unfavorably by the shooting of the President. There were sales of 288 shares of American Telegraph & Cable at 99, which was ¼ point higher than the last recorded sale several weeks ago; 800 shares of American Telephone & Telegraph were sold at prices ranging between 165 and 167¾, closing with a net loss of 2½ points. The sales of Brooklyn Rapid Transit aggregated 65,980 shares, the closing price, 65¾, being 9¾ points below that of the previous week; the prices ranged between 65⅛ and 75½. Metropolitan Street Railway closed with a net loss of 6¼ points, on sales of 5815 shares at prices ranging between 162½ and 169. General Electric also suffered a big drop, the net loss being 13¾ points on a range of prices between 253 to 267½. Western Union dropped 2½ points, the total sales for the week being 4350 shares, and the range of quotations 90¾ to 93½. Following are the closing quotations of Tuesday, Sept. 10:

NEW YORK.

	Sept. 3.	Sept. 10.		Sept. 3.	Sept. 10.
American Tel. & Cable...	—	—	General Carriage.....	½	¾
American Dist. Tel.....	—	—	Hudson River Tel.....	120	120
Brooklyn Rapid Transit..	75	68½	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....			Metropolitan Street Ry..	167½	163⅞
Electric Boat.....	23	20	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	48	47	N. Y. Elec. Veh. Tran...	10½	10
Electric Lead Reduc'n...	1½	2	N. Y. & N. J. Tel.....	168	168
Electric Vehicle.....	5½	5½	Tel. & Tel. Co. of Am...	5	5
Electric Vehicle pfd.....	10	8	Western Union Tel.....	93⅛	92⅝
General Electric.....	267½	264			

BOSTON.

	Sept. 3.	Sept. 10.		Sept. 3.	Sept. 10.
Am. Tel. & Tel.....	166	164	Mexican Telephone.....	2½	2⅜
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light...	250	250	Westinghouse Elec.....		—
Erie Telephone.....	42	35	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Sept. 3.	Sept. 10.		Sept. 3.	Sept. 10.
American Railways.....	40¾	40½	Phila. Traction.....	97½	97⅜
Electric Storage Battery..	72	70	Philadelphia Electric.....	6	5½
Elec. Storage Batt'y pfd.	72	70	Pa. Electric Vehicle.....	¾	½
Elec. Co. of America....	7⅜	7⅜	Pa. Elec. Veh. pfd.....	¾	½

CHICAGO.

	Sept. 3.	Sept. 10.		Sept. 3.	Sept. 10.
Central Union Telephone.	-	-	National Carbon pfd....	—	84¼
Chicago Edison.....	—	165	Northwest Elev. com....	—	39
Chicago City Ry.....	206	206	Union Traction.....	—	17⅛
Chicago Telep. Co.....	—	275	Union Traction pfd.....	—	58
National Carbon.....	18	18			

TELEPHONE, TELEGRAPH & CABLE CO.—A director of the Telephone, Telegraph & Cable Company of America says that the offer of Charles W. Morse to purchase the capital stock of the company is not in the interest of the American Bell Telephone & Telegraph Company, or any other organization, but purely a business venture of Mr. Morse who is a firm believer in independent telephony. A number of the largest holders of stock have already deposited their stock with the trust company and the full amount—at least two-thirds—will probably be deposited before this journal appears. Mr. Morse will immediately reorganize the company and appropriate $3,000,000 of money to build up the independent system in New York and Boston, including the construction of a line between the two cities. Five million dollars additional money has been provided for to carry the plans through to a finish as rapidly as possible. The long distance and exchange service will cover the principal cities and towns of New England. Mr. Henry Wilson will retire from the directory of the Erie Telegraph & Telephone Company and Mr. Morse will name a successor to represent his interest in that corporation. Two factions are giving Erie Telephone considerable attention in the market just now, seeking to obtain a controlling interest in the corporation.

PHILADELPHIA BELL TELEPHONE has been more active in the last two weeks than for some time. The sales, however, have not been very large, aggregating only 185 shares last week, and 100 shares the week before. The price has held firm at 72½. It is supposed that the holders were influenced to sell by the growing activity of the Keystone Telephone Company in the local field. The Keystone, with $10,000,000 authorized capital, has $2,500,000 subscribed and about $600,000 paid in. Good progress has been made by the new company, in the laying of conduits and cables, as well as in obtaining subscriptions. The Keystone Company is understood to have obtained over 5000 subscribers. The Bell has about 14,000 subscribers.

SCHENECTADY RAILWAY BONDS.—Perry, Coffin & Burr and N. W. Harris & Co., jointly, have purchased $1,250,000 Schenectady Railway Company, 4½ per cent first mortgage 40-year gold bonds, due September 1, 1941, but callable at 110 and interest after 10 years. The proceeds will pay for the double track extension recently completed to Albany, for the line under construction to Troy, and for extensions and improvements to the railway and illuminating properties in Schenectady. The Schenectady Railway Company controls the entire railway and electric lighting business of Schenectady. Its capital stock is owned by the General Electric Company. Further extensions are contemplated. The Mercantile Trust Company, New York, is trustee for the bonds.

DECLINE IN ERIE TELEPHONE.—The recent decline in Erie Telephone to 40 is attributed to the fact that the company has been obliged to borrow $1,500,000 additional money from the Old Colony Trust Company syndicate for construction purposes. Of the $7,500,000 furnished by this syndicate the early part of the year only $1,000,000 was provided for needed extensions and improvements. This additional $1,500,000 is raised through the issue of 5 per cent notes, which have been underwritten by the syndicate managers at 99 and accrued interest, and makes the total amount of short-term notes now outstanding $9,000,000, all of which expire January 10, 1902. The security back of this additional money furnished consists of notes or stock or both of the subsidiary companies.

MANHATTAN ELEVATED.—The Manhattan statement shows after paying 4 per cent for the year ending June 30, a surplus of more than $400,000. July, one of the poorest months of the year, showed $53,000 increase and August $68,000 increase over the corresponding months of last year—a total of $121,000 for the two poorest months of the year. If Manhattan, with its old power, can make such a showing as this, very much better results are to be expected when it is electrically equipped. The first generator is now being set up.

MORTGAGE.—The Birmingham Railway, Light & Power Company, Birmingham, Ala., has filed a mortgage and deed of trust to the Old Colony Trust Company, of Boston, for $6,000,000. Of this sum $2,000,000 will be placed aside for future use and $2,250,000 are to be sold for immediate use, and of this sum $1,000,000 is to be sold at not less than 77½, to be used for the purpose of construction to the extent of 75 per cent of the value. This deed represents the final step in the previously mentioned consolidation of the electric railway, light and gas interests.

GRAMOPHONE COMPANY RECEIVER.—Application was made to Justice Herrick in Special Term of the Supreme Court, Brooklyn, last week, and by him granted, for the dissolution of the National Gramophone Company, and the appointment of a temporary receiver on the ground that the corporation is insolvent. A receiver will be agreed on this week.

DIVIDENDS.—Directors of the South Side Elevated have declared a quarterly dividend of 1 per cent, advancing the stock from 3¾ per cent to a 4 per cent basis. Twin City directors have declared a dividend of 1¾ per cent on preferred stock. The directors of the Commercial Cable Company have declared the regular quarterly dividend of 1¾ per cent, payable Oct. 1.

AMERICAN TELEPHONE & TELEGRAPH stock, the old Bell telephone, was dealt in for the first time last week on the New York Stock Exchange.

PITTSBURG TROLLEY CONSOLIDATION.—It is rumored that the Mellons have offered to buy control of the Consolidated Traction system on the basis of $30 a share for the common stock and $60 a share for the preferred. The report combines all the Mellon suburban lines with the Consolidated, adding these to the lines to be constructed on the North Side, charters for which have been obtained and franchises granted. This would give the Mellons control of all the traction lines of the two cities and suburbs, with the exceptions of the Southern Traction and the United Traction, which is controlled by the Philadelphia Company.

DETROIT UNITED RAILWAY.—Circulars to stockholders state that a new company is being organized in Michigan to acquire all the railway lines of the Detroit United Railway Company. The capital stock of the new company is to be $12,500,000, and the authorized issue of bonds, $50,000,000. This is but one part of the plan to consolidate all the street railway lines of northern Ohio. Similar companies are to be formed to secure the ownership of lines in Toledo and Cleveland. Then a new company is to be incorporated under the New Jersey laws under a capital stock of $125,000,000, and all the companies are to pass under the control of one management.

RAILWAYS COMPANY GENERAL.—No official statement has yet been given out concerning the sale of the Michigan Traction Company to the Boland syndicate, of New York, but it is said that the Railways Company General received $60 a share for its 3300 shares of the total 5000 shares of Michigan Traction Company stock, amounting to $198,000. It is understood that at the Railways Company General meeting this month a dividend disbursement at the rate of 5 per cent per annum will be authorized, on the reduced capitalization of $1,200,000.

CHICAGO NORTHWESTERN ELEVATED.—Articles have been filed increasing the capital stock of the Northwestern Elevated Railway from $10,000,000 to $25,000,000. The increase is made in connection with the purchase of the Union Elevated Loop.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade advices received by the mercantile agencies indicate a generally satisfactory condition of affairs. The fall demand, which is now in full blast in all sections, compares well with that of last year, and business at the South continues to expand. Specially marked features are the reports of a large seasonable distribution, heavy shipments and improved collections from leading Western centres. All the measures of trade demand point to the maintenance of general business on a scale not heretofore equaled for this time of the year. The industrial disturbances are not having as much effect as they did earlier, and despite the steel strike the trades affected are doing a large business, pig iron being in better requisition. The demand for steel and iron grows steadily and premiums for quick delivery of affected products are advancing. Gross railway earnings of 36 roads for the fourth week of August, as reported by *Bradstreet's*, aggregate $11,235,644, a gain of 12 per cent over the same week last year. Roads reporting for the month of August show earnings of $51,827,152, a gain of 13.6 per cent over last year. Business failures, while more numerous than those of the corresponding week last year, are less hurtful than they were one or two months ago, and really reflect only the normal friction inseparable from the conduct of business in a large volume. The total number for the week, as reported by *Bradstreet's*, was 169, as against 180 the previous week and 154 the corresponding week last year. There were 788 failures in August, involving liabilities of nearly $10,000,000, a decrease of 6.3 per cent in the number and of 34 per cent in liabilities from July, but an increase of 12 per cent in number and of 63 per cent in liabilities over August last year. Copper remains unchanged as to prices, Lake being quoted at 16½ cents and casting from 15⅞ cents to 16¼ cents. The exports of domestic copper from Atlantic ports for the month of August, as compiled by the New York Metal Exchange, aggregated 64,084 tons.

OUTFITS FOR GREAT NORTHERN STEAMSHIPS.—The two huge steamships which are now under construction for the Great Northern Steamship Company, at the yards of the Eastern Shipbuilding Company, New London, Conn., are to be equipped with Westinghouse apparatus for electric lighting and ventilating purposes. The contract, which has just been secured by Westinghouse, Church, Kerr & Co., provides for eight generating sets, consisting of Westinghouse compound engines of 150 horse-power each, direct connected to 75-kw generators. There will be the same number of blowing outfits. The engines, which will be direct connected to the blowers, are to be 90 horse-power each. The value of the contract is about $50,000. Electricity will play an important part in these vessels, which are being built for the Oriental trade, and several important contracts in connection with such apparatus have yet to be placed. The large cargo conveyors are to be operated by electricity. The steering gear will be of the electrical tiller type, and the winches for handling cargo will also be worked by motors. There will also be a large electrically operated ice machine of the ammonia compressor type.

AMERICAN EQUIPMENT FOR NEW ZEALAND.—Some important contracts are being placed in connection with the Auckland Electric Tramways Company, Limited, the construction contract for which has been secured by J. G. White & Co., Limited, of 22a College Hill, Cannon Street, London, E. C. The power house will be equipped with three generators of 300 kilowatts each, also switchboard and all accessories, manufactured by the General Electric Company. The generators will be direct connected to 475-hp horizontal cross compound condensing engines of British make. Cole, Marchens & Morley, Limited, having secured the contract. The rails—4000 tons—will be turned out by the Lorain Steel Company. Fifty motor equipments have been ordered of the General Electric Company. The boiler contract has, however, not yet been placed. The Auckland system, which will entail an initial expenditure not far short of $1,500,000, will be about 20 miles long. The greater portion of the road will be double track. The company will begin with 50 cars.

BRITISH THOMSON-HOUSTON CONTRACT.—The contract with the British Thomson-Houston Company for the equipment of the underground Great Northern & City Railway provides for 36 motor cars, each carrying two G. E. motors, with four third-rail collector shoes. Each train will consist of seven cars, three being motor, the two end and the middle. The generating plant will comprise four generators with switchboard apparatus, all of G. E. type, with four vertical cross compounds. Musgrave condensing engines, of 1250 ihp as normal load each. There will be two auxiliary generators, each 50 kilowatts. All the steam auxiliaries, etc., will be motor operated, and there will be a Hunt coal conveyor equal to 30 tons of coal per hour. This will be the first road in Great Britain to be operated entirely on the "train control system."

TROLLEY FREIGHT HANDLING.—The Milwaukee Common Council has passed an ordinance granting a franchise to the Milwaukee, Burlington & Lake Geneva Railroad to build an elevated road through the city. The road will be operated by electricity, and permits the running of freight trains over the streets. The franchise is perpetual. The route traverses the best part of the Kinnickinnic and Milwaukee River manufacturing districts. The company pays nothing for the franchise, except damages secured by abuting property-holders. The terminus of the road is at Michigan and Milwaukee Streets, in the heart of the East Side. Clarence Darrow, of Chicago, is one of the promoters. It is rumored that the Illinois Central or the Wisconsin Central is back of the project.

FIRST YANKEE PRODUCER GAS PLANT FOR SOUTH AMERICA.—The South American commission house of Agar Cross & Co., 11 Broadway, has just placed a contract for an American producer gas plant, which it is said is the first such order placed in this market for shipment to South America. The engine order, which calls for a 180-hp machine, has been allotted to Westinghouse, Church, Kerr & Co. The requisite producer will be manufactured by R. D. Wood & Co., of Philadelphia, Pa. The equipment is intended for operating an electric light plant in Buenos Ayres, Argentine Republic.

MR. GEORGE BULLOCK RETURNS FROM EUROPE.—Mr. George Bullock, president of the Bullock Electric Company, of Cincinnati, Ohio, who has been in England for the last two months, in connection with a proposition to build a plant on the other side for the purpose of manufacturing Bullock apparatus for the British and other European markets, returned last week to the United States. While nothing exactly definite has been decided upon, it may be said that negotiations are progressing satisfactorily for the establishment of works in the United Kingdom.

TO ENLARGE ALUMINUM PLANT.—The Pittsburg Reduction Company, which manufactures aluminum at works in New Kensington, Pa., and at Niagara Falls, N. Y., has let contracts that will practically double the capacity of the Niagara Falls works. The contract calls for a steel building with corrugated sheet covering, which has been placed with the McClintic-Marshall Construction Company, of Pittsburg. About 400 tons of structural iron are required, and the work is to be done by the middle of November.

SERRELL, WHITE & CIE., of Paris, have undertaken the establishment of a number of selling houses throughout France for the A. S. Cameron Steam Pump Works, of New York City. An order for a number of service pumps was received last week, this being the second order from the Marseilles district. The local branch of the above concern is Serrell & White at 18 Broadway, New York.

BIDS WANTED ON AUTOMOBILES.—B. H. Kroger, wholesale grocer, Cincinnati, Ohio, has asked for bids from builders of automobiles. He wants 30 vehicles, with a carrying capacity of from 1500 to 1800 lbs.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended Aug. 28: Antwerp—68 packages electrical material, $3,659. Argentine Republic—19 packages electrical machinery, $2,002; 4 packages electrical material, $405. Aberdeen—1 package electrical machinery, $60. British Possessions in Africa—70 packages electrical material, $6,312; 23 packages electrical machinery, $4,000. British Australia—18 packages electrical machinery, $608; 498 packages electrical material, $131,668. British East Indies—3 packages electrical material, $250. Brazil—64 packages electrical material, $1,306. Bremen—4 generators, $1,080. British West Indies—68 packages electrical material, $1,606. Brussels—1 package electrical machinery, $45. Barcelona—64 packages electrical machinery, $2,619. Bilbao—1 case electrical material, $50. Cuba—8 packages electrical material, $91. Central America—11 packages electrical material, $170. Dutch Guiana—1 case electrical material, $13. British East Indies—17 cases electrical material, $300. Glasgow—26 packages electrical material, $1,647; 4 packages electrical machinery, $80. Havre—13 packages electrical machinery, $1,000; 19 packages of electrical machinery, $862. Hamburg—2 cases electrical material, $217; 56 cases electrical material, $2,617; 30 packages trolley poles, $1,000. Liecester—1 case electrical material, $131. Liverpool—43 packages electrical material, $5,243; 24 packages electrical material, $1,543. London—252 packages electrical machinery, $9,935; 81 cases electrical material, $4,166. Mexico—4 cases electrical material, $503; 13 cases electrical material, $322. Magdeburg—1 case electrical machinery, $45. Market Harbrough—3 cases electrical machinery, $250. New Zealand—12 cases electrical material, $200; 26 cases electrical material, $870. Newcastle—54 packages electrical material, $10,155. Peru—10 packages electrical material, $129. Rotterdam—2 cases electrical material, $50. Santo Domingo—19 cases electrical material, $533. Sheffield—1 case electrical machinery, $35. Southampton—44 cases electrical machinery, $6,326. Uruguay—16 packages electrical material, $435. Venezuela—1 case electrical material, $14. It is worthy of note that our best customers among our near neighbors on the South for electrical supplies are the Argentine Republic, Brazil and Mexico, all of whom are weekly importers. Of our patrons in the Eastern hemispere British Australia is at present our heaviest buyer, taking from us this week over $100,000 worth in one lot, while our English cousins still continue excellent weekly purchasers. The following are the exports of electrical material from the port of New York for the week ended Sept. 4: Antwerp—41 packages electrical material, $4,043. Alexandria—1 package electrical material, $40. Argentine Republic—193 cases electrical material, $10,403; 15 cases electrical machinery, $9,190. British Possessions in Africa—84 cases electrical material, $3,987; 1 case electrical machinery, $130. British East Indies—18 packages electrical material, $299; 3 packages electrical machinery, $150. Bremen—8 packages electrical material, $140. Berlin—6 cases electrical material, $294. British Guiana—8 cases electrical material, $75. British Australia—154 cases electrical material, $23,012; 21 cases electrical machinery, $2,193; 1 reel cable, $368. Brazil—25 packages electrical material, $1,700. British West Indies—3 cases electrical material, $1,700. Chili—7 cases electrical material, $153. Central America—21 cases electrical material, $858. Cuba—90 packages electrical material, $3,452. China—9 cases electrical material, $290. Cardiff—1 case electrical material, $135. Copenhagen—2 coils cable, $1,123. Genoa—22 cases electrical machinery, $3,000. Glasgow—420 cases electrical machinery, $52,310; 5 cases electrical material, $159. Hayti—1 case electrical material, $56. Hamburg—34 cases electrical material, $1,801. Hong Kong—28 cases electrical material, $728. Havre—14 packages electrical material, $1,258; 14 packages electrical machinery, $340. Japan—49 packages electrical material, $12,712. Liverpool—92 packages electrical material, $4,688; 18 packages electrical material, $981. Leeds—3 packages electrical material, $267. London—64 packages electrical machinery, $3,491; 110 packages electrical material, $4,456; 2 packages electrical machinery, $305. Mexico—91 packages electrical material, $3,138. Newfoundland—24 cases electrical material, $565. Nova Scotia—1 package electrical material, $40. Newcastle—3 cases electrical machinery, $582. Philippines—51 cases electrical material, $528. Rotterdam—2 cases electrical material, $100. Santander—3 cases electrical machinery, $258. Siam—2 cases electrical material, $208. U. S. Colombia—11 cases electrical material, $380. Vladivostock—10 cases electrical machinery, $2,355. Venezuela—374 cases electrical material, $1,695.

THE GREEN ENGINEERING COMPANY, Chicago, Ill., manufacturers of the well-known Green traveling link grates, report besides the sales of 12,000 horse-power to the Metropolitan Street Railway Company, Kansas City, which was the third order from this Company; sales to Cleveland City Railway Co.; Steubenville Traction Company; East St. Louis & Belleville Suburban Railway Company; Michigan Construction Company; B. J. Arnold Power Station Company; Danville Street Railway Company; Cudahy Packing Company; Anglo-American Provision Company; La Belle Iron Works; C. A. Pope & Co., Steubenville, Ohio; Lake Superior Power Company; Waukesha Sheet Steel Company, etc., etc. The officers of the company are P. Albert Poppenhusen, president, and Herman A. Poppenhusen, secretary and treasurer, while the office force and correspondence is in charge of Mr. J. William Helm, formerly secretary and treasurer of the North Chicago Street Railway Company, Chicago.

STORAGE BATTERY INSTALLATIONS.—Sipe & Sigler, of Cleveland, manufacturers of the Willard storage battery, are meeting with marked success in securing contracts for heavy installations, to which business they have recently commenced to cater. They have just closed a contract for a plant of 220 cells, 600 ampere-hours capacity, to be installed at St. Albans, Vt., for the New England Electric Railway Construction Company, and are making a complete installation of battery plant, booster and switchboard for the power plant at the United States Naval Academy, Annapolis. The battery will contain 140 cells, 2800 ampere-hour capacity. Sipe & Sigler are rushing work in order to complete the 4000 ampere-hour battery station being installed for the Cleveland Electric Railway Company. It is under forfeit to be completed in time for the heavy loads consequent upon the G. A. R. annual encampment to be held in that city this month.

THE MICA INSULATOR COMPANY announces that its selling agency in Europe, hitherto entrusted to Messrs. Bergtheil & Young, 12 Camomile Street, London, has ceased, and that an English company has been formed under the name The Mica Insulator Company, Limited, for the purpose of carrying on the European business. The principal office of the new company will be at its factory at Stansted, Essex. By uniting the selling department with the factory, the company believes that business will be facilitated by bringing it into closer touch with the market and enabling it to serve customers more promptly. The manufacture of the well and favorably known "Micanite," "Empire" insulating cloth and paper, and "M. I. C. Compound," of which this company is the inventor and originator, will be continued in America, as heretofore, by the Mica Insulator Company, with offices at 218 Water Street, New York, and 117 Lake Street, Chicago, and factories at Schenectady, N. Y.

HYDRAULIC PLANTS FOR BRAZIL AND PORTO RICO.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, has obtained a contract from Rose & Knowles, San Paulo, Brazil, calling for a complete water power plant of 500 horse-power, which will be utilized for operating a cotton mill. A number of large compound condensing pumps have been ordered from the Stilwell-Bierce people for installation in the Central Aguirre, one of the most important sugar estates in Porto Rico. These pumps will have a capacity for handling 3000 gallons of water per minute. They are intended for irrigation purposes. The before-mentioned contracts were secured by Mr. George W. Neff, the New York manager of the Stilwell-Bierce & Smith-Vaile Company.

MACHINERY FOR SOUTH AMERICA.—Chief Engineer Pease, of the Buenos Ayres & Rosario Railway, is now here for the purpose of placing contracts for quantities of machine tools and electrical equipment to be installed in the new workshops of that road. He left this city Wednesday for Pittsburg, where he proposes to remain till the 19th inst., when he returns to New York. He intends to sail for South America Saturday, Sept. 21. While in this city Mr. Pease will stay at the Hoffman House. It is said that his purchases will aggregate a quarter of a million dollars.

GOULD STORAGE BATTERY COMPANY has recently closed a contract with Mr. George W. Vanderbilt for an equipment, and is now installing 64 cells of a normal 2000 ampere-hour capacity on his estate, Biltmore, North Carolina. The battery is for lighting and motor work, etc., and replaces one of older make put in some years ago.

BALL ENGINE CONTRACTS.—The Craddock-Terry shoe factory at Lynchburg, Va., will be equipped with electricity. The Ball Engine Company, Erie, Pa., furnishes the engine, which will be direct connected to a General Electric generator. The Billings Water Power Company, of Billings, Mont., has recently purchased a 250-hp engine from the Ball Engine Company.

THE RAWSON TELEPHONE COMPANY, of Elyria, Ohio, manufacturer of telephones, has decided to enlarge its plant. A third story will be added to the present building, and another building will be erected. The company is working on a large contract for telephones for an Albany, N. Y., exchange.

POWER FOR GREAT NORTHERN.—The Great Northern Railroad has decided to change the power of the shops at Hillyard from steam to electricity, the local water power company having contracted to furnish all the water power needed.

BULLOCK ELECTRIC CONTRACT.—The Bullock Electric Company, of Cincinnati, Ohio, has secured a contract for the supply of three 350-kw slow-speed generators to be installed for electric lighting purposes in the Mutual Life Building, New York City.

General News.

THE TELEPHONE.

DOVER, DEL.—The Indiana Long-Distance Telephone & Telegraph Company of Kentucky, with a capital stock of $1,000,000, was incorporated here. The company is authorized to construct and operate telegraph and telephone lines in Indiana, Ohio and Kentucky.

CAMILLA, GA.—The Camilla Telephone Company, recently incorporated, has a capital stock of $10,000, and will install a system starting with forty subscribers.

ATLANTA, GA.—The Standard Telephone Company will remodel and improve its entire plant, installing new machinery, etc., at a cost of $8,000.

SPRINGFIELD, ILL.—There is talk of an independent telephone system at Springfield.

CUSTER, ILL.—Dr. J. R. Allen has commenced putting up a telephone line between New City and Berry.

MORRISON, ILL.—The Whiteside County Telephone Company, capital stock $120,000, has been incorporated by Harry L. Hall, Walter W. Warner and Albert R. Baird.

ALTON, ILL.—The Board of Local Improvement at Upper Alton has decided to permit the Kinloch Telephone Company to enter the village by placing poles along Manning Street.

STERLING, ILL.—The City Council has granted a new twenty-year franchise to the Harrison Telephone Company, giving it the right to rebuild its lines and reconstruct its system in this city.

TAYLOR RIDGE, ILL.—The Farmers' Independent Trunk Telephone Association has been incorporated; capital stock, $2,500. Incorporators: Peter Eckhardt, W. H. Miller and A. A. Buffum.

CHICAGO, ILL.—Since the Banks and Burke telephone systems in Eminence township have been sold to a company, the citizens have decided to build their own lines independently of any company.

CHICAGO, ILL.—The Independent Telephone Company is pushing vigorously the work of installing its plant and announces that it will have 15,000 telephones in the downtown district by next spring.

CHICAGO, ILL.—A two-story addition is being made to the manufacturing plant at the southwest corner of Jackson Boulevard and Clinton Street for the Stromberg-Carlson Telephone Company, to cost $40,000.

MORRISON, ILL.—An ordinance requiring the Central Union Telephone Company to remove all its poles, wires and other property from the streets and alleys of the city of Peru, Ill., has been passed by the City Council of that city.

HARDIN, ILL.—At a stockholders' meeting a few days ago the Calhoun Telephone Company voted to increase its capital stock from $5,000 to $15,000. A proposition was also submitted to consolidate with the Pike County Telephone Company.

EDWARDSVILLE, ILL.—The Kinloch Telephone Company has secured admission to the county seat of Madison County. An ordinance has been passed granting it permission to install and operate a system. It provides for the carrying of wires in cables. The Central Union fought against granting the privilege.

BUSHNELL, ILL.—The Kurtz Telephone Company, which was recently granted a franchise at Macomb and intends to cover this part of the State with a network of wires, has commenced by purchasing the private line connecting Macomb and Colchester.

CHICAGO, ILL.—It is reported that the judges of the Circuit Court have been asked to assume jurisdiction over the affairs of the National Automatic Telephone Company. The petition was filed by Melvin E. Richardson, president of the company, and one of the creditors of the concern. The company, it is stated, is indebted to the amount of $13,000.

PLEASANT PLAIN, ILL.—The Boynton Telephone Company is constructing a line to Ashland and expects to connect several other towns before the winter sets in. The company has a station at New Berlin, at which point there are 25 local subscribers and 6 toll lines. At Pleasant Plains there are 25 local subscribers and 12 toll lines, and each of the two exchanges is equipped with a 100-drop cabinet board. The Swedish-American system is used.

TELL CITY, IND.—Manager John Backer will extend his telephone lines to Tell City soon.

ROSSVILLE, IND.—The Home Telephone Company, Rossville, has been incorporated; capital stock, $2,500.

INDIANAPOLIS, IND.—The Dubois County Telephone Company has increased its capital stock from $10,000 to $20,000.

WATERLOO, IND.—Manager Kelley of the local telephone exchange is preparing to extend the line southeast of Waterloo to Moore's Station.

MARION, IND.—The City Council has granted a franchise to the American Telephone & Telegraph Company, to place its poles and string its wires through the city.

LOGANSPORT, IND.—The Franklin City Council has declined to renew the Central Union telephone company's franchise, and has forbidden the company to place any more poles and dig any more holes in the streets. The marshal has been instructed to rigorously enforce the decree.

ELKHART, IND.—People of South Bend to the number of 500 have subscribed for service by the proposed new independent telephone company at that place. The Bell Company bought the other independent company's system about two years ago, and the citizens are now anxious to secure another competitor.

GREENSBURG, IND.—The New Independent Telephone Company, of this city, has increased its capital stock to $20,000 and is rapidly extending its lines throughout the county. Connections will soon be made with Milhousen, Newport and Westport. Considering that the company was organized but one year ago, the record is a good one.

WABASH, IND.—The Central Union Telephone Company has given notice to the people in this city and community that hereafter only telephones with long-distance transmitters will be put in, and that there will be no reduction in rates for long-distance service, which is now $3.50 and $2.50 a month. The rates for ordinary instruments are now $1 and $1.50 a month.

TIPTON, IND.—An enterprising postmaster at Tipton, Ind., has made a new use of the telephone which has proved successful. Each evening at 7 o'clock the farmers from all over the county put their receivers to their ears and hear the news of the day through their telephones. They are all connected by the Farmer's Telephone Company and the postmaster reads the news, beginning with the weather, then crop reports, etc. The day is at hand when all the farmers will be connected in this way and receive the news daily.

FRANKLIN, IND.—A motion has been filed in the United States Court to modify the injunction granted to the Central Union Telephone Company recently against this city to prevent the officials from removing the poles and wires and interfering with the company's property in any way until Oct. 1. The Central Union bought the plant and franchise of an older company and had begun to extend new lines when the city officials interfered by arresting the workmen. The city demands that all work cease until the matter is finally determined. The Council threatens to revoke the franchise.

INDIANAPOLIS, IND.—The Central Union Telephone Company boasts over an increase of 2000 subscribers since May 20. The company now has 6500 telephones in service. This large increase in so short a period has necessitated the enlargement of its switchboard capacity, and it is sparing neither labor nor expense in its efforts to furnish its patrons with a strictly first class service. It now has two switchboards on the way from New York. The new equipment will be installed at once. When this is done it can assure its patrons of a service superior to that ever furnished to the Indianapolis public.

GLEN HALL, IND.—The Odell Telephone Company has elected S. B. Lutz, president; H. G. Lutz, secretary and treasurer, and W. B. Foresman, manager. The company, whose incorporation was recently noted, purchased from the Receiver the Shawnee-Mound system, which has been in operation for six years. In one of the exchanges a Sterling board is used and in the other an American board, of 70 and 50 drops respectively. The line will be practically entirely reconstructed, and a toll line between Lafayette and Attica will be strung on the new poles. Most all of the company's subscribers, of which it has 187, are farmers.

INDIANAPOLIS, IND.—The Cumberland Telephone Company of Kentucky has filed articles of incorporation with the Secretary of State under the foreign corporation law. The capital stock is given in at $6,237,600; amount invested in Indiana, $201,732. The Indiana headquarters will be in Evansville. Under the same law the Central Union Telephone Company, with headquarters in Chicago, has filed articles of incorporation. The capital stock of the company is $6,963,000. The amount invested in Indiana is $1,740,750, and its Indiana representative is Walter Hill, of this city. The company paid the State a generous incorporation fee of $1,740.75.

BLUFFTON, IND.—The United Telephone Company, of Bluffton has consolidated its system with that of the independent companies at Hartford City on Sept. 7. This makes one of the largest telephone companies in the United States. The Bluffton Company turns into the pool 517 miles of toll lines, and the exchanges at Bluffton, Huntington, Portland and Geneva. The Hartford City Company puts into the pool the systems at Hartford City, Marion, Montpelier and Upland, and 210 miles of toll lines. The new organization will be known as the United Telephone Companies, and its headquarters will be in Bluffton. The capital stock has been increased from $100,000 to $300,000. The company claims to have 2,100 subscribers.

DUNCAN, IA.—There is being built a telephone trunk line from this town to Eliza.

WASHINGTON, IA.—The Union Dale Telephone Company, which has been organized at Riverside, has filed articles of incorporation. The capital stock is $3,000.

IONA CITY, IA.—The Uniondale Telephone Company has been incorporated. It is extending its line to the southwest and also to the north. It has about fifty or sixty patrons now, and is still growing.

DUBUQUE, IA.—The Tristate Telephone Company has filed articles of incorporation. The capital stock is $100,000. This is a Waukon institution, the men interested representing the Standard Telephone Company. The officers of the new company are: President, Vic H. Stevens; Vice-President, E. L. Cass; Secretary and Treasurer, C. H. Sandbeck. These, with Messrs. J. H. Denflhoff, J. W. Blessing and F. A. Irish, are directors, and also incorporators.

INDIAN TERRITORY.—Mr. Hummer, of Roff, president of the Arkansas Telephone Company, has received a permit from the Secretary of the Interior to build a line of telephone from Stroud, Oklahoma, to Sapulpa, Creek Nation, from Denison to Sapulpa, from South McAlester to Shawnee and from Hartshorne to Ardmore.

TOPEKA, KAN.—The McMahan Telephone Company is figuring on a line from Harveyville to Dover.

TOPEKA, KAN.—The Kansas & Missouri Telephone Company is erecting a new telephone line between Rossville and Willard.

LAKE CHARLES, LA.—The Louisiana & Texas Long-Distance Telephone Company is gradually making its way to Lake Charles and the west.

PERRY, LA.—A new telephone line has just been completed, running north from Linden to the old Greenvale post office. This line is seven miles long, with numerous branches.

WHITEFORD CENTRE, MICH.—There is talk of extending the telephone to Gert.

MIDLAND, MICH.—The Union Telephone Company is taking steps to establish an exchange here.

DETROIT, MICH.—The Wyandotte Council has granted a 30-year franchise to the People's Telephone Company.

GREENVILLE, MICH.—The Independent telephone exchange at Greenville will pass into the hands of the Citizens' Telephone Company, of this city, Oct. 1.

DETROIT, MICH.—The permit for the People's Telephone Company's new building was taken out by Architect Louis Kamper and the construction of the masonry has been commenced.

GRAND RAPIDS, MICH.—The Michigan Telephone Company has discontinued work on its "south" and "west" branch exchanges, and it is doubtful if work will be taken up again by fall. The reason assigned to the suspension of work is that its central exchange is entirely adequate to handle its present number of subscribers.

DETROIT, MICH.—It is stated that the People's Telephone Company of Detroit will soon absorb the Oakland County Telephone Company. If the plan is carried out all of the places of any importance in the State excepting Ann Arbor, Ypsilanti, Mt. Clemens and possibly one or two other cities will be connected with independent toll lines.

JACKSON, MICH.—Articles of incorporation of the People's Telephone Company have been filed; capital stock, $149,500. Incorporators: J. C. Richardson, George W. Carter, George A. Matthews, Thomas M. Smith, M. F. Cottrell, W. H. Maloney, Z. C. Eldred, all of Jackson, and Arthur Pack, of Orchard Lake, and Joseph B. Ware, of Detroit.

SAGINAW, MICH.—The Valley Telephone Company has nearly finished its new lines in Huron County. The copper circuit is now in operation from Saginaw to Bay Port and will be finished to Bad Axe within a week. The company has leased the old Stebbins line, which will add to the service Port Hope, Redman, Soule, Clark's Siding and Crown.

WELLS, MINN.—The Western Electric Telephone Company is extending its telephone line from Bricelyn through Frost and Marna to Blue Earth.

WINONA, MINN.—The Winona Telephone Company completed its line from Witoka to Pickwick, and will have it in operation to La Moille.

MINNEAPOLIS, MINN.—The Western Electric Telephone Company has finished its line between here and Mitchell. The workmen went to Kimball to put in a line from that place to Gann Valley.

CASS LAKE, MINN.—An agreement has been entered into between the Cass Lake Water, Light & Power Company, owners of a telephone franchise granted by the village Council of Cass Lake and the Iron Range Electric Telephone Company whereby a telephone exchange will be put in here.

MINNEAPOLIS, MINN.—The newly-organized Consolidated Telephone & Telegraph Company will be associated with the Twin City Telephone Company, and will have its headquarters in the latter's new exchange which is being erected at Third Avenue South and Seventh Street. The company will have a working capital of $100,000. The officers and directors are: E. H. Moulton, president; Clarence H. Judson, secretary; Edward E. Webster, treasurer; H. H. Potter and F. R. Clement. In Duluth the Consolidated Company will connect with the Zenith City Telephone Company, having between 1500 and 1600 subscribers, and in West Superior the connection will be with the People's Telephone Company, which has 800 subscribers. The Zenith City Company has been making great progress in Duluth.

BOONVILLE, MO.—An independent telephone line is being built from Lamine to Chouteau Springs in Cooper County.

KANSAS CITY, MO.—An independent telephone system will probably be established in Warrensburg in the near future by McDonald Bros., of Pleasant Hill.

NEVADA, MO.—The Nevada & Monticello telephone line is completed and in operation. It will be extended to Stockton, thence to Lamar, to connect there with the zinc belt of southwest Missouri.

ST. LOUIS, MO.—The Kinloch Telephone Company has taken possession of its new quarters in the Haagen building. The exchange is located on the third floor, and the local offices of the company will adjoin the exchange.

WARRENSBURG, MO.—The Independent Telephone Company, of Windsor, has applied for a franchise in this city. The Twentieth Century Telephone Company, of Pleasant Hill has been here for several weeks endeavoring to secure a franchise. The companies will endeavor to oust the Bell company's local system if admitted.

PLEASANT HILL, MO.—The Twentieth Century Telephone Company of the United States of America, with office in this place, has been incorporated, with a capital stock of $10,000. The incorporators are B. T. McDonald, H. B. Howell, J. M. McDonald and others.

DURHAM, N. C.—R. S. Plummer, recently appointed manager of the local Bell telephone exchange, will take charge Sept. 1. It is announced that the Bell telephone exchange will be rebuilt. Long-distance connections with New York and other points is expected to be made about Sept. 15.

DAVENPORT, N. D., wants a telephone system.

GRAND FORKS, N. D.—Langdon's new telephone line has fifty telephones in use and applications for thirty more.

ALBION, NEB.—The Farmers' Telephone Company, of Scribner, will soon have its line in operation.

OMAHA, NEB.—The Nebraska Telephone Company has completed the construction of a line to Sarpy Mills Park.

SALEM, N. J.—The City Council has passed an ordinance granting the Interstate Telephone Company a franchise providing it furnish the city with six telephones free, and pay $1,000 for the franchise.

ELIZABETH, N. J.—The Elizabeth Telephone Company, which was organized six years ago, has been sold to Barker Gummere, of Trenton, and J. L. Hommell, president of the Trenton Trust Company, who, it is understood, are interested in the Interstate Telephone Company.

SILVER CITY, N. M.—It is stated that the long-distance telephone line between this city, Deming and El Paso will be commenced in the near future.

BUFFALO, N. Y.—The Home Telephone Company, of this city, has been granted a franchise to erect a line in Niagara Falls, Ont.

ALBANY, N. Y.—The Watkins Telephone Company has been incorporated to operate in Watkins and Montour Falls; capital, $25,000. Directors: J. H. Fuller, K. F. Gill and Charles B. Stowe, of Cleveland, Ohio.

FREMONT, OHIO.—The Fremont Home Telephone Company now has over 600 telephones in operation.

WAYNESFIELD, OHIO.—The Auglaize Telephone Company has been incorporated with a capital stock of $5,000.

MAUMEE, OHIO.—A franchise has been granted to the Home Telephone Company of Toledo to establish an exchange in Maumee.

FREMONT, OHIO.—The Fremont Home Telephone Company will install a branch exchange at Lindsey, connecting it with Fremont.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has secured the franchise for an independent telephone line through Zanesfield.

CHAGRIN FALLS, OHIO.—The Central Union Telephone Company has again failed, after several attempts, to secure a franchise in Chagrin Falls.

COLUMBUS, OHIO.—During the State Fair the Columbus Citizen's Telephone Company operated a completely equipped branch exchange on the fair grounds.

FT. RECOVERY, OHIO.—The Home Telephone Company, of Ft. Recovery, Ohio, has been incorporated, with $10,000 capital, by local people to build an exchange.

TOLEDO, OHIO.—Charles Sumner and Frank W. Wachter went to Sylvania and secured a franchise from the village council for an independent telephone lines.

OXFORD, OHIO.—Ezra Bourne has made a proposition to buy out the Oxford telephone exchange. The Bell Company made a similar proposition, but it has been rejected.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company has just completed the installation of an up-to-date telephone system, replacing the old one, at a cost of over $15,000.

BOARDMAN, OHIO.—The Youngstown Telephone Company has opened a branch exchange at Boardman, giving free connection with Youngstown, Canfield, Lowellville, Greenford and New Buffalo.

BELLEVUE, OHIO.—The Flat Rock Telephone Company, heretofore a partnership, has been organized as a stock company. Improvements will be made and lines to Colby and Fireside will be built.

CHICAGO JUNCTION, OHIO.—The Huron County Telephone Company now has 275 telephones in operation in Chicago Junction, 25 new subscribers having been added to the list in the past month.

CLYDE, OHIO.—The Clyde Telephone Company has increased its capital stock from $10,000 to $40,000, and improvements will be made. The company is rapidly covering the farming section in this vicinity.

SALEM, OHIO.—Work of rebuilding has been started on the independent exchange at Toronto, Jefferson County. The subscription list has increased from 15 to 150 since W. F. Crossley obtained control.

MANSFIELD, OHIO.—The Mansfield Telephone Company is making connections very rapidly, and the exchange, which will supply 1200 subscribers in Mansfield and vicinity, will soon be ready for operation.

COLUMBUS, OHIO.—The United States Telephone Company (long-distance) has large forces of men at work on a through trunk line from Columbus to Richmond, Ind., connecting Dayton, Springfield, Eaton and other towns.

ASHTABULA, OHIO.—The Ashtabula Telephone Company is receiving bids for the construction of a new exchange building and will also install a new central energy system plant. The exchange is to be in operation within 90 days.

MASSILLON, OHIO.—The United States Telephone Company has completed two long-distance lines connecting Cleveland and Massillon, and a third is now being built. Lines are being built from Massillon to Canal Fulton and Richville.

LANCASTER, OHIO.—C. T. Moore, superintendent of the Lancaster Telephone Company, has been made manager of the independent plant at Logan, Ohio, which has recently been absorbed by the Federal Telephone Company, of Cleveland.

CINCINNATI, OHIO.—The Cincinnati Telephone corporation is extending its subway system on Walnut Hills and has asked of the Board of Public Service permits to open up several downtown streets and to erect distributing poles in various parts of the city.

TOLEDO, OHIO.—The Home Telephone Company's request for permission to build underground conduits has been granted by the city engineer, and operations have commenced. The telephone company has been granted permission to build a conduit in Seneca Street from Cherry to Walnut Street.

WAPAKONETA, OHIO.—A temporary injunction has been granted against W. H. Fledderjohann and R. F. Coppess, of New Knoxville, Ohio, at the instance of J. Maisch & Company, who claim to have bought the former's telephone franchise here. The former firm was preparing to build an exchange in Wapakoneta.

SYLVANIA, OHIO.—The Sylvania Home Telephone Company of Lucas County has been incorporated, with $10,000 capital, to build an independent exchange. Incorporators: Frank W. Wacher, F. F. Graves, Henry M. Barfield and Charles E. Sumner. The same people are interested in the new exchange being built at Toledo.

CLEVELAND, OHIO.—The two local telephone companies have been asked by Mayor Johnson to submit propositions for laying cables and placing telephones in the three water works cribs, which have recently been the scene of a series of accidents. In one case loss of life might have been averted had the men been able to communicate with the shore.

CIRCLEVILLE, OHIO.—The new exchange of the Circleville Home Telephone Company will be placed in operation within a few days with about 400 subscribers. The company expects to cover the whole of Pickaway County with farmers' and toll lines with branch exchanges in the smaller towns. Exchanges are being installed at Ashville and Williamsport.

HAMILTON, OHIO.—The City & Suburban Telephone Company (Bell) has brought suit to restrain the Hamilton, Hughes & Monroe, and the Western Butler Telephone companies from erecting poles and stringing wires through Hamilton, on the ground that it is in violation of franchises and the city ordinances. The companies mentioned propose to give independent long-distance service through Hamilton.

PORTSMOUTH, OHIO.—In less than one year the Portsmouth Telephone Company has increased its subscription list from 500 to 750, which is 300 more than the Bell Company ever had. The company is preparing to build a number of rural lines and expects to cover the whole of Scioto County. The demand for farmers' telephones is increasing faster than it can be taken care of. F. B. Finney is president of the Portsmouth Telephone Company.

CLEVELAND, OHIO.—The United States Telephone Company, which operates the long-distance wires in Ohio and Michigan, and portions of Indiana and Pennsylvania, has completed arrangements to connect with the lines now being built in Kentucky by the New Long-Distance Telephone Company, of Kentucky. This company was incorporated recently with $1,000,000 capital stock, and it proposes to connect up all the independent exchanges in that State and vicinity. The new connection, when built, will give the United States system connection with the Southern States.

CLEVELAND, OHIO.—The Consolidated Telephone Company, which was recently organized in this city to develop the independent telephone movement in New York State, has made several announcements as to the personnel of its business management. Richard Bacon, a well known Cleveland attorney, has been appointed general counsel of the company, and will have charge of its legal matters. He will have his headquarters at the company's general offices in the Electric Building, Cleveland. Mr. E. Bingham Allen has been appointed general right of way agent for the Inter-Ocean Telephone Company, the New York long-distance company.

FORT GIBSON, OKLA.—The Council has granted a franchise to Stapler & Hicks, of Tahlequah, to erect and maintain a telephone system in Fort Gibson for twenty years, 5 per cent of the proceeds to go to the town.

GUTHRIE, OKLA.—A charter has been granted to the Kiowa & Comanche Telephone Company, which will have a local exchange at Lawton and toll lines through the new country, connecting with all other independent lines. The incorporators are Daniel Rinehart, of Horton, Kan.; H. C. Cash, A. W. McKeand, E. G. Muliken and A. H. Cobbs.

BAKER CITY, ORE.—The Pacific Coast Telephone & Telegraph Company will build a telephone line from Baker City to Cornucopia.

ASTORIA, ORE.—The City Council passed an ordinance granting a 35-year franchise to the Pacific Coast Telephone & Telegraph Company.

BAKER CITY, ORE.—The Express Telephone & Telegraph Company, of Express, has been incorporated. The officers and stockholders are: W. E. Ayers, president; F. L. Shaw, vice-president; F. S. Bubb, secretary and treasurer. This is a local telephone line connecting with the various settlements in the vicinity of Express.

ASTORIA, ORE.—The City Council has finally reached an agreement with the Pacific States Telephone & Telegraph Company in the matter of a license. Under the new arrangement the franchise of the company is extended 35 years longer, or until 1937. The company is required to pay $500 to the city immediately, and, commencing with January, 1902, $250 yearly thereafter for 15 years. After 15 years, $400 must be paid yearly until the franchise expires. The arrangement will net the city $10,250.

LAMBERTVILLE, PA.—A direct telephone line has been established between Stockton and Sergeantville.

PHILADELPHIA, PA.—The Keystone Telephone Company has been granted permission by the Rockledge Council to lay its wires in that borough.

NEWTOWN, PA.—The Standard Telephone Company, which has constructed a line from this place to Bristol, will extend its service to Burlington, N. J.

DOYLESTOWN, PA.—The Standard Telephone Company, which has constructed a line through a section of Bucks County, will extend its service to Burlington, N. J.

CHESTER, PA.—The Independent Telegraph & Telephone Company of Delaware County will ask Chester City Councils for the privilege of putting its wires underground.

WEST CHESTER, PA.—The Delaware and Atlantic Telegraph & Telephone Company has made arrangements with the Southern Telephone & Telegraph Company to connect with Lancaster via Quarryville.

WILKESBARRE, PA.—J. B. Russell & Company, local bankers, are the fiscal agents of the new Illinois Telephone & Telegraph Company, of Chicago, capitalized at $5,000,000. The investors are all Luzerne and Lackawanna County capitalists.

PITTSBURG, PA.—The Union Telephone & Messenger Company, of East Pittsburg, Pa., has been chartered, with a capital stock of $1200. The company has organized, with the following-named gentlemen on the Board of Directors: F. R. Cyphers, James P. Kelly, Archie Graham, John S. Stewart and D. R. Fose.

PITTSBURG, PA.—The stockholders of the West Penn Telephone Company of Washington, Pa., have increased the capital stock of the company from $12,000 to $50,000. With the additional financial resources the company expects to gain entrance into the town of Washington, a right which has hitherto been denied.

PARKSTON, S. D., is talking of a local telephone system.

ARTESIAN, S. D.—The people of Artesian have decided to put in a local telephone system which it is expected will be in operation by Oct. 15.

MITCHELL, S. D.—C. E. Wisard, of Howard, has been awarded the contract for furnishing the material for the local telephone system to be established at Bridgewater.

PIERRE, S. D.—A project is under way for the construction of a telephone line from this city to the Black Hills.

NASHVILLE, TENN.—The Tennessee River Telephone Company, of Meigs County, has increased its capital from $3,000 to $10,000.

FRANKLIN, TENN.—The organization of a local telephone company is said to be under consideration. Local and Pennsylvania capital are said to be interested.

KNOXVILLE, TENN.—The Cumberland Telephone Company has commenced the construction of a toll line from Jellico, Tenn., to Richwood, Ky., a distance of sixty-five miles. At Jellico the line connects with the toll line into Knoxville. At Richwood connections will be made with Louisville and Cincinnati.

HEMPSTEAD, TEX.—C. A. Horton, of Austin, has contracted to construct a telephone system from Hempstead to Prairie View College.

EMORY, TEX.—The Emory Telephone Company, capital stock $1,000, has been incorporated by W. D. Peeples, A. H. Rhodes, T. R. Potts and others.

GREENVILLE, TEX.—J. T. Young, J. G. Gordon and Messrs. Thompson, of Cooper, have been granted a franchise for an independent telephone company in this city.

STAUNTON, VA.—The Long-Distance Telephone Company of Virginia contemplates the extension of its lines.

RICHMOND, VA.—The Peninsula Telephone & Telegraph Company has been chartered, to operate a line in York and Elizabeth City counties, Va., connecting with the Hampton exchange.

WILLIAMSBURG, VA.—The Peninsula Telephone & Telegraph Company will probably extend its line up the Peninsula to Richmond. There are already two telephone lines in this section, and the advent upon the scene of a third one has created no little surprise. It is said work on the new line will begin as soon as the right of way has been secured.

SEATTLE, WASH.—By a recent change in the management of the Automatic Telephone Exchange Company of Seattle, Wash., General Manager E. A. Seeley and General Superintendent G. G. Hunt have been relieved of their positions and W. S. Claypool, who recently arrived from the East, has assumed the local management. It is understood the company will soon reorganize under the franchise of the Independent Telephone Company and drop the present name. Messrs. Seeley and Hunt will retain a financial interest in the company, but will engage in other business in another State.

BARBADOES, W. I.—There are 600 miles of telephone lines in this island. The system is operated by a private company.

LEETOWN, W. VA.—The Winchester Telephone Company will soon extend the line from Leetown to Middleway in Jefferson County.

HARPER, WIS., is to have a telephone exchange.

WAUKESHA, WIS.—A. L. Hutchinson, of Weyauwega, Wis., will, in the interest of the Independent telephone combination, ask this city for a franchise to build a telephone exchange.

APOLLONIA, WIS.—The Chippewa Valley Telephone Company has completed its Atlanta, Bruce and Baldwinsville lines to this place, and a local and central exchange will now be installed.

LADYSMITH, WIS.—The stringing of the wires of the Chippewa Valley Telephone Company from Barron to this place has been completed, and work will now be started on the local exchange in this city.

LA CROSSE, WIS.—The Bell Telephone Company has taken down its line between Houston and Money Creek, Minn. It has not been abandoned permanently, and as soon as it is possible will be rebuilt.

KENOSHA, WIS.—An ordinance is being drawn up to cause the telephone wires to be placed underground. In order to anticipate the demands of the city the telephone company has cabled many of its wires.

OREGON, WIS.—W. H. Jones, W. A. Soden, J. M. O'Brien, J. Barry and W. I. Ames, of this city, have organized and filed articles of association for a telephone company to build an exchange in this city. The capital stock is $5,000.

MADISON, WIS.—The Chippewa Valley Telephone Company, of Bruce, recently incorporated, has organized and is officered as follows: T. W. Borum, president; A. L. Arpin, vice-president; A. Hein, secretary, and O. E. Pederson, treasurer. The exchange was started on Sept. 1 with 100 subscribers, using Stromberg-Carlson apparatus. The company has 60 miles of toll line, and contemplates extending to Prentice Point and to Rhinelander.

MENOMINEE, WIS.—The Green Bay & Lake Michigan Telephone Company has been organized, with ex-Governor Edward Scofield, of Oconto, Wis., and A. L. Hutchinson, of Weyauwega, Wis., at the head. The company has applied for franchises in Escanaba, Menominee, Marinette, Oconto, Green Bay, Sheboygan and Manitowoc. It will build toll lines connecting with the independent system of the company. E. T. Munger, of Havana, Ill., president of the Havana Telephone Company, has been engaged as superintendent. The new company will offer house telephones at $1 per month and office instruments for $2.

MARSHFIELD, WIS.—Within a very short time Marshfield will have long-distance telephone connections. The differences between the local telephone company and the Wisconsin Telephone Company have finally been amicably adjusted. The points of difference which have prevented an earlier adjustment have been conceded by the Wisconsin company agreeing to connect with the local line and come into the city on the poles of the latter, the business to be in charge of the operator of the local company, for which service they agree to pay 15 per cent on long-distance business. They also agree not to operate a local exchange.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company has been organized, and articles of incorporation filed. The capital stock is $500,000. Officers were elected as follows: President, Ed. T. Fairchild, of Milwaukee; Vice-President, F. T. Boesel, Milwaukee; Secretary, A. H. Low, of La Crosse, and H. S. Hadfield, of Milwaukee, treasurer. These, together with A. L. Hutchinson, of Weyauwega, form the board of directors. They are also the principal stockholders, but W. W. Townsend and F. H. Lord, of Chicago;

E. T. Monger, of Green Bay; E. W. Keyser, of Waukesha; L. W. Burch and J. C. Harper, of Madison; R. Valentine, of Janesville and C. W. Switzer, of La Crosse are more or less interested. The company will co-operate with the independent companies throughout the State. It has already secured options on a greater portion of the independent lines, amounting to probably 600 miles of toll lines, with some 1200 subscribers. The systems brought together will be greatly improved in equipment, etc.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—At the Union shaft of the Sierra Nevada, Union Consolidated and Mexican mines on the Comstock, the installation of the new electric hoist plant is nearly completed, and it will soon be in operation.

SAN FRANCISCO, CALIF.—It is again reported that there is a probability of a sale of the Mutual Electric Light Company's plant in San Francisco to the People's Gas & Electric Company, on a basis of about $12 a share, which would make the purchase price nearly $500,000. It is said that the would-be purchasers wish to use the plant to force the San Francisco Gas & Electric Company to sell out also.

MONTREAL, CAN.—The Royal Electric Company, which is now merged in the new electrical combination of Montreal, the Montreal Heat, Light & Power Company, has secured a renewal of the contract for the lighting of the city of Montreal. At a special meeting of the City Council a motion was carried offering the Royal Company the contract for a term of five years at $60 per lamp. This figure is $35 less than the company's tender and $6 more than the tender of the St. Lawrence Power Company, which was the lowest tenderer.

HARTFORD, CONN.—The property of the Hartford Light & Power Company, having passed into the hands of the Hartford Electric Light Company, the first-named company will cease to be a corporation after Oct. 1. The outstanding obligations of the Hartford Light & Power Company at the time of the arrangement made with the Hartford Electric Light Company consisted of its capital stock, a first mortgage of $150,000, a second mortgage of $60,000, and claims against the company amounting to $644.80. This indebtedness has all been taken care of except the first and second mortgages. The price paid for the stock was $10 a share.

DOVER, DEL.—An amendment was sent here from Baltimore, Md., to the certificate of incorporation of the Standard Light, Heat & Power Company, of Washington, filed here some months ago, with a capital stock of $200,000, increasing the same to $1,000,000. The incorporators of the concern are Robert S. Lawrence, Edward A. Oldham, E. Hume Talbot and Frank J. Stillman, of Washington, D. C., and Jems Virdin, Dover.

JONESBORO, IND.—The Jonesboro Electric Lighting Company has incorporated, with a capital stock of $20,000. A new and modern plant will be installed at once.

WINDFALL, IND.—The town trustees have approved the estimates for an electric light and water works plant, and will advertise for bids to construct the plant at an early day.

INDIANAPOLIS, IND.—The People's Electric Light & Heating Company of Bloomfield has filed notice with the Secretary of State of an increase of capital from $35,000 to $150,000.

LAPORTE, IND.—The Laporte County Electric Company, with a capital stock of $160,000, has filed articles of incorporation. The company proposes to furnish light, power and heat to Laporte and Michigan City.

INDIANAPOLIS, IND.—Under the foreign incorporation act articles of incorporation were filed by the General Gas, Electric & Power Company, the principal office of which is in New Jersey, with a capital stock of $75,000. The property in this State is at Connersville, and is valued at $40,000.

BALTIMORE, MD.—The Fidelity & Deposit Company, of Maryland, as trustee and commissioner, will sell the Catawba Electric Power Company of North Carolina at public auction at Dallas, N. C., on Sept. 11.

MINNEAPOLIS, MINN.—The Pipestone Electric Light, Heat & Power Company, has filed amended articles of incorporation, fixing its capital stock at $50,000.

BROOKFIELD, MO.—The electric light plant, which has been able to run only a few hours each evening for the past two weeks, was compelled to shut down entirely on account of the lack of water. It will remain closed until it rains.

LEBANON, OHIO.—The Council of Lebanon has decided to issue bonds to the amount of $6,000 to increase the capacity of the municipal electric lighting plant.

WARREN, OHIO.—The Warren Electric Light & Power Company has elected officers as follows: Directors—B. C. Geiger, Chas. Fillis, S. A. Corbin, D. R. Dodson, H. B. Weir, J. N. Green and C. D. Backus; President, R. D. Dodson; Secretary-Treasurer, C. D. Backus.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Light Company is preparing to enlarge its power station, and has placed a contract with the Warren Electric Manufacturing Company, of Sandusky, for a large alternating current generator. Other machinery will be purchased. The lighting company has a contract to illuminate the city after Jan. 1.

CINCINNATI, OHIO.—The contract for the motor cars to be used in the operation of the new system of canal transportation by the Miami & Erie Transportation Company has been awarded the Cleveland Construction Company. The cars will be equipped with 150-hp motors and will be powerful enough to draw ten heavily laden canal boats at a speed of ten miles an hour. This speed may not be maintained, however, because the State charter stipulates a uniform speed of not to exceed four miles an hour. The cars will be 7 feet 10 inches long. The road will be standard gauge, rails 75 pounds to the yard. Eighteen of the cars will be built at once. Contracts for two cars of a smaller pattern are to be awarded also. These cars are to be used to draw the boats under bridges in Cincinnati which are too low to permit passage of the larger cars. The Edison plant in Cincinnati will furnish the power, and fourteen substations will be installed along the line.

OKLAHOMA CITY, OKLA.—Contracts have been made for the installation of a $15,000 storage battery plant in the Oklahoma City Electric Light & Power Company's plant.

CORNWALL, ONT.—The town Council is considering the question of pumping the water supply of the town by electricity.

PITTSBURG, PA.—Two hundred organized electrical workers and wiremen of Pittsburg and Allegheny threatened to go on a strike last week unless the contractors grant them an advance in wages. At a conference a compromise was effected. The contractors promised to advance the wages 50 cents a day two months from now.

PITTSBURG, PA.—The Morgantown Electric Light & Power Company, of Morgantown, W. Va., has sold its plant and franchise for $14,000 to a syndicate composed of I. C. White, S. D. Hirschman, Frank Cox, W. E. Glasscock, Joseph H. McDermott and R. E. Fast. The plant will be enlarged and an electric railroad is contemplated.

THE ELECTRIC RAILWAY.

ENSLEY, ALA.—The Steel Cities Railway Company has been incorporated at Ensley; capital $500,000. It is proposed to build a local electric railway, to be extended to Bessemer and Brookside. J. W. Minor, of Ensley, is president

SAN FRANCISCO, CALIF.—It is reported that the Market Street railway lines in this city are to be sold to an Eastern syndicate backed by the Widener-Elkins-Whitney interests.

MONTREAL, CAN.—The Montreal Street Railway Company is making extensive alterations to its power house on William Street. Two big 1600-hp engines and dynamos are now being installed there.

GAINESVILLE, GA.—The Gainesville & Dahlonega Electric Railway Company has purchased the Dunlap water power, which embraces 750 acres of land, for $20,000. A dam will be constructed at the shoals of such height as will furnish fall enough to generate 5000 horse-power. Seven hundred and fifty thousand dollars' worth of bonds have been issued and the company will begin work not later than Oct. 1.

WAUKEGAN, ILL.—The survey for a double-track electric railway connecting the Chicago and Milwaukee electric railway at Lake Bluff with the St. Paul railroad depot at Libertyville is completed and the projectors expect to build the line unless something arises to prevent their securing the right of way.

LA PORTE, IND.—The County Commissioners have granted to the Chicago, Valparaiso & Michigan City Railway Company a franchise for 50 years.

KOKOMO, IND.—A new company was recently organized in this city to build an interurban railway line from here to Peru. The men composing the company are Allen Shewman and Dr. Henry Holmes, of Greenbay, Wis.

INDIANAPOLIS, IND.—According to a statement given out by the Secretary of the State Tax Board, there are 513.38 miles of electric railway in Indiana, valued for taxation at $6,696,210; the rolling stock at $774,412, and improvements and right of way at $275,830, making a total valuation of State taxation of $7,746,452. Each county in addition taxes the value of the companies' personal and real property, which amounts to a million or more dollars.

LEAVENWORTH, KAN.—The Kansas City-Leavenworth Electric Railway Company contemplates building an electric line from Leavenworth to Atchison, Kan., and St. Joseph, Mo., with a branch to Platte City, Mo., and another line from Leavenworth to Topeka.

MONTICELLO, KY.—J. C. Slayback, of Hamilton, Ohio, and T. F. McClure, of Cincinnati, are interested in a proposed electric railway from Monticello to Burnside or Sommerset.

BALTIMORE, MD.—The Liberty Turnpike Electric Railroad Company has been incorporated. The directors of the company are Messrs. Frank H. Callaway, James F. Ingram, Jr., Milton W. Offutt, Fielder C. Slingluff and John W. Styne. The capital stock is fixed at $150,000.

MARYLAND.—At a meeting in Baltimore of the Havre de Grace Railway & Power Company, it has been decided to begin immediately the construction of the line, which will be 16 miles in length. Capital and right of way to a sufficient amount have been secured. The line will connect the towns of Belair and Havre de Grace. At the former it will be able to convey passengers to and from the Maryland & Pennsylvania Railroad, and at the latter it will reach the Baltimore & Ohio and Pennsylvania roads.

UPTON, MASS.—The Selectmen of Upton have voted to grant a franchise to the Milford & Upton Electric Railway Company.

SPRINGFIELD, MASS.—A company has been organized under the name of the Ludlow & Holyoke Street Railway Company to build an electric road from Ludlow to Chicopee. The officers are: President, John E. Stevens, Ludlow; Clerk and Treasurer, George A. Birnie, Ludlow.

KALAMAZOO, MICH.—The proposed electric railway between here and Grand Rapids has been purchased by the Bishop syndicate, of Ohio, which intends putting in a system costing about $1,250,000. The system will take in the towns of Plainwell, Otsego and Martin, as well as numerous small villages on the route.

ST. PAUL, MINN.—The Chicago Great Western, it is stated, contemplates the installation of electric power for all its suburban service out of St. Paul, reaching as far south as Randolph, 30 miles. Edward C. Boynton, of the engineering department, it is said has been engaged in making estimates.

NATCHEZ, MISS.—The Natchez electric street railway is now assured. The necessary amount of bonds has been subscribed and the contract for the work will be closed in a few days. The company will build about four miles of track. The track and equipment will cost $50,000.

TRENTON, N. J.—The Trenton Street Railway Company still keeps up its fight to prevent the Tom Johnson line, which proposes to run cars from Philadelphia to New York, from getting into Trenton by way of the Calhoun Street bridge. It has begun condemnation proceedings in the name of the Mercer

Traction Company, organized under the General Railway law and so having the power to condemn land, to secure the strategic strip of land which now belongs to a son of Mr. Johnson.

ALBANY, N. Y.—A certificate of change of name of the Colonial City Traction Company, of Kingston to the Kingston Consolidated Railroad Company, has been filed with the Secretary of State.

SYRACUSE, N. Y.—The State Railroad Commission has granted the application of the Syracuse, Skaneateles & Moravia Railway Company for a charter to build an electric railway from Moravia, in the southern part of Cayuga County, to Syracuse.

ROCHESTER, N. Y.—Application for a certificate authorizing the construction of the Monroe County Electric Belt Line Railroad has been filed in the office of the State Railroad Commission. The road will connect Rochester with Penfield, Dispatch, Fairport and Pittsford.

ALBANY, N. Y.—The Ontario & Wayne Traction Company has been incorporated, with a capital of $500,000. The directors are: Senator John Raines, William L. Parkhurst, J. L. Burnett, Walter H. Knapp and J. H. Pardee, of Canandaigua; B. H. Davis, F. W. Griffith, of Palmyra; J. M. Stoddard, of Shortsville, and L. S. Cuyler, of Pultneyville.

ALBANY, N. Y.—The New York & Port Chester Railroad Company has filed with the Secretary of State an amended certificate of incorporation to construct an electric railroad from Willis Avenue, Borough of the Bronx, New York City, through Mt. Vernon, Pelham, New Rochelle, Larchmont, Mamaroneck, Rye and Port Chester, a distance of about 25 miles. The company has a capital of $250,000.

CANASTOTA, N. Y.—The Canastota & Morrisville Railway Company has been incorporated to construct an electric street surface road fifteen miles long, in Madison County, connecting Canastota and Morrisville, N. Y. The capital is $200,000. The directors are Leander W. Burroughs, John Reidy, John A. Johnson, John H. Broad and Brownell Tompkins, of Morrisville; William H. Patten, Milton DeLano, and John B. Weaver, of Canastota, and W. Emmet Coe, of Peterboro.

ALBANY, N. Y.—A joint agreement of consolidation between the Glens Falls, Sandy Hill & Fort Edward Street Railway Company; Warren County Railway; Stillwater & Mechanicsville Street Railway Company, Greenwich & Schuylerville Electric Railway; Saratoga Traction Company, and Saratoga Northern Railway has been filed with the Secretary of State. The capital stock of these companies is $2,600,000. The name of the new company is Hudson Valley Railway Company. The principal office is at Waterford, N. Y., which is the southern terminal of the above system of electric railroads, heretofore known as the Powers-Colvin system.

NORTHPORT, L. I.—The Northport Traction Company has been incorporated, to build and operate a street surface electric road three miles long, between East Northport station, on the Long Island Railroad, in Suffolk County, and Northport Harbor. The capital stock is $50,000, divided into 500 shares of $100 each. The directors for the first year are: William H. Baldwin, Jr., William F. Brown and William J. Kelly, of Brooklyn; Frank E. Haff, of Long Island City; John Wolf Hillman, Edward Pidgeon and Edward Thompson, of Northport; William F. Potter, of Flushing, and F. C. Scudder, of Babylon. The company's principal office is to be in Northport.

OSSINING, N. Y.—Receiver John V. Cockcroft has sold the Ossining Electric Railroad Company to Barnet & Henderson, of Cleveland, Ohio, who represent a syndicate. The price paid was $50,000. The line will be carried eastward to Pleasantville, and from there to Port Chester, via White Plains. Southward it will go as far as Kingsbridge. From Ossining it is proposed to go northward to Croton and Croton Dam, and from the latter place to Golden's Bridge, on the Harlem Railroad, where connections will be made with a new line in course of construction in Connecticut. The new line will run an extension from Croton to Ver Planck's Point to connect with the Peekskill Electric Railroad.

COLUMBUS, OHIO.—There is a field for an electric railway between Kenton and Wapakoneta, in this State.

COLUMBUS, OHIO.—The Galion & Crestline Traction Company has been incorporated; capital stock, $110,000.

CANTON, OHIO.—The Canton-Akron Railway Company is securing right of way for its proposed extension to New Philadelphia.

TIFFIN, OHIO.—The Seneca County Commissioners have granted a franchise through the county to the Tiffin & Port Clinton Railway Company.

DAYTON, OHIO.—G. M. Hodges, of this place, is promoting a road to be known as the Cincinnati, Hamilton, Richmond & Muncie Traction Company.

CINCINNATI, OHIO.—The Rapid Railway Company, which is promoted by G. R. Scrugham and others of this city has applied for a franchise in Hamilton County.

COLUMBUS, OHIO.—The Franklin County Commissioners have granted a 25-year franchise over the Granville Pike to the Columbus, Newark & Eastern Traction Company.

BUCYRUS, OHIO.—The Buckeye Traction Company, which proposes to build a road from Bucyrus to Norwalk, has been granted a franchise through town by the Bucyrus Council.

MARIETTA, OHIO.—The Washington County Traction Company has been incorporated by local people to build a line from Marietta to Newport, a distance of 15 miles. The capital is $250,000.

TOLEDO, OHIO.—The Toledo & Lima Traction Company has been incorporated, with $50,000 capital stock, by J. D. S. Neeley, D. J. Cable, A. K. Detwiler, H. A. Tobey and G. G. Metzgar.

TOLEDO, OHIO.—C. A. Thatcher, of Toledo, has secured franchises for street railway lines in Petoskey, Mich., and an interurban line connecting with Harbor Springs and a number of small towns.

TOLEDO, OHIO.—The villages of Bellmore and Weston have granted franchises to the Toledo, Columbus, Springfield & Cincinnati Railway Company, which proposes to build a road across the State.

XENIA, OHIO.—Hon. John P. Martin, of Xenia, has secured franchises for a system of electric railways in Florida, involving an expenditure of $2,500,000. A. . . Abbott, of Chicago, is engineer for the project.

CLEVELAND, OHIO.—Franchises and right of way for a road projected by A. D. Prosser to extend from Grand Rapids to Kalamazoo, Mich., have been purchased by George T. Bishop and others of this city.

COLUMBUS, OHIO.—The Conneaut & Southeastern Railway Company of incorporated, with $10,000 capital stock, by George C. Chapman, Clifford W. Smith, George H. Cleveland, C. M. Brown and G. W. Watson.

CLEVELAND, OHIO.—The Cuyahoga County Commissioners have granted a 25-year franchise to Daniel Gindelsperger, Fred. Green and others for a second line from Cleveland to Akron by way of Brecksville and Richfield.

CLYDE, OHIO.—The Sandusky, Clyde, Tiffin & Southern Railway will be built over a private right of way just outside the corporation line in Clyde. All right of way for the road has been secured and surveys are being made.

LIMA, OHIO.—Stockholders of the Lima, Lewison & Bellefontaine Railway Company have agreed to the terms of a plan for merging the property into the newly organized Toledo, Columbus, Springfield & Cincinnati Railway Company.

COLUMBUS, OHIO.—The Conneaut & Southeastern Railway Company of Conneaut, capital $10,000, has been incorporated. The incorporators are: George J. Chapman, Clifford W. Smith, George B. Watson, George H. Cleveland and G M. Brown.

NORWALK, OHIO.—The Norwalk Council has granted a franchise into town to the Cleveland, Elyria & Western Railway Company. A franchise for the Sandusky & Interurban Company is being held up because the company declines to give universal transfers.

CLEVELAND, OHIO.—R. L. Andrews, general manager of the newly consolidated Cleveland & Eastern Railway, is making plans to greatly improve the Chagrin Falls & Eastern line, which is being extended to form the through line to Warren and Youngstown.

NEW BERLIN, OHIO.—L. E. Meyers, president of the Canton-Akron Railway Company, states that the company will build at this point a mammoth lighting and power plant, sufficient to supply light in Canton, Akron and surrounding towns and to furnish power for the road.

COLUMBUS, OHIO.—The Columbus, Marion, Tiffin & Toledo Electric Railway Company has been incorporated, with a capital of $20,000. S. E. Barlow, G. W. Kemp, C. E. Sawyer, H. B. Hane and Senator W. S. Harding are the incorporators. Marion will be the headquarters.

CLEVELAND, OHIO.—The Cleveland & Southern Railway Company has filed a mortgage for $1,000,000 given to the Cleveland Trust Company to secure funds with which to prosecute the work of building the road. The mortgage is for 20 years and will bear interest at 5 per cent.

CLEVELAND, OHIO.—F. H. Ginn and George T. Bishop, of Cleveland, are promoting a line which will extend from Kalamazoo, Mich., to Grand Rapids, with a branch to Otsego. The company will be known as the Southern Michigan Traction Company, and E. P. Roberts & Company, of Cleveland, are preparing estimates on the project.

COLUMBUS, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company, whose incorporation was recently noted in these columns, is at work on the construction plans. Seven miles of the road are now under construction. Power will be furnished temporarily by the Western Ohio Company from St. Mary's. The company will be in the market for equipment and supplies.

CLEVELAND, OHIO.—The latest move of the Everett-Moore syndicate is the securing control of several lines on the Canadian side of the Detroit River. The roads are the Windsor, Sandwich & Walkerville Electric Railway, the South Essex Railway and the Windsor City Railway Company. The properties include about 15 miles in operation and several under construction, and it is said that the combined roads are valued at about $500,000. It is stated that the power-house of the Detroit system will be enlarged to take care of the entire system on both sides of the river.

TOLEDO, OHIO.—The stockholders of the Toledo, Columbus, Springfield & Cincinnati Railway Company organized in this city last week as follows: Directors, Wm. P. Heston, Claud Wyant and S. C. Heston, Toledo; C. H. Wells, Milwaukee; Ellis Bartholomew, Youngstown; I. N. Covault, Sidney; X. H. Holler, Lima; E. M. Hamilton, Bellefontaine, and Hon. A. F. McCormick, Columbus. Officers: Ellis Bartholomew, president; C. H. Wells, first vice-president; A. F. McCormick, second vice-president; I. N. Covault, secretary; Wm. P. Heston, treasurer; Claud Wyant, general counsel.

CLEVELAND, OHIO.—An important move on the plans of the Everett-Moore syndicate which will be announced shortly, will be the consolidation of all the traction properties in Michigan now owned by the syndicate, into one company, to be incorporated under the laws of that State. It will include the city lines of the Detroit United Railways and the interurban lines radiating from Detroit which have been purchased or are held under option by the syndicate. Mr. Everett is quoted as saying that the Michigan corporation will have a capital stock of $12,500,000 and bonds to the amount of $30,000,000, this amount being necessary to cover all the outstanding securities of the various companies.

OTTAWA, ONT.—The deal by which a syndicate of Montreal capitalists have secured the amalgamation of the Pontiac & Pacific Junction Railway, the Hull Electric Railway and the Interprovincial bridge, which spans the river between Ottawa and Hull, at figures aggregating some $5,000,000, is one of the largest railway deals which has taken place in Canada for some years. The three railways and the bridge will, in future, be under one management under the name of the Ottawa, Northern & Western Railway Company. The purchase price of the Hull Electric Railway was $1,000,000.

CARLISLE, PA.—The City Council has granted a franchise to the Baltimore, Westminster & Gettysburg Street Railway Company. The company will lay more than 100 miles of track.

WASHINGTON, PA.—The Washington Electric Street Railway Company will build a trolley line from the terminus of the present line at Tylerday

through the new industrial section west of town, through West Washington and connect with the main line in Washington.

HARRISBURG, PA.—A syndicate, of which L. H. Mathews, of Pittsburg, is president, has secured charters for the following companies: The Canonsburg & Washington Street Railway Company, to build a line eight miles long; capital, $48,000. The West Washington Street Railway Company, to build a line three miles long; capital, $18,000. The North Washington & Meadow Lands Street Railway Company, to build a line six miles long; capital, $36,000. East Washington Street Railway Company, to build a line four miles long; capital, $24,000. The Washington & Oak Grove Street Railway Company, to run through Washington; capital, $18,000.

PHILADELPHIA, PA.—A despatch received here from Nebraska states that plans are under way for the consolidation of a number of street railway lines in four cities in that State, and the operation of the combined system with the energy derived from a water-power plant. It it stated that the plans involve an outlay of $20,000,000, and the project is backed by J. Pierpont Morgan. According to the report, the railway interests in Omaha, South Omaha and Freemont, Neb., and Council Bluffs, Ia., are to be amalgamated. The second object of the enterprise is the establishing of a power plant at a point four miles south of Freemont. The dam, it is stated, will itself cost $3,500,000, and it is calculated that there will be a fall of water of 157 feet. Engineers estimate that 30,000 horse-power will be available for 24 hours a day, or 50,000 horse-power for ten hours a day. The power will be used for the operation of the consolidated railway systems and for electric lighting in the four cities named, besides its distribution among manufacturing plants.

PROVIDENCE, R. I.—The United Traction & Electric Company, of New York and Providence, announces the purchase of the branch steam road connecting Attleboro and North Attleboro, now operated by the New York, New Haven & Hartford Railroad Company.

COLUMBIA, S. C.—South Carolinans are going in for long electric railways. Recently the building of a line from Aiken to Augusta was begun, and now the Secretary of State has chartered the Greenville-Piedmont Traction Company, with a minimum capital of $100,000, that may be increased to $250,000. This company will construct a line from Greenville to Piedmont, a distance of twelve miles. Pennsylvania capitalists are interested. A plan is on foot to extend the Buffalo road, running from Union, about eight miles, to Buffalo mills, via White Rock Lithia Springs and Glenn Springs, connecting at White Rock with an extension of the Spartanburg electric line, giving an electric road between Union and Spartanburg.

CHATTANOOGA, TENN.—The Gadsden and Attalia car line, operating between this place and Gadsden, has been sold by Colonel R. B. Kyle, of Gadsden, to Messrs. W. H. Weller and C. D. Ward, of Gadsden.

SAN ANTONIO, TEX.—Permission having been granted the San Antonio Traction Company to consolidate with the West Side Street Railway line, the Traction Company has taken formal possession.

SALT LAKE, UTAH.—The street railway systems of Salt Lake City were recently merged into one corporation. At directors' meetings the property of the Salt Lake City and of the Rapid Transit companies was transferred to the Consolidated Railway & Power Company, which is capitalized at $4,000,000. The new company includes as well several smaller companies previously absorbed.

KEWAUNEE, WIS.—The city has granted the Northwestern Interurban Electric Railway Company a 35-year franchise.

MILWAUKEE, WIS.—The Northwestern Interurban Electric Railway Company has been incorporated, with a nominal capital of $25,000. The incorporators are C. A. McGee, H. F. Cochems, W. Y. Scanlan and B. Eaton, of Milwaukee.

OSHKOSH, WIS.—Manager E. E. Downs, of the traction company, confirms the sale of the Oshkosh city electric line, of 17 miles, and the Oshkosh-Neenah interurban, of 13 miles, by Emerson, McMillin & Company, of New York, to an Eastern syndicate, of Boston, headed by F. S. Donnell. The purchase means the building of the Oshkosh-Fond du Lac line, of 20 miles, and the Oshkosh-Omro-Berlin line, of 24 miles.

LEGAL.

"ONCE A CONTRACT ALWAYS A CONTRACT."—Judge Wallace, of Newcastle, Pa., has just handed down a decision in a case in equity between the Newcastle Electric Company and the city of Newcastle, which may be of great interest to every corporation selling electric current. It appears that five years ago the city of Newcastle entered into a contract with the Newcastle Electric Company for lighting the streets. This contract the city now wishes to rescind, and hence the suit. In his decision the judge says that when the city entered into a contract five years ago with the electric company to light the streets, the municipality waived all rights it might hold to build a plant of its own or give the contract to another company. In other words, the judge holds that once a contract always a contract, the only matter to be agreed upon being the price.

STORAGE BATTERY LITIGATION.—Richard Siegman, of New York, who began suit a few days ago in the Court of Chancery against the directors of the Electric Vehicle Company, has instituted a similar proceeding against the directors of the Electric Storage Battery Company. Mr. Siegman alleges that the directors of the two companies entered into a conspiracy to divert from the Vehicle Company into the treasury of the Battery Company certain of the assets and stock of the Vehicle Company. He charges that this was done to enrich the directors at the expense of the stockholders of the Vehicle Company. His bill of complaint narrates the various complicated transactions in Columbia Automobile, Electric Vehicle and Electric Storage Battery plants and stocks which took place last year.

EJECTMENT SUIT.—A great legal battle has commenced at Sault Ste. Marie, by the St. Mary's Power Company filing a suit in ejectment against the Chandler-Dunbar Water Power Company and the Edison Sault Electric Company, for a half interest in certain private land claims. The suit is a sequel to the recent organization of the St. Mary's Power Company, which is capitalized at $100,000, with $50,000 paid in. The incorporators and stockholders are Francis H. Clergue, Bertrand J. Clergue, Ernest V. Clergue, Sault Ste. Marie, Ont.; Edward V. Douglas, Walter P. Douglas, Frank S. Lewis, Philadelphia, Pa.; William B. Cady, Detroit, Mich. The pieces of land in contention are situated at the head of the falls, and have been held by the Chandler-Dunbar people under purchase and tax title for about ten years. The Chandler-Dunbar holdings are considered to be worth anywhere from $750,000 to $1,000,000 in prospective value.

FORGERY BY TELEGRAPH.—The United States Circuit Court of Appeals, in the Northern District of California, has held the Pacific Postal Telegraph Cable Company liable for the sum of $840, which one of its operators in San Francisco secured from the Bank of Palo Alto by means of a false telegram, which the operator forged in the name of the Farmers & Merchants' Bank of San Francisco. The operator, while employed in the company's office at San Francisco, conspired with another man to defraud the Palo Alto bank. He forged and sent a telegram to that bank, and transmitted it himself over the wires to the operator at Palo Alto, requesting the bank to pay $840 to Harry L. Cator, "without identification." The bank paid the money to the other man, who impersonated Cator. It does not appear that there was any such person as Cator. The bank sued the telegraph company, and the latter tried to evade responsibility on the ground that the act was one which was not within the scope of the operator's authority and was entirely unauthorized. The company was held liable, however, on the ground that the act was within the apparent scope of the operator's employment; and where one of two innocent parties must suffer the loss must fall on the one who made the injury possible.

PERSONAL.

MR. JOSEPH LAWRENCE, president of the Edison Ore Milling Syndicate, is now on a visit to the United States.

GENERAL JOHN I. SABIN, president of the Chicago and Central Union Telephone Companies, sailed on the Deutschland last week for Europe.

MR. R. H. BEACH, manager of the Railway Department of the General Electric Company, returned last week from a four weeks' tour in Mexico.

PROF. R. B. OWENS, of the department of electrical engineering at McGill University, Montreal, has been in the United States lately visiting friends, etc.

MR. G. MARCONI has been presented in London by the Marquis Di Loreto, in behalf of the Italian Foreign Office, with the gold medal of the Italian Science Society.

MR. FREDERICK WENDELL HUME, formerly connected with the Western Electric Company, of Chicago, has accepted a position with the Electric Storage Battery Company, of Philadelphia.

MR. H. D. HUBBARD, who is private secretary to President Harper, of Chicago University, has been appointed secretary of the new National Bureau of Standard created by Congress this year.

MESSRS. F. SARGENT and L. A. Ferguson, who have been making a trip together through England and Europe, have returned home after making a very complete study of recent electrical work there.

MR. R. W. PALMER, the inventor of the ingenious electrograph, has been in New York lately promoting the interests of the corporation formed in Cleveland to push the device, the Electrograph Company of America.

MR. G. W. CHANCE, chief engineer of the Tagona Water & Light Company, has complete charge of the Lake Superior Power Company's electric installations at the "Soo," and has in hand the building of the street railways there.

PROF. CHAS. R. STURDEVANT has resigned as professor of electrical engineering at the State College of Kentucky, at Lexington, and has become associated with the consulting firm of E. P. Roberts & Company, of Cleveland.

MR. C. T. MALCOLMSON, mechanical and electrical engineer of the Charleston, S. C., Exposition, has been in New York arranging for the plant for that show, and will shortly start installation. He will visit Buffalo this week to study electrical conditions at the Pan-American.

PROF. W. S. ALDRICH has now been appointed to the directorship of the Thomas S. Clarkson School of Technology, Potsdam, N. Y., where he may be counted upon to do good work. The entrance requirements are those of the regents of the University of New York. The school has been thoroughly provided for in the appointment of new instructors, additional equipment and reorganization of courses. There are four-year engineering courses in theoretical and practical work leading to degrees of batchelor of science in civil, electrical and mechanical engineering.

MR. CHARLES A. PRATT, of Chicago, who for the past five years has been in business as a consulting electrical engineer, has announced the formation of a co-partnership with Mr. Charles G. Atkins. This step is the natural result of Mr. Pratt's expanding business which necessitated increased facilities to handle the work. He has secured in Mr. Atkins a man of ability and wide experience, and one who is well and favorably known in Chicago engineering circles. The new firm of Pratt & Atkins will conduct a general engineering business in electrical, steam and mechanical lines.

MR. W. S. BARSTOW, until recently chief engineer of the Brooklyn Edison Company, has now opened offices as a consulting electrical engineer at the Bowling Green Building, New York City. Mr. Barstow will give special attention to central station and power plant work, for which an active experience of some fourteen years eminently qualifies him, the engineering upon which he has been engaged ranking with the heaviest and most progressive in this country. Mr. Barstow is a graduate of Columbia University, was in the Edison Machine Works at Schenectady from 1887 and 1889, and was associated with the Brooklyn Edison Company from 1889 until this summer. His references include Messrs. C. A. Coffin, T. A. Edison, F. B. Crocker, E. M. Shepard, A. W. Brady, Spencer Trask Company, J. D. Fairchild, president of the Kings County Trust Company; G. H. Southard, president of the Franklin Trust Company, and L.

M. Palmer. In short, this accomplished and public-spirited young engineer carries with him into his new work the good wishes and support of a host of influential friends.

MR. C. W. MORSE.—The well known newspaper correspondent "Holland," in the Philadelphia *Press* says, relative to C. W. Morse, who offers $2,000,000 in cash for control of the Telephone, Telegraph & Cable Company of America, that he gained his first notoriety through his association with the Ice Trust. He was not then conspicuously identified with New York banking interests, although he was associated with the Garfield Bank, through which Mayor Van Wyck negotiated the loan as alleged by which he secured a large block of Ice Trust stock. Within a few months, however, Mr. Morse was discovered to have become perhaps the largest individual owner in banking stock in New York City. He bought all he could get of the stock of the National City Bank, paying a very high price for it. He also secured the control of the Bank of New Amsterdam and following that bought a majority of the stock of another bank and changed its name. Then he was discovered to have secured practically the control of the Nineteenth Ward Bank and he went on buying bank stock until he was a large owner in twelve banks or trust corporations and the owner of a majority of stocks of some of them. Mr. Morse is one of the wealthiest men in New York and it has been the presumption that it was his purpose ultimately to become a master capitalist operating through the many financial institutions wherein his interest gave him command of vast resources.

BUFFALO PERSONALS.—Following is a list of recent callers at the booth of the ELECTRICAL WORLD AND ENGINEER in Electricity Building, Pan-American Exposition: C. J. Bogue, New York, N. Y.; Wm. M. Porter, Elwood, Ind.; P. J. Kruesi, New York, N. Y.; D. R. Clayton, Athens, Ohio; Samuel B. Zerfou, Harrisburg, Pa.; G. E. Cornisch, Oswego, N. Y.; Walter J. Garside, London, Ont.; Walter Gummey, Depew, N. Y.; O. W. Visscher, Holland, Mich.; J. S. McBride, Pittsburg, Pa.; J. M. Howard, Ogdensburg, N. Y.; E. Bracken, St. Catherines, Ont.; J. T. Freeman, Rochester, N. Y.; F. J. Skinner, Boston, Mass.; G. Wiebe, Halstead, Kan.; Henry Watts, Buffalo, N. Y.; F. J. Carlton, Toledo, Ohio; Claude E. H. Law, Solina, Ont.; Willis L. Towne, Amherst, Mass.; A. J. Nixon, Richmond, Ohio; T. J. Vanar, Detroit, Mich.; C. N. Smith, Cleveland, Ohio; J. C. Stut, San Francisco, Calif.; Ralph A. Garrison, Albany, N. Y.; C. W. Squire, Bloomfield, N. J.; T. Defor, Bay City, Mich.; Alfred I. Brown, Cincinnati, Ohio; I. F. Shepard, Cincinnati, Ohio; J. D. Kieley, Brooklyn, N. Y.; F. E. McNall, Medina, N. Y.; Geo. H. Harris, Birmingham, Ala.; A. H. Ford, Buffalo, N. Y.; Edward Durant, New York, N. Y.; Arthur H. Potts, London, Eng.; M. Dings, Milwaukee, Wis.; F. A. Williams, New York, N. Y.; Alex. F. Ormsbee, Brooklyn, N. Y.; C. H. Tyndall, Mt. Vernon, N. Y.; W. N. Smith, New York, N. Y.; W. S. Bennett, New York, N. Y.; E. F. Morrill, Brooklyn, N. Y.; E. H. Couwbe, London, Eng.; Geo. E. Holton, Catasauqua, Pa.; A. E. Payne, Montreal, Can.; R. L. Bruce, Pittsburg, Pa.; A. H. Mitchell, Thayers Corners, N. Y.; Thos. H. Capener, Cleveland, Ohio; D. B. Long, Buffalo, N. Y.; Geo. R. Smith, Solsville, N. Y.; W. A. Davis, Buffalo, N. Y.; Arthur Hull, Cayuga, Ont.

Trade Notes.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently installed a Cross oil filter in the power plant of the Washington monument.

THE ELECTRIC APPLIANCE COMPANY has just placed upon the market a new cabinet type of wall telephone for both series and bridging work. Special descriptive matter is being sent upon application.

BECK ELECTRIC COMPANY, St. Louis, Mo., has moved to larger quarters in that city, at 10 North Twelfth Street, where it will carry a larger and more complete stock than ever of electrical supplies, which can be drawn on by mail or telephone.

CHAPMAN VOLTAGE REGULATORS.—Mr. W. H. Chapman, of Portland, Me., informs us that his voltage regulators will hereafter be manufactured exclusively by the Portland Company, which is said to be the largest manufacturing concern in the city, dating back to 1846.

THE STUART-HOWLAND COMPANY, Boston, has recently sent out a circular letter to the trade, announcing the fact that it has added to its list of travelling salesmen Mr. A. McNab Little, formerly of the Western Electric Company. He will represent the Stuart-Howland Company in New York and Northern Pennsylvania.

J. J. REIDY & CO., New Haven, Conn., have added new machinery to their plant for manufacturing climbers. The Manhattan Electrical Supply Company, Chicago; McIntosh-Huntington Company, Cleveland, and W. B. Belknap, Louisville, carry a very large stock of these Donnelly climbers and can supply small dealers from stock at factory prices.

CINCINNATI PLANER COMPANY.—The new addition to the plant of the Cincinnati, Ohio, Planer Company, having been completed, the company is now putting in the equipment of machine tools, which includes several planers of its own make, a 36-inch automatic gear cutter, a universal grinding machine, a horizontal boring and drilling machine, a radial drill, a large special turret machine, a milling machine, and several engine lathes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has published a new discount sheet on its general catalogue dated Sept. 1, which has been distributed to the general trade. Any one having a Central Electric Company general catalogue who has not received a discount sheet should notify the company, and a copy will be sent by return mail. This discount sheet not only covers everything listed in its general catalogue, but contains much new material which has been placed on the market since the publication of the same.

WOTTON ELECTRIC MANUFACTURING COMPANY, Atlanta, Ga., contemplates enlarging its plant very extensively in the next month or two. Mr. G. F. Schoen, the secretary, reports that the company's extension bell is meeting with a great demand all over the country. It is particularly well adapted to noisy places where the ordinary extension bell on telephone lines cannot be heard, and is also well adapted for use at railway crossings for signaling purposes. The concern is making, in addition, a specialty of dental apparatus and is turning out a very unique outfit in the way of a surgical transformer for cautery work.

RAILROAD CAR LIGHTING EQUIPMENT.—The Gould Coupler Company, of Depew, N. Y., whose local offices are at 18-20 West Thirty-fourth Street, New York, reports a number of sales of its railroad car electric lighting equipments. The Royal train of the Canadian Pacific Railway, which will convey the Duke and Duchess of York and Cornwall through Canada, will be furnished with the Gould system of electric lighting. There will be seven cars, lighted with 960 candle-power each. The Governor-General of Canada's new car, built by Barney & Smith, is to have an 800-cp equipment. A similar equipment has also been ordered for the car of the Governor of New South Wales, and three Pullman cars recently built for use by President Diaz, of Mexico, will also have lighting equipments of 800 candle-power each. Domestic Gould orders include equipments for 14 dining cars on the New York Central and a number for the Wabash Railroad.

ASBESTOS INSULATION.—The H. W. Johns Manufacturing Company reports the following recent contracts: William Cramp & Sons Ship & Engine Building Company, Philadelphia, for work on the battleship "Maine," installing asbestos non-splinterable bulkhead insulation; Mackay residence, Roslyn, L. I., using fire felt sectional covering; all the covering at the Hahne Building, Newark, N. J., using fire felt, asbestocel, anti-sweat and homogenous brine, sectional covering, also fire felt blocks and cement; State Normal School, Fredonia, N. Y., using nonburn, fire felt sectional covering; New York State Custodial Asylum, Newark, N. Y., non-burn and fire felt covering; Strathmore apartments, 52d Street and Seventh Avenue, asbestocel covering; Connecticut State Prison, using asbestocel covering and asbestocel sheets, finished with cement; Youngstown, Ohio, Consolidated Gas & Electric Company, using 1½-inch fire felt sectional, and also 1½-inch asbestos cement; Fazenweather Building, New Haven, Yale College, fire felt and cement felting; Newark Free Library, Newark, N. J., using fire felt and cement felting; Scoville Manufacturing Company, Waterbury, Conn., covering for new insulation of engines, H. W. Johns Manufacturing Company's materials used.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED SEPT. 3, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

681,692. ELECTRIC INCANDESCENT LAMP; P. A. Gibbins, New York, N. Y. App. filed Feb. 18, 1899. Renewed Jan. 16, 1901. (See Current News and Notes.)

681,694. TUBE WELDING MACHINE; W. S. Gorton, Cleveland, Ohio. App. filed Jan. 26, 1901. Relates to the supporting mandrils and the construction of the electrical contacts.

681,696. APPARATUS FOR HAULING ELECTRIC CABLES; H. B. Grinnell, New York, N. Y. App. filed Nov. 30, 1900. A wheeled vehicle having hauling sheaves and means for driving the same whereby cables can be readily drawn through subway conduits.

681,712. MEANS FOR CONTROLLING ELECTRIC CURRENTS; P. Kennedy, Brooklyn, N. Y. App. filed March 26, 1898. Various features of an automatic controller.

681,716. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, New York, N. Y. App. filed March 27, 1899. The rheostat arm rubs heavily against the final contact.

681,724. TELEPHONE EXCHANGE SYSTEM; J. L. McQuarrie, Chicago, Ill. App. filed Nov. 10, 1898. Means for automatically conveying intelligence between the operators as to the condition of the various devices employed in establishing and severing connections.

681,725. ELECTRICAL FLUSH RECEPTACLE AND PLUG; W. J. Newton, New York, N. Y. App. filed Oct. 10, 1899. Details.

681,730. ELECTRIC PIANO PLAYER; T. B. Powers, New York, N. Y. App. filed July 11, 1900. An armature of the magnet connected with the key, rotates, and by means of a crank connection this rotation depresses the key.

681,739. ELECTRIC IGNITER; F. A. Ruff, Detroit, Mich. App. filed Dec. 3, 1900. Details.

681,742. CONNECTION COUNTER FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Nov. 22, 1897. Details.

681,743. SWITCHBOARD FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Dec. 26, 1899. Automatic appliances for preventing impulses of current in the lines, arising from accidental contact between parts of the plugs and jacks.

681,744. TELEPHONE CALL BELL; C. E. Scribner, Chicago, Ill. App. filed Jan. 20, 1900. The bell magnet is wound so that it will ring with either a continuous or an alternating current.

681,754. SAFETY DEVICE FOR AUTOMATIC ELECTRIC GAS LIGHTING APPARATUS; H. C. Thomson, Boston, Mass. App. filed Aug. 6, 1900. Details.

681,757. INSULATOR; H. Traun, Hamburg, Germany. App. filed Dec. 7, 1900. A metallic frame provided with a cross-bar extending from one side to the other, the whole being entirely covered by a layer of vulcanite.

681,763. ART OF DEVELOPING STATIC ELECTRICITY; R. V. Wagner, Chicago, Ill. App. filed March 7, 1901. The method of developing electrical energy, which consists in rotating a non-conducting body continuously in one direction in proximity to an inducer continuously charged with energy of one polarity only, inducing on a rotating surface a development of electrical energy on one polarity only, and collecting the electricity so developed.

681,768. REGULATING AND CONTROLLING ELECTRICAL TRANSLATING DEVICES; Granville T. Woods, of New York. App. filed Jan. 14, 1895. The working motor is regulated by means of a second motor or other suitable induction apparatus placed in series with the armature so as to set up a regulating e. m. f. in the circuit, means being provided whereby this e. m. f. can be varied at will.

681,776. ELECTRIC SWITCH; W. F. Bossert, Utica, N. Y. App. filed May 20, 1901. A spring is located at the pivot of the switch arm to help release it from the clips.

681,779. ELECTRIC CLOCK; O. A. En Holm, Pleasantville, N. Y. App. filed Oct. 1, 1900. The driving weight of the clock is of magnetic material and surrounded by a solenoid coil which raises it after a certain movement downward.

681,780. SIGNAL FOR ELECTRIC RAILROADS; H. T. Gibbs, Portsmouth, R. I. App. filed Feb. 20, 1901. The signals are set by means of certain selective devices.

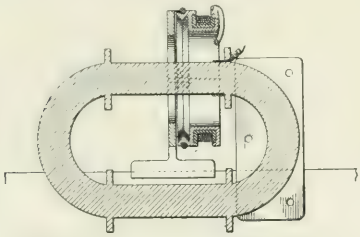
681,800. STATIONARY ARMATURE AND INDUCTOR; O. Lasche, Berlin, Germany. App. filed June 18, 1901. Sheet metal rings and segments for stationary armatures and inducer rings of electrical machines, provided with one or more pressure exerting devices at or near those points where deformation is greatest, for the purpose of obviating the inward and outward bending of the rings or segments.

681,812. SUPPORT FOR TELEPHONE APPARATUS; E. E. Ries, New York, N. Y. App. filed Sept. 19, 1898. A telescoping arm carrying the mouthpiece.

681,813. SUPPORT FOR TELEPHONE TRANSMITTERS OR OTHER APPARATUS; E. E. Ries, New York, N. Y. App. filed Sept. 10, 1898. An extensible arm for the telephone, made up of groups of sliding rods insulated from each other and having sliding contacts to carry the current.

681,835. MEANS FOR BRAKING ELECTRICITY METERS; F. Saldaña, Paris, France. App. filed May 22, 1900. (See Current News and Notes.)

681,860. SERVICE METER FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed Jan. 12, 1901. A signal is automatically operated to show that the meter has properly registered.



682,142.—Means for Coiling Flexible Material.

681,868. CONNECTING PLUG FOR TELEGRAPH SWITCHBOARDS; J. A. Bowen, Millvale, Pa. App. filed Dec. 8, 1900. The plugs are so constructed that when necessary a second plug can be inserted into the first to obtain a different connection, without removing the first plug from the board.

681,878. TELEPHONE SWITCH APPARATUS; L. M. Ericsson, Stockholm, Sweden. App. filed March 29, 1899. Improvements in automatic switching apparatus.

681,918. MACHINE FOR LEADING SOUND RECORDS; E. R. Johnson, Philadelphia, Pa. App. filed Jan. 20, 1900. A machine for applying graphite to the grooved surface of phonograph cylinders, before the electro plating process.

681,932. TELEGRAPHIC RECORDING APPARATUS; J. F. Skirrow, East Orange, N. J. App. filed Jan. 25, 1901. An apparatus for recording messages on a moving paper strip by means of a series of recording instruments, each of which is in circuit with a telegraph instrument and is adapted to work in unison therewith.

681,933. TROLLEY; H. Smith, Watervliet, N. Y. App. filed Jan. 7, 1901. Details.

681,939. ELECTRICAL MUSICAL INSTRUMENT; R. L. Venuto, Kansas City, Mo. App. filed Aug. 7, 1900. Electric bells of the various tones are connected electrically with a keyboard.

681,943. ELECTRIC SWITCH; C. F. Zeigler, Chicago, Ill. App. filed May 4, 1901. Details of a rotary switch controlling a multiplicity of circuits.

681,[illegible]. SYSTEM OF ELECTRICAL INTERCOMMUNICATION; E. A. Clark, Sioux City, Iowa. App. filed June 8, 1896. Details.

681,965. APPARATUS FOR TRANSFORMING ALTERNATING INTO CONTINUOUS CURRENT; Maurice Hutin and Maurice Leblanc, of Paris, France. App. filed Jan. 5, 1900. (See Current News and Notes.)

681,981. TROLLEY ARM FOR ELECTRIC CARS; J. F. Snow, Pawtucket, R. I. App. filed Feb. 19, 1901. The trolley wheel is carried in a lever pivoted to the upper end of the arm and restrained by springs; the pivot is vertical to provide for lateral movement of the wheel.

681,982. COOKING UTENSIL; G. E. Savage, Meriden, Conn. App. filed March 5, 1901. A mechanical arrangement for securing a cooking utensil to an electric heater, whereby the parts will be detachably connected and yet cannot be accidentally separated.

681,992. FLASHER FOR ELECTRIC LAMPS; C. Slusser, Danville, Ill. App. filed April 15, 1901. A flashing device for electric lamps, comprising a thermostat arranged in the electric circuit and partially surrounding the lamp globe at irregular intervals of time.

681,999. ART OF TRANSMITTING BODIES BY MEANS OF ELECTRO-MAGNETS; J. P. Swift, Pawtucket, R. I. App. filed Sept. 10, 1900. The process of transmitting a body or bodies from one point to another, which consists in placing a movable magnet in proper relation to a second magnet, then energizing the first magnet to cause it to attract and hold said body till brought to said second magnet, and then energizing the second magnet and demagnetizing the first-named magnet.

682,007. ELECTRO-MAGNETIC APPARATUS; I. G. Waterman, Santa Barbara, Calif. App. filed April 19, 1901. An apparatus for controlling valves electro-magnetically.

682,030. SERIES TELEPHONE SYSTEM; C. A. Casperke, Brandenburg, Ky. App. filed April 17, 1901. In a series telephone system, a ringer-coil at each station and a condenser in multiple therewith, the said condenser being included in a shunt-circuit having no source of impedance therein.

682,056. CONTACT FOR UNDERGROUND TROLLEYS; J. S. Garousi, New York, N. Y. App. filed July 10, 1901. A contact frame having contacts on its ends freely slidable on the plow.

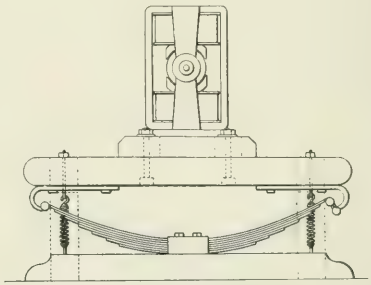
682,088. ELECTRIC FURNACE; F. A. Kjellin, Gysinge, Sweden. App. filed March 13, 1901. (See Current News and Notes.)

682,089. MEDICINAL ELECTRODE; O. L. Leach, Providence, R. I. App. filed June 6, 1901. A tubular conductor having an enlarged end containing spongy material and adapted to be applied to different parts of the body.

682,093. CONTROL OF ALTERNATING-CURRENT MOTORS; Reni Dassy de Lignieres, of Paris, France. App. filed March 22, 1901. (See Current News and Notes.)

682,101. ARC LAMP; J. C. Mayrhofer, New York, N. Y. App. filed July 27, 1898. Details.

682,104. BASE FRAME FOR ABSORBING VIBRATION OR TREMOR; G. Middleton, London, Eng. App. filed May 13, 1901. The base frame of a motor or dynamo is supported on springs.



682,104.—Base Frame for Absorbing Vibration or Tremor.

682,108. TIME REGULATOR FOR ELECTRIC MOTORS; M. M. Movshovitch, New York, N. Y. App. filed March 19, 1901. A time regulator for an electric motor, comprising a shaft having gear connection with the motor, a cylinder mounted on said shaft but insulated therefrom, said cylinder consisting of two compartments communicating one with the other, a liquid in the cylinder, and floats in the compartments for closing the electric circuit.

682,114. ROSETTE; H. T. Paiste, Philadelphia, Pa. App. filed Oct. 20, 1900. Details.

682,116. ELECTRIC LIGHT ATTACHMENT; J. H. Rusby, Nutley, N. J. App. filed Oct. 20, 1900. Details.

682,122. FUSE BOX; E. A. Wilson, Niles, Ohio. App. filed Sept. 11, 1900. Details.

682,142. MEANS FOR COILING FLEXIBLE MATERIAL; E. R. Gill, New York, N. Y. App. filed March 28, 1899. In a means for coiling flexible material, a divisible rotatable outer carrier adapted to loosely surround the device to be wound upon, a divisible inner carrier borne loosely thereon, and means for rotating one of said carriers.

682,152. TELEPHONE EXCHANGE APPARATUS; A. B. Stetson, Malden, Mass. App. filed May 24, 1901. To prevent the clicks in the receiving telephone, caused by the various connections by central office, the switch board cord and its ringing key are provided with means for preventing the discharge current from acting upon the repeating induction coil, by diverting the discharge through an alternative channel of lesser resistance.

682,155. ELECTROLYTIC APPARATUS FOR EXTRACTING PRECIOUS METALS; C. P. Tatro and G. Delius, Seattle, Wash. App. filed Jan. 15, 1901. (See Current News and Notes.)

11,930. (Reissue.) ELECTRIC ARC LAMP; D. Higham, Winthrop Highlands, Mass. App. filed July 20, 1901. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, SEPTEMBER 21, 1901. No. 12.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, SEPTEMBER 21, 1901.

CONTENTS.

	PAGE
Editorial	453
The Automobile Run	456
Telephony in Cities	456
Electrical Engineers of the Day—XII. W. S. Barstow	456
High-Speed Electric Railway Car of the Allgemeine Elektricitats Gesellschaft, Berlin—II ; by O. Lasche (*Concluded*)	457
Motor Generators vs. Rotary Converters	460
Elements of Illumination—XXXI; by Dr. Louis Bell	463
The Induction Motor for Railways—II (*Concluded*)	464
Plant of Big Fork, Montana, Electric Power & Light Co., by A. E. Ransom	467
The Evolution of Exposition Lighting	468
Annual Meeting New York State Street Railway Association	469
Annual Meeting of the Association of Edison Illuminating Companies	470
President McKinley on Telegraphy and Cables	472
Current News and Notes	472
LETTER TO THE EDITORS:	
Phosphorus in Incandescent Lamps, by Reginald A. Fessenden	473
Digest of Current Electrical Literature	474
New Books	478
G. A. R. Electrical Display in Cleveland	478
A New Electrolytic Generator	479
Jenney Linotype Motor	479
Exhibits at the Rochester Street Railway Convention	480
Collective Electrical Exhibit, Pan-American Exposition	480
DEPARTMENTS:	
Financial Intelligence	482
Commercial Intelligence	483
General News	485
Trade Notes	489
Record of Electrical Patents	490

REASONS FOR CONFIDENCE.

This country has passed through a severe and painful ordeal during the past fortnight in the assassination of President McKinley, whose death has left everywhere a sense of personal loss, so greatly was he admired and esteemed. At no time, however, did the feeling of consternation develop into panic, and now that Mr. McKinley's successor has been inducted into office, the great onward movement of national affairs has been quietly resumed. The firm condition of our financial markets is an evidence of the stability of things and of faith in the continuance of that prosperity which marked in general the whole period of Mr. McKinley's presidency. The foul murder by an anarchist of a man so universally beloved would have justified serious perturbation in trade and industry, but the very occurrence has only served to show how free our people, as a whole, are from acceptance of the villainous doctrines of those who see in social chaos a regeneration of mankind. And yet heaven knows how sedulously the yellow press for years past has been preaching discontent, hatred of wealth, dislike of work, enmity toward corporations, and particular distrust of Mr. McKinley as an alleged "tool of the trusts." It has been sickening the past week to see how the same papers, realizing at last how utterly out of touch they are with real American sentiment, have turned around and tried to square themselves by representing the martyred President as little short of an archangel

President Roosevelt has already declared his intention to maintain and carry on the policy of Mr. McKinley, and this is in itself another reason for public confidence. That policy found its last expression in Mr. McKinley's speech, made at the Pan-American the day before he was shot, and in that broad, statesmanlike utterance was embodied the larger programme of trade, shipping and international relationships, which may be summed up in the two ideas of peaceful imperialism and progressive reciprocity. In Mr. Roosevelt we have a man of the highest character, lofty courage, extensive culture, and a capacity of intellectual growth—in short, all the qualities that afford bright auguries for his administration. The very impetuosity that has carried him far now becomes a pledge of vigor and efficiency in every governmental department; for no President yet had too much energy and activity for all the multitudinous duties and responsibilities of his great office.

President Roosevelt begins his administration at a time when the country under Mr. McKinley's beneficent rule has enjoyed several years of prosperity, and there are pessimists who hold that "good times" cannot go on forever. On the other hand, it might be fairly asserted that the tide of prosperity has had at least two ebbs even under Mr. McKinley, but that progress goes on all the time. Since 1896, moreover, agencies have been set in motion for the development of the resources of this country, which will be long in exhausting their possibilities, and it is certain that under Mr. Roosevelt we shall all lead the "strenuous life" that lifts nations from higher to higher spheres of influence and success.

THE TELEPHONE IN DIPLOMACY.

In regard to the recent extension of long-distance telephone lines in Europe, the *New York Times* makes the interesting suggestion that a good deal of international misapprehension might be avoided if diplomats would resort to the telephone. As it says: "It involves no stretch of the imagination which taxes its elasticity to fancy the

German Chancellor calling up the French Minister of Foreign Affairs to get knowledge of some matter which can be explained in three minutes to the satisfaction of both. Verbal communications are likely to be much more frank and confidential than letters can safely be, since they cannot be subsequently referred to or verified by the production of the manuscript. While the telephone may not be suitable for the discussion of grave questions of state on which the fate of nations depends, it may very well tend to keep out of that classification a thousand minor matters which are exaggerated by formal treatment and become 'significant' without really having any significance." There is something in this, but the difficulty will always exist that diplomacy must be "documented." Without the "papers in the case," little will be done. In addition there is the fact that international intercourse by wire is largely done in code, and that applied to conversation is out of the question. Besides, Prince Bismarck once made the objection to the use of the submarine cable in international disputes, that it prevented diplomacy from being "unctuous." Coming from the diplomat of "blood and iron," that criticism sounded rather funny.

Switchboard Manufacture in England.

Our English cousins recently received another rude reminder of their subordinate position in the field of electrical manufacture, this time through the result of a competition for the supply of a switchboard to a Manchester lighting station. Twenty bids were tendered for the work, of which only two were from English manufacturers, and the lowest English tender was almost $100,000 higher than that of the successful bidder, which was about $200,000. The order went to a German manufacturer, and it may be added that the next lowest bid was from a firm that would have procured the switchboard from this country. Commenting upon the condition of English electrical manufacturing, which the above result implies, our London contemporary, the *Electrician,* says it seems incredible that the makers of switchboards in England should have been left behind as they were, and that several of the British firms should not have been equal to the occasion. To us, on the other hand, it seems clear that the cause of unreadiness recently displayed by English manufacturers to meet present home conditions in electrical development is to be ascribed to the manner in which the electric light and railway industry in Great Britain has in the past been trammeled by governmental regulation and a municipal dog-in-the-manger policy, which naturally has prevented manufacturing development. With our three thousand central stations and one thousand electric railways, as a market, electrical manufacturing in this country has happily been subjected to quite opposite conditions.

200-Volt Incandescent Lamps.

Steady improvements in the manufacture of high-voltage incandescent lamps have taken place during the last few years, with, of course, corresponding improvements in the manufacture of lamps for ordinary pressures. The result is that 235-volt lamps are now obtainable with an initial economy of 3.4 watts per candle. These lamps have two distinct spheres of usefulness. In the first place, they enable the installation of copper to be reduced in large two-wire isolated plants, such as hotels and office buildings. They also enable three-wire direct-current systems to be operated at double pressure, and double radius of economic distribution. The disadvantages are a reduced economy, and the somewhat greater cost of the lamps themselves, together with the relinquishment of all 8-cp lamps in favor of 16-cp lamps. In connection with alternating-current systems of lamp distribution, there seems to be less advantage in using lamps of higher pressure, since the use of transformers enables the amount of secondary copper to be kept within relatively small expenditure. There can be no question of the advantage and economy of using the higher pressure lamp in new direct-current three-wire systems, with overhead transmission wires, supplying a scattered suburban area. In large cities, however, in which direct-current three-wire systems of 120-volt pressure on a side have come into long established use, the cost of changing lamps, fixtures and apparatus from 120 to 240 volts is so considerable, that it is doubtful if the high-pressure lamp can gain entrance.

Motor Generators versus Converters.

An article appears in this issue upon a question of considerable practical importance, and one which elicits much difference of opinion. It is now a well established fact that the alternating-current system must be employed for long-distance transmission of electric power. On the other hand, many distributing systems, and in particular street railway systems, insist upon being supplied with direct currents. The consequence is that somewhere between the transmission line and the translating device, there must be machinery for converting alternating into direct currents. Of course, the simplest way of meeting the difficulty in theory would be to eliminate all direct-current machinery, and employ an alternating system from generator to motor, thereby dispensing with the apparatus for conversion. But at the present day we have to meet a condition and not a theory, so that converting machinery must be employed. There are two solutions of the problem, each having its devotees. One is to employ alternating-current motors coupled to direct-current generators, and the other is to employ converters. Motor-generators are almost exclusively employed in Europe, converters being rare, and when employed, almost invariably of American manufacture. In this country converters are the rule for railway work, motor-generators being sometimes employed for lighting.

The argument in favor of the converter is that it replaces two machines, i. e., a motor and a generator, by a single machine, and that the efficiency is greater on this account; also, that by properly proportioning the apparatus and system, the converter may be virtually compounded, so as to maintain a nearly constant potential difference at the terminals of the translating devices, in spite of variations of load. The argument made by the motor-generator advocates is that the apparatus is simpler and more readily controlled; that it is less liable to injury or break down, and that the secondary pressure may be manually regulated within a range far greater than that which the converter will permit. As regards the charge of inefficiency, they say that with moderate primary pressures a synchronous motor can be operated directly from the line, without the insertion of transformers; whereas, the pressure relations of a converter are such that step-down transformers almost invariably have to be inserted between the transmission line and the converter. They claim that after the losses in these transformers are taken into account the efficiency of the motor-generator is but little less than that of the converter, and that this disadvantage is more than made up by advantages in regulation and simplicity.

The article on a following page is written from the standpoint of motor-generator advocates. It shows that in sizes of 350 kilowatts, the joint full-load efficiency of the two machines is about 90 per cent. That is to say, about 5 per cent is lost in the alternating-current motor, and 5 per cent in the direct-current generator, at full load. At half-load they indicate 7 per cent loss in each component machine, or about 86 per cent joint efficiency. With this is a low full-load temperature elevation, the loss being distributed over the surfaces of two machines. The table of comparison contrasts the above results with some particular converters whose manufacturer is not

mentioned, and in which it would seem that the full-load loss is 7 per cent in the converter, and 3 per cent in the transformer, making the combined converter efficiency about 90 per cent, or no better than that of the motor-generators. We think that these figures do not represent the best practice, and that it would be quite commercial to have 350-kw converters with 5 per cent loss, and transformers with 2.5 per cent loss at full load, representing a joint efficiency of about 92.5 per cent, or a gain of 2.5 per cent efficiency over motor-generators. We think, therefore, that the argument in the article is somewhat strained in favor of the motor-generator.

It would seem that in this controversy no fixed rule can be laid down in favor of one side or the other. When, however, the distributed pressure does not require close regulation, as, for example, in the case of street railways, the advantages seem to lie on the side of converters, which are about 20 per cent cheaper than motor-generators, after allowing for the transformers and accessories, and which show a distinct saving of from 2 to 7 per cent in power, according to local conditions. On the other hand, where the distributed pressure has to be closely maintained, as in incandescent lighting systems, it would appear that motor-generators are often to be preferred, an attendant's services being, however, required for controlling the generator pressure. In such installations there is certainly less liability to accidental crosses between the high-tension primary and the low-tension secondary systems, through the transforming apparatus.

The Nernst Lamp.

The paper read at Buffalo by Mr. Wurts and the resulting discussion furnishes considerable food for reflection. There seems to be a striking difference between the Nernst lamp of the newspapers and of foreign prospectuses and the lamp actually developed by Mr. Wurts and his associates. These gentlemen are wont to make a pretty thorough job of their undertakings, and it is perfectly safe to assume that their product is as good as, or probably better than, anything else abroad which has been developed there along the same line. The Nernst lamp of the newspapers was a simple and beautiful thing far more efficient than the ordinary incandescent, lending itself with peculiar facility to distribution at high voltages, and altogether revolutionary in its properties. The Nernst lamp as disclosed in Mr. Wurts' paper is not in any apparent sense a direct competitor of the incandescent lamp, but rather occupies a distinct place between it and the arc lamp, which latter illuminant it can also evidently push pretty hard in the race for supremacy. The smallest Nernst lamp standardized appears to be of 50 candle-power, and this is admittedly inferior in efficiency to the larger lamps with multiple glowers. The objections to the new lamp raised in the discussion seem to us, therefore, rather founded on a misconception of its probable function. For an incandescent lamp it is undeniably highly complicated, but as compared with the mechanism of an arc lamp it is extremely simple. Again, the ordinary incandescent lamp requires no ballast, although if one were working for maximum efficiency it might conceivably prove useful, while the arc lamp practically does require ballast, although not for the precise purpose for which it is used in the Nernst lamp.

The "bugs" in the Nernst lamp seem to be three: First, the ballast, which reduces the working efficiency; second, the heater, which is one more rather delicate element to replace, and, third, the blackening of the globe, which is practically more serious than either of the other faults. It is this which really places the lamp in the arc light category, compelling periodical attention and forbidding therefore its installation in inaccessible places. The life of the glower seems reasonably good—very good, if new glowers can be cheaply supplied. The efficiency of the lamp is less than the early foreign reports would suggest—a little better than that of an ordinary incandescent, considering the drop in the efficiency of the latter during service, but scarcely so good as that of a first-class direct-current enclosed arc. The distribution is peculiar—from a single glower a cylindrical distribution, varied in the larger lamps by the arrangement of the glowers. The net result is a spherical efficiency little if at all higher than that of a first-class incandescent, and a hemispherical efficiency about equal to that of an enclosed arc or an incandescent with a well-arranged reflector. As to quality of light, the lamp seems to leave little to be desired. Its illumination is white and steady and free from shadows, surpassing, on the whole, either arc or incandescent. This advantage would give it a sufficient reason for existence if it had no other. Of course, for many purposes the advantage in color over the ordinary incandescent would more than make up for many failings, while steadiness cannot be yet reckoned among the chief virtues of arcs. If the Nernst lamp could be conveniently made of small candle-power, say, 16 to 20, it would intrude at once on the domain of the incandescent, but there are apparently difficulties in the way, and the attention required by the globes is a serious matter when one goes into small sizes that must be used in considerable numbers. Moreover, the present tendency is toward more thorough sub-division of the illumination than heretofore.

From the standpoint of the central station, the Nernst lamp presents an interesting problem. So far as the supply of energy goes the absolute amount required does not materially differ from that demanded by our present arcs and incandescents. The supply can be at 220 volts or thereabouts, which is a decided advantage, the lamp being, too, on a better plane of efficiency than the 220-volt incandescent. On the other hand, the new lamp requires practically about the same care as an arc, which will militate against its use in small sizes, and will demand the services of about the same number of trimmers as would be required for an equal number of arcs. No carbons have to be provided for the Nernst lamps, but the glowers must be replaced at about every eighth inspection. The price of a set of a half-dozen glowers has apparently not yet been fixed, but it must evidently, taking due account of rebates for parts returned, be low unless the up-keep of the lamp is to exceed that of an enclosed arc.

From the present outlook the alternating current is required for successful operation of the new illuminant, and obviously, if the lamp takes an important place in the art, there may be a considerable shake-up in central station equipment. With the present lack of data based on practical operation on a large scale it is very difficult to place a just value on the Nernst lamp. We should imagine that its first use would be the replacement of constant-potential alternating arc lamps on a scale depending on the outcome of further experience. It is at least equally efficient, is noiseless and is free from flickering or shadows, besides giving a whiter light than the enclosed arc, and these virtues should give it a powerful impetus. Its steadiness and conspicuously better light than the four and five-ampere enclosed arcs of any kind ought to give it a right to respectful consideration even as against direct-current arcs, but we are disposed to think its first function will be constructive rather than destructive. Within its presumable limitations, if it but fulfils the promise of the present, it yet is likely to influence powerfully the organization of future distribution systems. In other words, although the Nernst lamp is as yet untried on a commercial scale, and while its field is restricted by certain present faults, it is a factor that cannot safely be neglected in estimating the development of electric illumination and the future methods of electrical distribution.

The Automobile Run.

Owing to the death of President McKinley, the endurance test of automobiles from New York to Buffalo, of the Automobile Club of America was called off at Rochester, 394 miles, and the Erie-Buffalo sports this week have been abandoned. Of the 80 starters, 41 reached Rochester, 27 of which were gasoline and 14 steam. The weather was bad and the roads were wretched, being chiefly samples of stone quarry and sand pit. The wonder is so many got so far.

Telephony in the Cities.

Some statistics emanating from Boston go to show that in point of telephone development, San Francisco towers above the rest of the cities with a telephone for every 16 of its population. Estimating 5 persons to a family, every third family has a telephone. Boston takes second place in this development, with a telephone for every 24 inhabitants, or one telephone for every five families. Philadelphia shows the largest relative gain in the number of telephones in use, with an increase of 63 per cent over the year ended Dec. 31, 1899, Louisville coming next in the order with a gain of 43 per cent. The number of calls per subscriber is not given, however. The telephone situation in some of the larger cities in the United States is given as follows:

City.	Telephones, Dec. 31, 1899.	Telephones, Dec. 31, 1900.	Per cent of.	Population census 1900.	Population per telephone.
New York (all boroughs)	53,128	70,870	33	3,437,202	48
Buffalo	5,107	6,639	30.	352,219	53
San Francisco	16,817	21,324	27.	342,782	16
Boston	19,905	23,780	19.	560,892	24
Minneapolis	6,210	8,038	29.	202,718	25
Cleveland	13,158	14,570	11.	381,768	26
Detroit	7,434	10,190	37.	285,704	28
Milwaukee	6,893	8,492	23	285,315	33
Pittsburg	7,409	9,129	24.	321,616	35
Cincinnati	7,161	9,142	28.	325,902	35
Louisville	3,539	5,049	43	204,731	41
Newark	3,701	4,434	19.	246,070	55
Washington	3,278	4,650	42.	278,718	60
Chicago	21,237	27,734	31.	1,698,575	61
New Orleans	3,274	4,415	35	287,104	65
St. Louis	6,369	7,512	18	575,238	76
Baltimore	5,340	6,250	17.	508,957	81
Brooklyn	10,379	13,366	28.	1,166,582	87
Philadelphia	8,268	13,451	63.	1,293,697	96
Jersey City	1,607	1,906	18.	206,433	108

Electrical Engineers of the Day—XII.

W. S. BARSTOW.

In the last issue of this journal reference was made to the fact that Mr. W. S. Barstow had added his name to the growing list of consulting electrical engineers—that list which in itself is a striking indication of the maturity of the profession, although it by no means follows that the quality of merit throughout the list is uniform. Some men are born critics, others are born creators. It has been noted in literary work that the smartest critics have now and then written the worst books; in artistic life, that the poorest daubs have come from those who saw little to praise in a Sargent, a Landseer or a Meissonier. To combine the constructive or executive with the critical faculty is indeed rare, but Mr. Barstow has not only had to create central stations, but carry on their business, and has also had many a time already to pass judgment on the work of his fellow engineers in the same field. Indeed, it might well be claimed as to the engineering profession that it demands in its exemplars this combination of abilities or qualities.

After graduating from Columbia University in 1887, Mr. Barstow had the good fortune to enter the Edison Machine Works and to be brought in close touch with Mr. Edison. That worthy genius has a rather unflattering reputation for using men up. He not only takes out of them the best they have, but requires it twenty-six hours a day. To survive such an ordeal is in itself a testimonial to physique and intellect, while there are the compensations that come from sharing the ideas and aims of a leader among men, who works shoulder to shoulder with his associates. None the worse for this test, Mr. Barstow became associated with the Brooklyn Edison Company in its formative days, and as engineer and general manager contributed perhaps more than any other man to its brilliant growth and steady success. It is a trouble with many people that they can only hold one idea, and that while that idea lasts them for a lifetime, the great world has meantime been pushing along to larger and fuller notions of things. Mr. Barstow was not like an indurated direct-current, constant-potential man, who thought that electricity stopped when Edison hit on 110 volts, nor like the old arc-lighting men tied up forever to shoestring circuits. He saw the possibilities in electric power; developed the feasibility of running arcs and incandescents together; put his wires underground; and when the alternating current escaped from its single-phase restrictions, he saw swiftly the opportunity to enlarge the area of supply from a city central station, while none the less was he quick to adopt the storage battery for its reservoir and balancing capacity. Here was keen intuition and a progressive spirit, to whose advance the commercial and financial growth and the later consolidation of

the Brooklyn Edison system into the Kings County Gas, Electric Light & Power Company was at once incidental and inevitable. If anything, Mr. Barstow's engineering genius had easier play when working over a territory of a hundred square miles than when cooped up to the condition of ten blocks around Brooklyn City Hall. Thus, too, the problems of supplying current to the mighty congeries of Brooklyn street railways as well as to motors in a Myrtle Avenue coffee store or lights in a Fulton Street restaurant, were to him in the nature of a quite proper and feasible evolution.

Not wholly absorbed in the duties of his daily life, Mr. Barstow has long been prominent in the affairs of the Association of Edison Illuminating Companies, but his best known work on behalf of the profession as a whole has been done for the American Institute of Electrical Engineers, of whose council he is a member, his term as manager expiring in 1903. It was under his direction as chairman of the Papers and Meetings Committee that the remarkably successful conversazione was held this spring at Columbia University, and that all the arrangements were made and carried out for the Buffalo convention, just over, and the reception of the Institute's foreign guests. Mr. Barstow has also taken an active interest in the affairs of the Brooklyn Institute as chairman of its electrical section. All this, while indicative of disinterested willingness to work for the common good does not exhaust the range of his activities, for Mr. Barstow has made several useful inventions and was one of the first Americans to invest in Cuba, when that island became an American sub-station.

High-Speed Electric Railway Car of the Allgemeine Elektricitats Gesellschaft, Berlin—II.

By O. Lasche.

(*Chief Engineer Allgemeine Elektricitats Gesellschaft.*)

(*Concluded.*)

COLLECTOR BOWS.

THE current is led to the three vertically superposed wires, from which it is taken into the car through bow-shaped collectors. By this system of taking off the current any deflections of the working wire between the connecting points does not affect the bow, a jumping of the latter being less likely than if it has contact from below. Notwithstanding this fact, the question of the collectors had to be very carefully studied, and although the requirements of the work to be effected at a speed of 50-60 meters (164 to 196 ft.) per second could only be very incompletely complied with, an experimental arrangement was nevertheless made.

At both ends of the car (Fig. 1) the three arms are arranged on

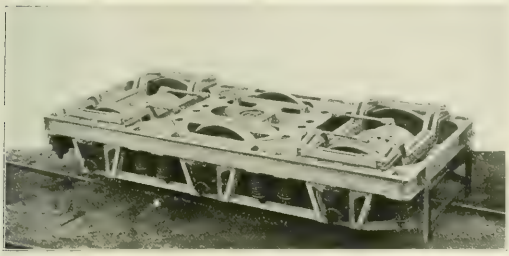


FIG. 5.—ONE OF THE TRUCKS.

the roof for the three different phases. The distance between the arms is determined by the space required by the bows to turn round their vertical axes. These distances are, however, kept as small as possible, and the arms are located close to the pivots of the bogies with a view to avoiding in the curves any material change in the distance up to the overhead wires. Two systems of bows were considered necessary, so that in the event of one failing to act, no sparking is produced, but the current is taken from the other bow.

This endeavor to increase the number of contact surfaces was carried still further with a view to reducing to a minimum the weight of the parts which slide along the wires. A number of aluminum bows were connected by plate springs of different length to the arm itself. This elastic arrangement was to ensure a first rate

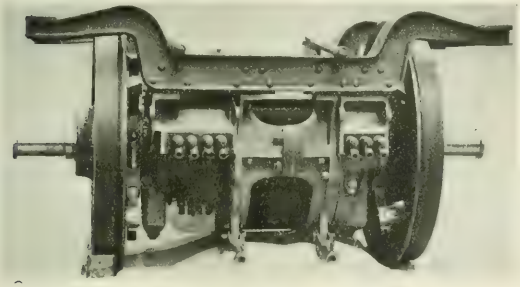


FIG. 6.—MOTOR MOUNTED ON AXLE.

permanent bearing action, and in the event of one bow getting off, to ensure that the others should be sufficient for collecting the current. For larger deviations of the conducting wire, the main spring arrangement of the whole arm begins to act.

THE BODY OF THE CAR.

On the basis of the requirements of the electrical equipment, the car was built by the firm, Van der Zypen & Charlier, of Cologne-Deutz, for accommodating 50 passengers. In consideration of the lengths required for the apparatus room and drivers' cab, the overall length of the body of the car is 21 meters (68.9 ft.), and the distance between buffer plates is 22.1 meters (72.5 ft.). The full width of the car is 2.6 meters (8.53 ft.). The body of the car (Fig. 2) remains in all its parts within the standard profile, but the middle part with the wide air-holes comes close up to this limit. The windows of the car are closed, ventilation taking place through the side windows of the very high skylight. On either side, at both ends of the car, are provided doors for the entrance and exit of the passengers.

The driver's cab (Figs. 13 and 14) is shut off from the passengers by a wide partition extending from the bottom to the top of the car, and serving as a back support for the occupant. On the sides thereof are grated doors, which during the stoppages at the station are arranged in such a manner that the driver's cab remains shut off from the passengers, granting them, however, access to the interior of the car. During the drive these doors are so adjusted that they block the exit and at the same time shut off the passengers, preventing them from disturbing the driver in the execution of his duty.

By the apparatus room the car is divided into two compartments. The passengers can, however, freely pass from one compartment to

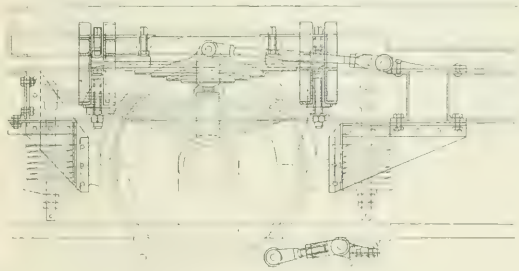


FIG. 7.—MOTOR MOUNTING.

the other, even when on the journey, in which case the apparatus room is protected in a similar manner to the driver's cab. Those parts which are liable to be touched by the passenger either do not carry current, or are suitably insulated.

As will be seen in the description of the cable arrangement the passenger compartments and also the driver's place are not under tension. The bows on the roof of the car are fitted with two insulators connected in series, each of which is tested to a potential of 20,000 volts. The high-tension current passes from here to the transformers through high-voltage cables, which, although they have been tested for 20,000 volts, are carried on high-tension insulators. Between the apparatus room and the passengers' compartments, and in

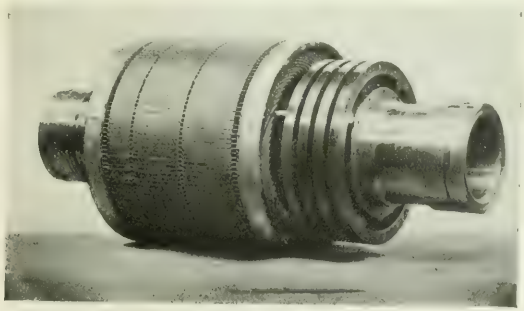


FIG. 8.—MOTOR ARMATUR.

the same manner between the passengers' compartments and the transformers suspended below the same, there are air shafts which form a double partitioned space. The storage batteries provided beside the transformers are likewise separated by double sheet metal walls.

The body of the car in its present construction is not of the shape generally expected for a vehicle running at a high speed. The car is slightly curved at the ends and not sloped off like the bow of a ship. The statements concerning the experiments which were made in this respect are contradictory, notwithstanding that they prove

that boat-shaped ends are of no advantage. One of the objects of the experiments is to clear up this point and to ascertain the difference in consumption of power at varying speed, also in the event of head and side winds. A suitable screen can be constructed at any time.

THE CAR TRUCKS.

The two trucks which carry the body of the car are 13.3 meters (43.6 ft.) apart. The diameter of the wheels was assumed to be 1.25 meters (4.1 ft.), thus enabling the trucks to swivel sufficiently below the car, while allowing the floor of the car being of the same level throughout its whole length.

Each of the trucks has three axles, the two outer ones carrying the motors, and the middle axle had to provide the necessary space for the pivot and the air cylinders of the Westinghouse brake. The distance between the wheels measures 2 (6.56 ft.) by 1.9 meters (6.23 ft.). Fig. 5 shows one of the trucks and the arrangements of the motors within the same. The load for each axle was less than the maximum allowed and amounted to a little over 14 tons.

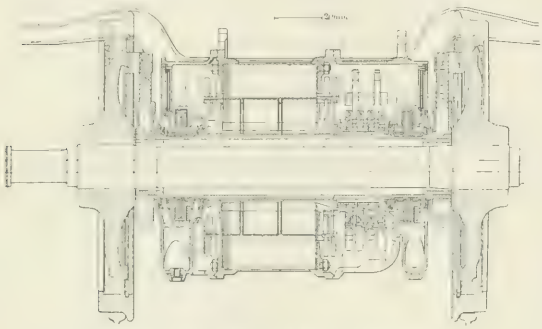


FIG. 9.—CROSS SECTION OF MOTOR MOUNTED.

An arrangement of springs bearing against the body of the car is not provided. The bogies themselves are supported against the axles by two sets of springs. Each axle box carries a strong plate spring, to the heads of which supporting springs are attached, which carry the frame.

On these axle boxes, i. e., on the shoe of the axle spring, plate springs are provided for carrying the motor. The connection between this spring and the motor frame is established by a curve block, against which the spring bears and on which it rolls off. By these shoes the spring action or its degree of elasticity can be varied. The first few millimeters it acts as a weak spring, then it begins to be more rigid, and at a deflection of about a quarter inch it becomes stiff. In the almost impossible event of these very strong springs breaking the motor is supported by the wheel axle with the interposition of a suitable metal packing close to the side of the wheel hub. The condition for the selection of a material for such packing were that it must be very soft for protecting the axle and hollow shaft, yet of sufficient resistance for bringing the car to a standstill before serious damage can be done.

The motors are firmly bolted to a riveted plate frame. The motor is protected against lateral movements by guide blocks, which bear against a corresponding guide on the frame of the truck. The casing of the motor is prevented from turning round by rods which only allow of its vertical movement (Figs. 6 and 7).

The transmission of the work from the motor to the wheels is effected by an elastic coupling entirely independent of the bearing construction (Fig. 11).

THE MOTORS.

Each of the four motors is adapted for a normal output of 250 horse-power and a maximum output of 750 horse-power. The speed of the motor is about 960 r. p. m., enabling the car to run at a speed of 225 km. (140 miles) per hour. The tension of 12,000 volts taken from the overhead wire is reduced in the transformers to 435 volts. This voltage was adopted so as to permit of constructing the motors with a bifurcated winding (Fig. 3). Although the motor, as above stated, is not subjected to a hammering action, it was nevertheless deemed advisable, for permanent safety in working, to have only one single bar in the separate slots of the primary, instead of a number of wires insulated from each other by a cotton covering. The insulation of the bars against the iron is effected by closed micanite tubing. In the same manner as the field winding, the armature or secondary winding is also constructed as bifurcated winding (Fig. 8). In consideration of the starting apparatus and cable arrangement the armature was wound with only two phases and not, as usual, with three phases.

The casing (Fig. 9) carries by means of two bearings the hollow shaft on which the armature body is built. One of these bearings (Fig. 10) carries in its top half the brush apparatus of the slip rings and the connections for the cables of the armature circuits which lead to the regulating apparatus. The cables of the primary circuit are passed through the other bearing. The bottom halves of the bearings can be easily removed, and allow of the removal of the brasses and also of free access to the brush apparatus.

Fig. 9 illustrates the journaling of the hollow shaft, and shows the manner of oiling the bearings. The oil level is located very high, so that when the motor is at full working condition the disk, which has to lift the oil still dips therein to a depth of 30 to 40 mm. (1 to 1½ inches). The material for the bearings is white metal of the alloy usually adopted for the Prussian State railways. Nickel-steel was adopted for the hollow shaft, both on account of its polishing qualities and the high degree of solidity or compactness of the material.

The radial distance between this hollow shaft and the axle is 30 mm. Copper rings are forced into the hollow shaft at both ends close to the hubs of the wheels. The hollow shaft is prevented from lateral displacement by one of the motor bearings; a guiding motion against only one of the bearings is adopted, so as not to produce, owing to heat and expansion of the material, a seizure between axle and bearing. The spring couplings are fixed on to the hollow shaft at both ends.

The object of this coupling (Figs. 11 and 3) is to transmit the torque of the motor—750 horse-power maximum at 960 revolutions—from the hollow shaft to the wheels, thereby allowing the latter a displacement against the coupling arms to the extent of 10 mm. (⅜ inch). To allow of this the arms must be elastic, and, moreover, the spring heads must slide against the guides mounted on the wheel. The construction of the whole required a division of the coupling into three parts, corresponding to the three double arms. The springs are built up securely in the annular pieces by wedges, in such a manner that the tension of the wedges is further increased by centrifugal force. Furthermore, the plates are laterally extended within the hub and thus secured against flying out. The hub portions are of forged steel, the strain on the material therefrom being very favorable. The transmission of the power from the hollow shaft to the three-part hub of the coupling is effected by interposed springs.

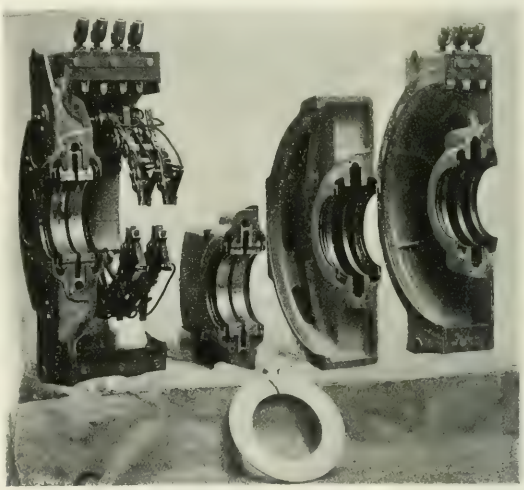


FIG. 10.—ONE OF THE BEARINGS.

TRANSFORMERS.

As to the transformers (Fig. 12), it may be added that the three cores are arranged side by side in accordance with the practice of the A. E. G. The axis of the cores is placed longitudinally in the car.

In conformity with the transforming ratio of 12,000 volts to 435 volts, the inner low voltage winding is arranged as a massive copper spiral, and the high voltage winding separated therefrom by a micanite cylinder. The iron cores are provided with a longitudinal slot, through which a strong current of air passes, in the same manner as through the space between the square cores and the round coil. The

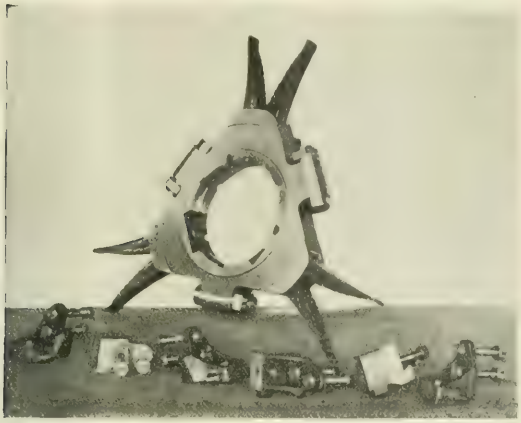


FIG. 11.—MOTOR COUPLING.

air for this purpose is, as above described, received through large air shafts on the roof and delivered through channels to the transformers. For the removal of rainwater, a protecting angle iron is provided on the roof, and before the air enters the shaft and the channels it passes several times through a wide meshed wire netting; the air is then conducted over the transformer and filtered again before entering the cores. Nothwithstanding these precautions, the air is only brought in direct contact with the interior of the cores of the transformer, and not with the current carrying parts. The cores are suspended in the middle of their length for the purpose of obviating any deformation due to the vibration of the car. The transformer is suspended to the body of the car by draw bolts, so that the lateral sheets are only used for lining purposes and have no strain to withstand. Any further arrangement of springs against the body of the car did not appear to be of any use, because the present arrangement of springs is similar to that adopted for the "International" sleeping cars and ought to be sufficiently springy to ensure a long life for the insulating materials.

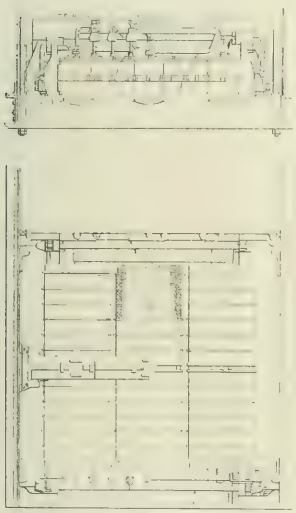


FIG. 12.—CAR TRANSFORMERS.

CABLES

The current is taken from each of the three feeding wires by two bows in parallel. The upper part of the bow arms bears a number of aluminum rods connected to narrow plate springs. The weight of these single rods must be small enough to ensure a constant bearing against the wire.

The head of the arm which carries the above mentioned bow is stamped out of aluminum sheet and connected to the vertical foot by rods, such foot being mounted by ball bearings in the casings secured to the car. By means of springs, the tension of which is regulated by cams, the bow is held against the wire. The current is conducted from the head of the bracket in insulated leads to the foot of the current-taking arms and transmitted therefrom through a contact to the cables affixed to the roof of the car.

The bows are brought to touch the wire and separated from the interior of the car, in such a manner that before getting on the roof the bows can be made free from current.

All high-tension conductors are assumed as high tension cables, and have been subjected to an insulating test of 20,000 volts. Not-

FIG. 13.—INTERIOR OF CAR.

withstanding this fact, the conductors were treated as bare wires, and placed on high-tension insulators.

Safety fuses are fixed close to the single bow. As soon as by some cause or other contact is made between any phase and the car put to earth, the car is made free from current by the melting of this fuse.

FIG. 14.—MOTORMAN'S WHEEL.

The wires of both collector systems lead from the safety fuses to the high-tension cut-out. This cut-out is not necessary for the control, and serves merely for cutting off the tension at the end of the drive.

The switch is operated from the apparatus room, or from either of the driver's cabs, thus serving as a safety switch in the event of the proper switch failing to act in case of an accident.

The two branches of current pass separately from this main switch to the two transformers of the bogey. Each of these circuits and transformers is protected by fuses. The low-tension conductors lead from the transformers through a switching device to the motors. On account of the play to be allowed between bogey and car, both with the lateral oscillation when running round curves and with the vertical deflection due to the action of the springs, the cables had to be hung up flexibly, i. e., the cables are suspended and supported by a strong girth or belt. The cables which lead from the motors back again to the starting device are secured by a similar girth.

The above mentioned switch effects the admission of the current to the motor casings from the transformers, and it furthermore allows of the adjustment for either direction of the driving, of the delivery of counter current. Besides, the storage battery is connected from here to the primary circuit of the motors when braking the car as an automobile, i. e., when braking independently of the overhead wire.

CONTROL OF THE CAR.

The car driver has to work only one single handwheel (Figs. 13 and 14) for carrying out all the operations. By means of an indicator, he can at any time ascertain the position of the apparatus, and by an amperemeter he can see the load on the motors. A further apparatus indicates continually the speed of the car.

By the handwheel (Fig. 14) the driver operates a shaft extending through the entire length of the car. By a pair of bevel wheels and cam wheels the switch is operated from this shaft. The movement of this cam gearing to the extent of one tooth effects the switching of the controlling cylinder to forward current, counter current or braking action. The intermediate path which the cam or gearing has to traverse is used for operating the valve of the liquid starting device. Reference is made above to this starting and regulating apparatus, but it may be repeated that the driver is in a position to regulate the speed of the car from standstill to the full speed of the motors within suitable limits, and that he can also effect a starting and braking movement as quickly and as softly as may be desired. The liquid of the starting device is fed continuously by means of a centrifugal pump through a cooling coil system through which a current of air continuously passes and is thereby constantly mixed and cooled.

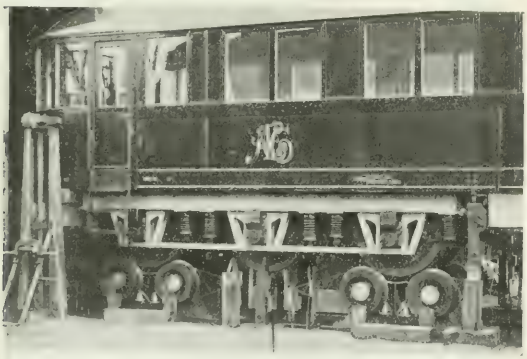


FIG. 13.—ARRANGEMENT FOR TRIAL OF CAR.

On the left of the driver is the handle for operating the compressed air brake, and on his right is another handwheel for the hand brake for shunting service. Other measuring apparatus is proposed for the trials, especially for indicating the acceleration of the speed, for measuring the air resistance in the event of a hand and cross wind, and also instruments for measuring and registering the consumption of current.

In view of the novelty of the entire construction and almost every single part of the electrical equipment, and of the great responsibility which the constructor had undertaken, it was deemed advisable to make trials with the car stationary. Four trailing axles, each provided with two rollers, were mounted on heavy cast iron erecting plates, for the two-motor axles of a bogey (Fig. 15). In view of the maximum circumferential velocity of 56 meters (183 ft.) per second, the rollers were made of steel casing and the bearing rims received the profile of the rail head. Wide, plain rims were provided laterally for putting on a brake strap, which, of course, had to be specially designed for the case in question, as also the rollers. The rollers are carried in plummer blocks, having white metal brasses. The speed of the rollers is 1800 r. p. m. By this experimental arrangement, it was possible to run the motors of each truck up to the full speed. The weights required for testing the brake action of the motors and batteries were, unfortunately, wanting; the small weights of the motors and wheel sets cannot furnish sufficient proof as to the efficiency of the brakes. On the other hand, the experimental results of the brake action having proved so highly satisfactory, the braking system cannot be considered objectionable.

The above statements give an idea of how the constructor solved the problem, to which we may add that the practical experiments in the trial platform gave very favorable results.

The great interest which the engineers of the whole world take in the development of the express railway has led to the publication of the above particulars. The question whether the speed aimed at will be fully attained depends partly on the car itself and partly on the nature of the track. For gaining further experience on this point and also with regard to the consumption of power for the varying working conditions, a good deal of time is still required, and this brings us to the second problem to be solved.

There is already sufficient experience at hand for many requirements and conditions of the electrical long-distance system, and many tests, the results of which will apply to both low and high speeds, can now be carried out without any difficulty.

Motor Generators vs. Rotary Converters.

A GOOD opportunity recently offered itself at the Oerlikon Works to test exhaustively two different types of motor-generators of considerable capacity, as to their efficiency, power factor, rise of temperature, regulation and individual losses. The machines tested are part of a large order for two central stations.

The machines are of three-phase direct-current motor-generator type, in one case consisting of a synchronous motor for 3500 volts and 50 cycles, coupled to an eight-pole direct-current dynamo for a normal output of 260 volts and 1350 amperes at 375 r. p. m. In the other case, the set is made up by a three-phase induction motor for 6000 volts and 50 cycles, coupled to a four-pole direct-current dynamo for a normal output of 450 volts and 510 amperes at 370 r. p. m. As several machines of each type were available, the set under test could be run under permanent full load without the expenditure of much energy. This was done by running one set with its three-phase current side as a motor and with its direct-current side as a generator, whilst the other set worked on the same circuits with its direct-current side as a motor and with its three-phase current side as a generator. The measurements were for the greater part made by the same instruments.

The results obtained are given herewith in the form of curves, but it should be said that some of the curves—notable the V-curves of the synchronous motor—were obtained by a calculation based on a limited number of observed values. The differences between the values representing the efficiency calculated from the individual losses and the values directly measured at different loads, were so trifling, that the mean values were taken as the basis for the efficiency curves.

In Fig. 1 are represented the characteristic curves of the synchronous motor at no load and on short circuit, plotted as a function of the exciting current. This same engraving also gives the individual losses as a function of the energy absorbed, and finally the V-curves at full load, half load and no load. The dotted curves represent the power factor (cos ø) at full load and half load as a function of the exciting current.

Fig. 2 gives the curves of the eight-pole direct-current generator coupled to the above synchronous motor, the characteristic curve at no load being a function of the excitation, and the individual losses and the total efficiency a function of the output in kilowatts.

Fig. 3 shows the total efficiency of this set and the power factor at two different values of exciting current kept constant, and as a function of the output of the direct-current generator.

Fig. 4 contains the usual curves for the efficiency, cos ø, primary

and secondary current and the individual losses of the 350-hp, three-phase induction motor.

Fig. 5 gives the curves for the four-pole direct-current generator for 450 volts, coupled to the induction motor referred to in Fig. 4.

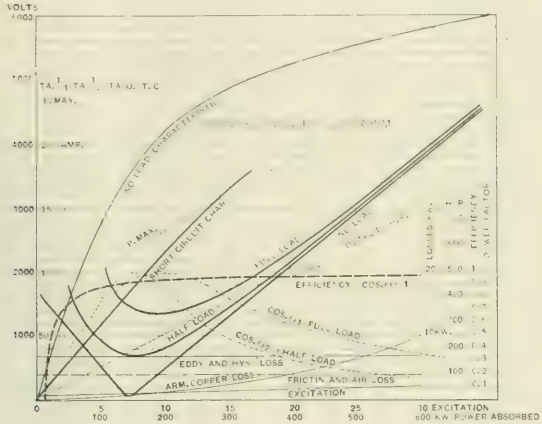


FIG. 1.—CURVES OF 525-HP, THREE-PHASE SYNCHRONOUS MOTOR.

Fig. 6 represents the total efficiency and the power factor of this latter set.

It may be added that after a 10 hours' run under full load the temperature rise did not exceed 30 degs. C. in any part of the windings and in the iron core of the three-phase current motors, nor of the direct-current generators. The commutators showed a temperature rise of only 35 degs. C. By specially dimensioning and forming the pole cores, all sparking of the carbon brushes on the commutators was avoided without adjustment of the brushes when the load was changed from full load to no load. It is quite evident from the values of the individual losses that if the carbon brushes were replaced by copper brushes, the efficiency of the direct-current generators, and thereby of the whole set, would be increased fully ½ per cent.

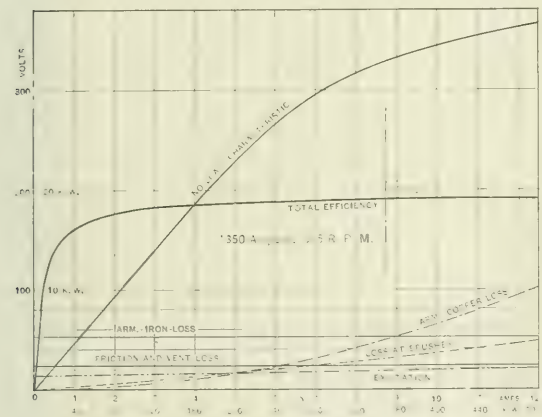


FIG. 2.—CURVES OF 350-KW DIRECT-CURRENT GENERATOR.

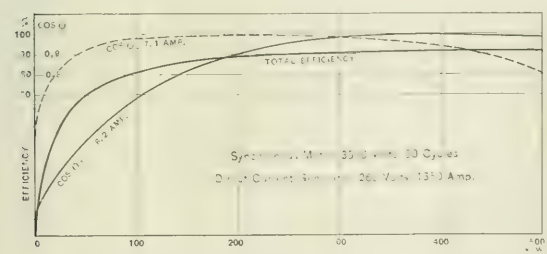


FIG. 3.—POWER FACTORS AND EFFICIENCY OF 350-KW MOTOR-GENERATOR.

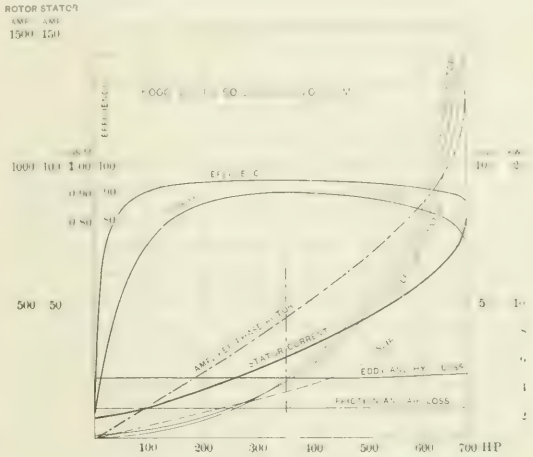


FIG. 4.—CURVES OF 350-HP, THREE-PHASE INDUCTION MOTOR.

For comparison with the data of some machines by another manufacturer, consisting of a static transformer and a rotary converter with a common armature for three-phase and direct current, values taken from the curves are given in the accompanying table. These sets consist each of three single-phase transformers and a rotary converter for 550-volt direct current, the frequency being 25 cycles and the rated capacity 250 kilowatts and 500 kilowatts, respectively.

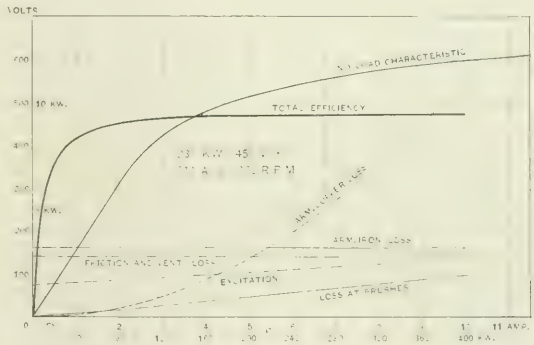


FIG. 5.—CURVES OF 230-KW DIRECT-CURRENT GENERATOR.

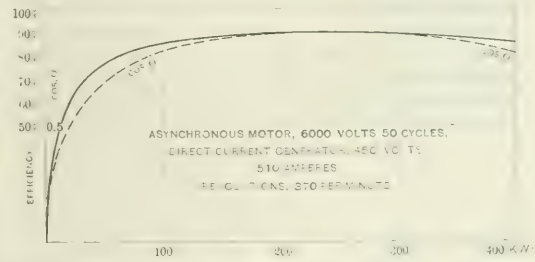


FIG. 6.—POWER FACTOR AND TOTAL EFFICIENCY OF 230-KW MOTOR-GENERATOR.

To make the comparison more conclusive the starting, the capacity and the "falling out of step" of the machines of the different types may also be considered.

The motor-generator set with induction motor starts with a current which at the most exceeds the no-load current by 10 per cent, or, in other words, with about one-fourth of the normal current. On the hub of the rotor is fixed a rotating starting resistance which, by means of a special connection, cuts out one phase after the other of the rotor circuit. This starting switch is so dimensioned that it just suffices to start the set, and is thrown in and short circuited by a lever having four different positions, which manipulation takes about 40 seconds.

The motor is capable of standing an overload of at least 100 per cent of the normal load, provided the tension at the terminals remains normal.

The well-known properties of the induction motor make it possible for the set to operate if the circuit suffers a momentary and sudden interruption, as, for instance, through lightning striking the line. The motor will again attain its normal speed without an excessive call for current even if the number of revolutions falls off as much as 10 per cent, so that even in the latter case the disturbance of service on the direct-current side is insignificant.

The consequence of this falling out of step are quite different in the case of the synchronous motor and of the rotary converter. Any momentary interruption of the line or momentary short circuit (through atmospheric discharges or any other cause) will in every instance cause a serious falling out of step, and the set must be restarted anew, which means an interruption of service on the direct-current side of more or less duration. Another feature in favor of the induction motor is the total absence of any tendency to "hunting" and "pumping."

In the present case the motor-generator set with the synchronous motor is set to work by starting the direct-current generator as a motor from the direct-current bus-bars. The starting current amounts to about 10 per cent of the current at normal load.

The overload which the synchronous motor is capable of standing depends largely upon the value of the exciting current used for regular running. If the exciting current is so regulated that under full load the power factor is unity, then the Oerlikon type of synchronous motor will stand an overload of about 90 per cent. If, however, the excitation is increased in such a manner that the power factor at full load is about 0.97 with a component of the current in advance, then the motor is capable of an overload of more than 100 per cent of the normal load.

The transformer sets with rotary converter are generally also started from the direct-current side with equally small currents.

The above comparison indicates that with respect to the efficiency attainable, the three different systems are about on a par, at least in all cases where the line voltage of the alternating current is not so high that the induction or even the synchronous-motor requires a previous step-down transformation. As far as the power factor is concerned, the induction-motor system appears to be, depending upon the regulation of the excitation, from 5 to 10 per cent behind the system employing a synchronous motor.

If, however, the decision depends upon the merits of the simplicity of the starting manipulation, upon the extremely great safety of service in the case of interruption to the line and the absence of tendency to hunting of the generators, then the induction motor system appears to be by far the most advantageous of all.

COMPARISON OF MOTOR-GENERATORS AND ROTARY CONVERTERS.

	I.			II.			III.					
	Oerlikon high-tension synchronous motor, coupled to a direct current generator of 350 KW., 375 r. p. m. and 50 cycles			Oerlikon high-tension induction motor, coupled to a direct-current generator of 230 KW., 370 r. p. m. and 50 cycles.			High-tension static transformer, with artificial ventilation, and rotary converter of 250 KW., 750 r. p. m. and 25 cycles.			High-tension static transformer, with artificial ventilation, and rotary converter of 500 KW., 500 r. p. m. and 25 cycles.		
WEIGHT (Tons)	Motor	Gen.	Total	Motor	Gen.	Total	Trans.	Conv.	Total	Trans.	Conv.	Total
	12	11	23	8	9.5	17.5	4.05	8	12.65	6.9	14.5	21.4
EFFICIENCY (Per Cent.)	Load	Motor	Gen	Total	Motor	Gen.	Total	Trans.	Conv.	Total	Trans.	Conv.	Total
	Full	96	95	91	94.5	95	90	96.6	92.7	89.5	97	93.2	90.5
	½	93	92.5	87	93	92.6	86	95.2	89.2	85	95.8	89.5	85.5
	¼	88	90	80	89	88	78	...	...	...	92.2	....	....
POWER FACTOR (Total)	Full load			1.0*		0.91							
	Half load			0.9		0.84							
	Quarter load			0.7		0.68							
TEMPERATURE RISE (Centigrade)	Iron core			30		30		45			42		
	Windings			30		30		45			45		
	Commutator			35		30		55			55		

* This is the power factor if the excitation is constant; if this is regulated, then the power factor is unity under all loads.

The motor-generator as compared with the rotary converter has the advantage that the tension of the direct current is independent of and can be regulated independently of the alternating-current voltage, and is free from the fluctuations of the alternating current.

Finally, from the point of view of the designer, the variable number of poles in both machines of the motor-generator system is a very essential feature, which permits of fixing the number of poles just as small as is necessary to secure perfect commutation of the current, no matter how high the line frequency and the speed of the three-phase current motor. On the other hand, in the case of the rotary converter system a periodicity exceding 30 cycles per second necessitates such a large number of poles as to give rise to very unfavorable conditions for the commutation of the direct-current.

Telephony and Mail Service.

It is stated that a feature of the postal service not enjoyed by any other city in Michigan has been inaugurated recently in the Saginaw Post Office. It consists simply of a system of collecting and delivering mail in response to telephone calls for such service. Its principal value will be in the delivery of letters in the same city. Mail intended for local delivery may be called for by the messenger and accepted for delivery, provided the postage is prepaid and a special delivery stamp is affixed. Upon receipt of the matter by the messenger he will at once take it to the post office, that it may be properly recorded, postmarked and the stamps thereon cancelled, as if mailed at that station, when it will be immediately taken out for delivery to the addressee in the usual manner.

Mail intended for dispatch to other cities may be called for in similar fashion, but two special delivery stamps are needed, one on an outer envelope addressed to the special delivery clerk of the post office and another on the inner envelope bearing the proper address of the person to whom the letter is to be delivered. Mail matter intended for dispatch, but not for special delivery at the office of address, may be similarly collected by the special delivery messenger when the letter is inclosed in another to the delivery clerk and a stamp properly affixed. In this case only one special delivery stamp is necessary, but in all cases the payment of the usual two cents postage is necessary in adition to the other stamps.

The experiment is being watched with considerable interest by post office officials. It is said that if the service proves successful in the cities in which it is being tried it may be adopted in the smaller cities of the country where there is not too much ground to be covered.

Elements of Illumination—XXXI.

By Dr. Louis Bell.

STANDARDS OF LIGHT AND PHOTOMETRY.

OF all important physical constants none are in so unsatisfactory a state as those pertaining to illumination. In spite of the efforts of several scientific congresses, there is no international convention regarding the unit of luminous intensity, nor is there any one practical unit in general use.

A standard to be worthy the name should be accurately reproducible without extreme difficulty, and ought, as well, to bear a fairly simple relation to other units which are related to it. Now, a standard of light stands quite by itself in kind, and should consist of some determinate light-giving body so constituted that it can be reproduced and used in any part of the world without material error.

Unhappily, such a light-giving body is not easily, if at all, obtainable, hence the present confusion.

The only attempt yet made to produce a really logical and scientific unit was that brought to the world's attention by M. Violle at the international electrical congress held in Paris in 1884. Violle proposed as the unit of luminous intensity the light emitted, normal to its surface, by one square centimeter of platinum at its melting point.

This unit was one based on definite things; was of very convenient magnitude, about 20 candle-power; and of good color, nearly white. But it is a very inconvenient unit to work with, and to reproduce accurately, on account of the enormous temperature necessary to melt platinum, the uncertainty introduced as to its exact melting point by the presence of trifling impurities, and for other minor reasons. So the upshot of the matter has been that this unit has been laid upon the shelf, and while much good came from the agitation of the subject the world still depends on the curious assortment of units sanctioned by more or less extensive usage.

The practical and legally adopted unit of light in English-speaking countries is the so-called *standard candle*. This illuminant has its composition, dimensions, weight and rate of burning specified by law, and can be cheaply and easily obtained. It is a spermaceti candle, weighing 1200 grains avoirdupois (6 to the pound), and burning at the rate of 120 grains per hour. The standard diameter is 0.8 inch at the top and 0.9 inch at the base, and the normal height of the flame is about 1⅞ inches over all.

The rate of burning may vary in practice from about 110 grains to 130 grains per hour, and in photometric work the luminous intensity is assumed to vary directly with the rate of burning. Selected candles burned under uniform conditions run somewhat closer to the standard rate of burning than the above figures, and burn with a uniformity that, considering their structure, is remarkable, but the presence of the wick, accidental variations in manufacture and numerous minor causes, make the candle at best rather unreliable. With great care in using it may be coddled into a degree of precision of approximately two or three per cent, but variations of twice that amount are not uncommon.

In France, and to a considerable extent in Italy, the Carcel lamp is used. This is a standard which was adopted after the investigations of Dumas and Regnault some 40 years since. It is an oil lamp of special construction, made according to a very minute specification as to dimensions, including the structure and weight of the wick, and burns refined colza oil, largely used as an illuminant in France. Its normal consumption of this oil is 42 grams per hour, with a permissable variation of 4 grams per hour in either direction. It gives a rather yellowish light of nearly 10 candle-power, and has probably about the same possible degree of precision as the English candle, though it should average a little better.

In Germany a standard paraffine candle made in pursuance of a most elaborate specification is used to some extent. It carries a longer flame than the English candle, 2 inches being the standard height, and is about 10 per cent more powerful, with, in other respects, much the same general properties.

The standard most used in Germany, however, and often employed in other countries for purposes of reference, is the so-called Hefner unit, being the light given by the amylacetate lamp introduced by Von Hefner-Alteneck. This standard lamp is made from a uniform specification as to dimensions, and has the great advantage of burning a perfectly definite chemical compound easily obtained in a state of great purity. It has been very exhaustively investigated at the Reichanstalt from which certified tested standard lamps can readily be obtained, and its performance under varying conditions of flame height, temperature, barometric pressure and so forth, has been carefully studied. Its normal flame is 40 mm. high and its intensity is about 10 per cent less than that of the English candle.

Being the legal standard in Germany, and widely used elsewhere on account of its steadiness and the accessibility of certified examples, the Hefner-Alteneck lamp comes nearer to being as real international standard than any other. When used in strict accordance with the minute instructions accompanying each lamp it is subject to errors not more than half as great as those met with in standard candles, and while not perfectly steady is far steadier than a candle or a Carcel lamp. Its weakest point is its color, which is distinctly reddish orange. This constitutes a rather serious objection to its use as a working standard in measurements made, for instance, on mantle burners or incandescent lamps. Even as a primary standard, its color and rather small intensity form an obstacle to its convenient use, but all in all it has been rather generally recognized as the best primary standard yet devised.

Reproducibility is the principal requirement in a primary standard, and this the Hefner-Alteneck lamp possesses to a very unusual degree.

In working standards the most necessary qualities are great temporary steadiness and convenience as to color and intensity. These requirements are far more easily met than that of exact reproducibility, and in practical photometry, reliable secondary standards are obtained with comparative ease.

One of the simplest and most useful is obtained from an Argand gas burner, such as has already been described as used for testing purposes. Burned at a carefully regulated pressure with a delicate meter to adjust the consumption by, and a blackened screen to cut off all the light save that through a narrow aperture of definite dimensions, a gas jet gives a wonderfully steady light, extremely well suited to photometric work. This arrangement is substantially that of the Methven screen which is widely used in photometry. If it were practicable to prepare on short notice a gas of definite composition this apparatus might make a good primary standard, but attempts along this line have not been very successful. Acetylene has been suggested for the purpose, but experiment has shown that it is peculiarly subject to variations in luminous intensity and is worthless as a standard illuminant.

Aside from the Methven screen, the most generally used secondary standard is the incandescent lamp. If the filament is not worked at too high a temperature, i. e., at too great efficiency, and is aged by several hundred hours of preliminary burning, it constitutes an admirably reliable standard. Burned at a fixed and uniform voltage its intensity can be accurately determined from comparison with a primary standard, and remains very nearly uniform, having a slight and definitely ascertainable decrement with time. In practical photometry such a lamp is merely balanced against an ordinary aged lamp used in the photometer for testing purposes, remaining itself a reference standard.

Several attempts have been made at an incandescent lamp as a primary standard, the filament being of definite material and dimensions, enclosed in a globe of specified character, and worked with a definite amount of current. The result has not so far been encouraging, and in the absence of anything better the Hefner-Alteneck lamp is the main reliance as a reproducible standard. At the time the Violle standard was proposed one-twentieth part of it was tentatively adopted and styled the bougie décimale, but this somewhat hypothetical unit has never come into any repute, although its relation to the more common standards has been determined with a fair degree of precision.

The following table gives the relation between the several primary standards here referred to with perhaps as much precision as the nature of the case permits, perhaps rather more since one must admit that in photometry the third significant figure is of somewhat dubious value.

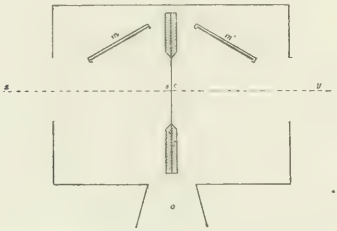
	Bougie décimale.	Carcel.	Hefner unit.	German candle.	English candle.
Bougie décimale	1.	0.104	1.13	0.955	0.97
Carcel	9.6	1.	10.9	9.20	9.6
Hefner unit	0.885	0.92	1.	0.815	0.91
German candle	1.05	0.109	1.23	1.	1.092
English candle		0.104	1.099	0.915	1.

There are here some evident discrepancies which serve to mark the unsatisfactory state of the art, and to measure the uncertainties which exist.

Given a standard, such as it may be, the process of comparing a given radiant with it is extremely simple in principle and somewhat troublesome and unsatisfactory in practice. The difficulties come in part from the inherent difficulties of the process in general and in part from the complications introduced by variations in the color of the light.

The Bunsen screen, which in ordinary practice is the backbone of photometry, has already been in some measure described together with one of its simplest applications. The general principle is that a translucent spot in a nearly opaque screen of light texture disappears when equally illuminated from each side. But for this to happen requires that the screen be entirely symmetrical. Light falling upon it must be transmitted through, and reflected from the surface of the grease-spot in precisely equal measure irrespective of the side of the spot on which the light falls. If not when viewed obliquely from one side the spot will seem to disappear at a particular point, but when viewed from the other side this point will be shifted. Moreover, unless the screen be viewed from the same angle on each side, it will not balance at the same point even if the spot be absolutely symmetrical as regards its two faces. If this condition is fulfilled one side of the spot will generally accumulate dust a trifle more freely than the other, and throw things out of balance again.

To eliminate as far as possible such difficulties it is usual to arrange the Bunsen screen so that both sides can be observed simultaneously, and from the same angle. To this end the apparatus is arranged as in the diagram. The screen marked *sc* in the cut is



ARRANGEMENT OF BUNSEN SCREEN APPARATUS.

placed in a blackened box, having openings in the ends along the line *xy* between the lights to be compared, and a lateral opening *O*, in which the edge of the screen is central. Two ordinary pieces of mirror, cut side by side from the same glass, are set vertically in the screen box in the positions *mm'*, as shown. To the observer looking fairly into *O* the reflected images of the two sides of the screen then appear side by side, and the slightest change in the appearance of either may be at once noted. Sometimes the mirrors are fitted to slide out so that they may be interchanged and another reading taken, and sometimes the sight box itself is arranged to revolve 180 degs. about a horizontal axis in the plane of the screen. The interior of the box must be blackened with extreme care to avoid diffused light.

In observing with this sight box one soon falls into a very uniform habit of setting the screen by reference to both its sides, and can take wonderfully concordant readings. But vision differs in different persons, and the "personal equation" in photometric work is of considerable importance.

Legality of Telephone Oath.

An affidavit by telephone, taken by a justice or notary, is legal, according to Judge Burke, of the Circuit Court at Baltimore, who, on Sept. 11, gave his decision to that effect in the case of the petition of the Manor Lumber Company, of Baltimore County, asking for the revision of an order appointing Osborne I. Yellott receiver for the concern. When Mr. Yellott was ready to file the necessary papers asking for a receiver, he had Mr. Cross come to the telephone at Cincinnati, and Justice Thomas Butler, who knows Mr. Cross very well, took his affidavit to the bill. The contention was made by the attorney for the company that affidavits taken in the manner described are not legal and bona fide.

The Induction Motor for Electric Railways—II.

(*Concluded.*)

In last issue was published an abstract of a paper read by Mr. A. H. Armstrong before the Buffalo convention of the American Institute of Electrical Engineers, entitled "Notes on Modern Electric Railway Apparatus." As already stated, Mr. Ernst J. Berg read at the same meeting a paper entitled "Electric Railway Apparatus," of which an abstract follows:

Mr. Berg's paper starts out with a discussion of the latest practice in the design and operation of apparatus employed in electric railway work; direct-current generators, alternating-current generators, inverted converters, rotary converters, synchronous and induction motor-driven direct-current generators, and direct-current railway motors being taken up in turn. The greater part of the paper, however, is devoted to a consideration of the induction motor in railway work, and this portion is reprinted below almost in full.

Alternating-current railway motors are of the polyphase induction type, and therefore their characteristics are essentially those of direct current shunt motors, that is, they run efficiently only at one speed, whereas the direct-current series motor will operate at high efficiency over a considerable range of speed. It is therefore obvious then in railway service where the speed for many reasons has to vary during the run and where cars are stopped and started at rather short intervals, the actual power taken by the induction motor will be greater than that taken by the direct-current motor. Since, furthermore, any induction motor must take a certain amount of wattless current, the apparent power input of the motor must be greater than with direct current. With the same mechanical clearance in the two types of motors, the amount of wattless current taken by the induction motor would be quite prohibitive, therefore these must be made with decidedly smaller air-gap than direct-current motors, which necessitates more careful adjustment, and involves more repair work. The wattless current is also dependent upon the voltage at which the motors are operated, and increases as the voltage increases. With the known methods of insulation and with the limited space available for railway motors, it seems that it is almost out of the question to consider a design at higher potential than 3000 volts. Even with the smallest safe air-gap this will give a power factor of at the most 85 per cent or 88 per cent at full load under the best conditions, which, with an efficiency of, say, 86 per cent including gear loss, gives an apparent efficiency of at the most 77 per cent; in other words, the kilovolt-ampere input of the motor would be about 30 per cent greater than that corresponding to the work done. Whereas, with the direct-current motor the power input would probably not be more than 12 per cent, or 15 per cent greater than that corresponding to the work done.

Therefore, and in view of the laws governing the design of such induction motors, it is to be expected that the copper losses in an alternating-current motor will be decidedly gerater than in a direct current motor. The core loss in the field of the induction motor is also greater than the core loss in the armature of the direct-current motor at maximum speed, so that this gives another source of increased heating of the motor. This increased heating is decidely objectionable, as it involves the use of a much larger machine than the direct-current motor, which increases the cost and weight of the equipment. To illustrate this somewhat more concisely, consider the losses occurring in a couple of motors of direct and alternating-current type while accelerating from standstill up to full speed. The core loss and eddy losses in the direct current motor are zero at standstill, and increase to a certain maximum at full speed. In the alternating-current motor at standstill even under favorable conditions, the core loss in the field is the same as the maximum core loss in the armature of the direct-current machine, and the core loss in the armature at standstill about the same as in the field. At full speed the core loss in the field still remains the same, but the core loss in the armature is zero, and therefore, roughly speaking, the core loss of the direct-current motor is in the neighborhood of half of the core loss at maximum speed, while accelerating, and is one and a half times as much in the alternating-current motor.

In other words, during acceleration the alternating-current motors have three times as much core loss as the direct current. Adding to this loss the greater copper loss due to the larger power input of the motor, we find from actual calculations that the alternating-current motors of good design will have in the neighborhood of four times as much loss as the direct-current motors when operating over

relatively short lines, as would be the case in rapid transit systems. To dissipate four times as much energy means that the volume of the motor has to be very much greater, and its heating facilities decidedly better. This does not mean that the actual heating will be as much more, since at least in long-distance runs, the time of accelerating is short compared with the total time of the run, nevertheless, the loss will be decidedly more and consequently it would seem as if the actual cost of the induction motor equipment per car would be from 50 per cent to double that of direct equipments, depending upon the service. Since the cost of the motor equipment is a very large factor in the installation of a plant, and since the direct-current equipment is so standardized and brought down to the least possible cost here in the United States, this is probably one of the main reasons why upon careful examination it has been found not only a saving of power, but great economy in the first cost to install direct-current rotary converters instead of alternating-current systems. In places, however, where the direct-current railway system is not so fully developed, the difference in cost between the two systems might not be so much, and that accounts for some European concerns installing alternating-current motors. To illustrate more fully the characteristics of the two types of motors, the following example is considered:

A double-track road with 27 stations is supplied power from a station located a distance from the tracks. Eight trains are running in each direction, which cover the entire distance in 52 minutes.

Weight of loaded train, including locomotive equals 180 tons (2000 lbs.).

Weight on driving wheels equals 50 tons.

Thus maximum draw-bar pull at 25 per cent of weight equals 25,000 lbs.

Which corresponds to a maximum acceleration of 2 ft. per second, per second.

Distance of run is 2560 ft.

Schedule speed, 15 miles per hour.

Maximum speed, 27 miles per hour.

Total distance is covered in 95.5 seconds, 20 seconds allowed for stops at each station.

No appreciable grades exist and effect of curves is negligible.

The three systems considered are:

A. The standard direct-current railway system with series parallel control of the motors.

B. Three-phase induction motor system with rheostatic control.

C. Three-phase induction motor system with concatenated control in accelerating as well as braking.

Obviously, when running at uniform and maximum speed one system offers no advantage over any other in energy consumption, assuming same efficiency of the motors (which is very nearly the case) while the volt-amperes taken by the motors are about 20 per cent greater with the alternating-current system (running at relatively light load).

While braking, the use of either of the first-mentioned systems is immaterial, since no return of power can take place, but the third, that with concatenated control, offers some advantage in returning power which, however, is practically offset by the large current taken, and the complication of control and design of motor.

While accelerating, however, marked differences exist in the three systems, therefore the choice of one or the other is largely dependent upon the relative time of accelerating, running at uniform speed, and braking. Since, furthermore, the power required with any particular system depends upon the method of accomplishing the run, a number of schedules have been worked out.

The important results of the various runs are shown in the table given below, which undoubtedly is more comprehensive than the diagrams for a superficial investigation.

Columns A, B and C are most important, and show the conditions of the best runs. Upon the constants given there and the corresponding curves the rest of the investigation is based.

Columns D and E show two direct-current runs at different gear ratios.

Columns F and G show two runs with rheostatic control only.

Columns H, I and J show three runs with concatenated control in accelerating only.

Columns K and L show two runs with concatenated control in breaking as well as in accelerating.

In going over the matter in more detail are considered the direct-current run, as shown in Column A, and the alternating current runs with rheostatic and concatenated control as shown in Columns B and C.

To sum up the results, it is found from the various methods of running trains, first, that under apparently the most favorable as well as average conditions, the most economical alternating-current system will take 26 per cent more power and 2.2 times as many volt-amperes as the direct-current system. Second, that the concatenated control takes 26 per cent less power, but only 10 per cent more apparent power than the alternating-current system with rheostatic control. It must, however, be borne in mind that these values refer to power input at the motors, not the relations at the sub-stations and power house, as will be seen later.

Power is supplied to four sub-stations located, respectively, 16,600 ft., 17,400 ft., 22,800 ft., and 35,000 ft. from the generating station. The transmission potential is 11,500 volts.

Since the supply of power is located at some distance from the receiving circuit, high-potential three-phase generators are proposed in all three cases.

	D. C. Series Paral. 33 Seconds Coast. A	A. C. Rheostat 14 Seconds Coast. B	A. C. Concat. 14 Seconds Coast. C	D. C. Motors 42.5 Seconds Coast. D	D. C. Motors 14.5 Seconds Coast. E	A. C. Rheostat 40 Seconds Coast. F	A. C. Rheostat No Coast. G	A. C.—Concat. only when Accel. 40 Seconds Coast H	A. C.—Concat. only when Accel. 14 Seconds Coast I	A. C.—Concat. only when Accel. no Coast. J	A. C. Contat. Brake and Accel. 40 Seconds Coast. K	A. C. Concat. Brake and Accel. No Coast L
K. W Seconds Accelerating	21800	31700	25100	22700	23000	39100	31100	30900	25100	22700	30900	22700
K. W. Seconds Uniform Speed	....	5400	5400	....	....	....	7800	....	5400	7800	....	7800
K. W. Seconds Braking	....	....	—3230	....	....	....	....	....	....	....	—2800	—5400
Total K. W. Seconds	21800	37100	27270	22700	23000	39100	38900	30900	30500	30500	28100	25100
Average K. W. per Run	190	322	237	197	200	340	338	268	265	265	244	218
K. V. A. Seconds Accelerating	21800	37000	33600	22700	23000	44900	35800	40000	33600	32100	40000	32100
K. V. A. Seconds Uniform Speed	....	6600	6600	....	....	....	9500	....	6600	9500	....	9500
K. V. A. Seconds Braking	....	....	7730	....	....	....	....	....	....	....	5400	10600
Total K. V. A. Seconds	21800	43000	47900	22700	23000	44900	45300	40000	40200	41600	45400	52200
Average K. V. A. per Run	190	379	416	197	200	390	394	348	350	362	394	454
Maximum K. W. per Run	780	977	977	912	725	1080	965	1080	977	965	1080	965
Maximum K. V. A. per Run	780	1140	1140	912	725	1240	1110	1240	1140	1110	1240	1110
Watt Hours per Ton-mile	70	120	88	73	74	126	125	99	98	98	91	81
V. A. Hours per Ton-mile	70	138	154	73	74	145	146	120	120.5	134	146	108
Ratio $\frac{\text{Average a-c K. W.}}{\text{Average d-c K. W.}}$		1.72	1.26			1.80	1.79	1.41	1.40	1.40	1.30	1.26
Ratio $\frac{\text{Average a-c K. V. A.}}{\text{Average d-c K. V. A.}}$		1.97	2.20			2.07	2.09	1.85	1.85	1.92	2.09	[illegible]
Average P. F.	1	87	57	1	1	87	86	77	75.5	73	62	48

A. Direct-current motors with series parallel control.

Installation.—The road-bed has double tracks of 85-lb. rails and the combined cross-sections of feeders and trolleys for two tracks is 1 square inch of copper. In the calculations, all tracks and feeders are assumed interconnected, and the feeder copper strung all around the track.

The resistance of steel rails is assumed as 12 times that of the corresponding copper, and that of bonds as 50 per cent of rails. This gives the ohmic resistance of four rails in multiple between two sub-stations (average 17,100 ft.), as .09 ohm, and the corresponding resistance of copper as .159 ohm, or a total resistance of .25 ohm.

Each sub-station has three 650-kw converters (one as spare) and ten 240-kw transformers. The high-potential lines consist of two cables No. 0 B. & S. (one of which is spare) for each of the two distant stations and two cables No. 3 B. & S. for the two nearer stations.

Distance between sub-stations equals 17,100 ft.

The transformers have 2 per cent *I. R.* loss and 1 per cent core loss. The converter has 94 per cent efficiency over considerable range of loads. The generating station has four 1600-kw generators (one as spare) and engines.

Neglecting losses, we find that—

	Kilowatts.
Average load in kilowatts on one sub-station is...	760
Maximum load on one sub-station is.....	1600
Average load on the generating station is.....	3040
Maximum load on the generating station is.....	4400

This brings the average actual load on a rotary converter to 832 kilowatts.

Maximum load on rotary conveter.....	1910
Average load on generating station.....	3650
Maximum load on generating station.....	5650

The converters run at 64 per cent load at average load.
The converters run at 146 per cent load at maximum load.
The generators run at 76 per cent load at average load.
The generators run at 118 per cent load at maximum load.

B. *Alternating-Current Motors with Rheostatic Control.*—The motors are supplied power from four sub-stations at an average potential of 3000 volts over two sets of three-trolley wires, No. 00 B. & S. (interconnected). Each sub-station has four 700-kw transformers (one to spare). The high-potential lines are two sets of No. 00 B. & S. and No. 2 B. & S., respectively, for the longer and shorter distances.

The generating station has five 1800-kw three-phase 11,500-volt generators and five 1700-kw steam engines.

From load diagrams it is found that neglecting losses—

	Kilowatts.
Average power on sub-station is.....	1290
Average k. v. a. "	1515
Maximum power "	2300
Maximum k. v. a. "	2800
Average power generating station is.....	5150
Average k. v. a. " "	6060
Maximum power " "	7100
Maximum k. v. a. " "	8300
This gives an average kw output of power station..	5600
" " k. v. a. " " " ..	6500
" maximum kw " " " ..	7780
" " k. v. a. " " " ..	8880

The generators will run at 90 per cent load at average load.
The generators will run at 123 per cent load at maximum load.
The engines will run at 92 per cent load at average load.
The engines will run at 126 per cent load at maximum load.

C. *Alternating-Current Motors, Concatenated Control.*—The secondary network is laid out as in previous case, but the high-potential lines are duplicate sets of No. 000 B. & S. and two No. 000 B. & S. cables in multiple for the shorter and longer distances, respectively.

Each of the four sub-stations has four 800-kw transformers. The power station has five 2000-kw generators and five 1700-kw engines.

From load diagram it is found that neglecting all losses—

	Kilowatts.
Average power on sub-station is	948
Average k. v. a. "	1660
Maximum power "	2000
Maximum k. v. a. "	3500
Average power on generating station is.....	3800
Average k. v. a. " "	6650
Maximum power " "	6000
Maximum k. v. a. " "	10000
This gives an average kw output of power station..	4170
" " k. v. a. " " " ..	6850
" a maximum kw " " " ..	6000
" " k. v. a. " " " ..	10000

The generators will run at 85 per cent load at average load.
The generators will run at 125 per cent load at maximum load.
The engines will run at 75 per cent load at average load.
The engines will run at 107 per cent load at maximum load.

The selling prices of the various items referred to are assumed as follows:

Complete steam equipment, including installation, per kw	$75.00
High-potential generators, switchboards and instruments, per kw.	26.00
Rotary converter sub-stations and apparatus, per kw.	40.00
Transformers (700 kw.), per kw.	4.50
Direct-current electric locomotive complete..	$15,000.00
Alternating-current electric locomotive complete.	19,000.00
Passenger coaches (70 seats)	4,500.00
High-potential cables (10,000 volts) No. 000 B. & S., per 1000 ft.	1,060.00
High-potential cables (10,000 volts) No. 00 B. & S., per 1000 ft.	930.00
High-potential cables (10,000 volts), No. 0 B. & S., per 1000 ft.	840.00
High-potential cables (10,000 volts), No. 1 B. & S., per 1000 ft.	710.00
High-potential cables (10,000 volts), No. 2 B. & S., per 1000 ft.	650.00
High-potential cables (10,000 volts), No. 3 B. & S., per 1000 ft.	600.00
Copper, per lb.	.186
Direct-current trolley construction, per mile..	900.00
Alternating-current trolley construction, per mile	1,200.00
Eighty-five-lb. rails, per ton	26.00
Track construction, per mile	500.00

EXPENSES OF INSTALLATION AND AMOUNT OF POWER REQUIRED.

A. Continuous-current motors with series parallel control.
B. Alternating-current motors with rheostatic current.
C. Alternating-current motors with concatenated control.

	A.	B.	C.
Power house steam equipment.	$480,000	$600,000	$525,000
Power house electrical equip..	166,000	234,000	260,000
	$646,000	$834,000	$785,000
Rotary converter station	$312,000	.....	.....
Transformers	.....	50,500	57,500
	$312,000	$50,500	$57,500
17 locomotives, complete	$225,000	$322,000	$322,000
68 passenger coaches	306,000	306,000	306,000
	$531,000	$628,000	$628,000
Cables, duplicate	$157,000	$172,000	$366,000
Trolley and feeder copper.....	49,000	31,000	31,000
	$206,000	$203,000	$397,000
Track construction	$109,000	$109,000	$109,000
Trolley construction	23,400	31,200	31,200
	$132,400	$140,200	$140,200
Total cost	$1,857,000	$1,856,000	$2,008,000
Average kw power required.....	3650	5600	4170
Kilowatt average loss	600	440	380
Per cent loss	16.4	7.8	9.1

Percentage of d. c. power	100	153	114
Percentage cost of d. c. installation.	100	100	107

It is thus apparent in this particular instance, which is fairly representative for heavy urban work, that the direct-current system offers decided advantages in economy if installed at the same price as the alternating-current system, and that the same economy cannot be obtained with alternating current, no matter at which cost; furthermore, that the alternating-current system with concatenated control is preferable to that with rheostatic control. It must, however, be borne in mind that for an actual installation, practical conditions might warrant different amount of machinery and different units, and that allowances must be made for sharp turns, grades, etc., and that the prices given are somewhat arbitrary. The three systems are, however, placed on as nearly as possible the same footing, so that the comparison should be fair, even if the actual cost of the installation is considerably different.

In conclusion, Mr. Berg considers that owing to the favorable characteristics of the direct-current railway motor and the rotary converters, compared with the alternating current motor for this class of work, very few propositions warrant the use of the alternating current throughout. He considers that the stand taken by American engineers in this matter in recommending rotary converter systems almost exclusively, is correct and warranted by considerations of economy and first cost, no matter what the adverse criticisms have been of late; and that while there is undoubtedly a field for alternating-current motors, it is strictly limited to long distance schemes with very few stops, or to mountain roads.

Plant of Big Fork, Montana, Electric Power and Light Company.

By A. E. Ransom.

During the summer of 1900 Mr. L. Tinkel & Son, of Kalispel, Mont., started work at the mouth of the Big Fork River on the north shore of Flathead Lake, on the erection of a plant to furnish light and power to the city of Kalispel, 19 miles distant. An ideal water power exists at this point. The Big Fork River, a deep flowing stream to within a mile of the lake, falls at that point 125 ft. in a series of swift flowing rapids. At the head of the rapids a ditch capable of furnishing water for 3000 horse-power was commenced, and continued around the hill for a distance of 6000 ft., including about 3000 ft. of timbered flume. At the end of this ditch and flume a 54-inch pipe dropped down to the power house, giving a head of 100 ft. for the waterwheels, and from thence into the river.

The power house is a substantial frame building erected on the bank of the river on solid rock, and built large enough for twice the present capacity of the plant. The waterwheel equipment consists of two 300-hp Leffel turbine wheels operating at a speed of

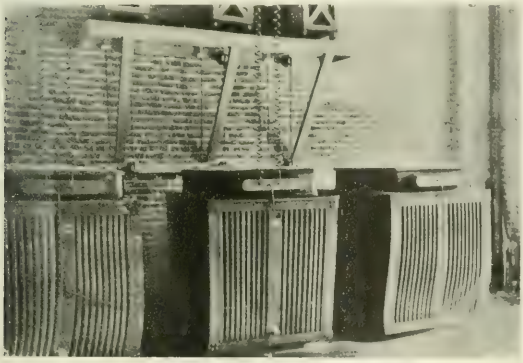


FIG. 1.—TRANSFORMERS IN SUB-STATION.

514 r. p. m. and equipped with Lombard governors. The turbines are arranged in a very compact form, as shown in the accompanying illustration. The wheels are direct-connected to two 225-kw, two-phase, 440-volt, 60-cycle, composite-wound Westinghouse alternators, the exciters of which are mounted on a platform above the turbines and belted direct to the connecting shaft. The switchboard apparatus consists of two white marble generator panels arranged for parallel operation.

The current is transformed, through a set of Westinghouse oil-cooled transformers connected on the two-phase three-phase sys-

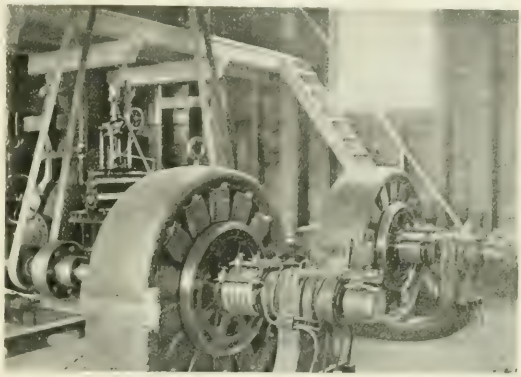


FIG. 2.—INTERIOR OF POWER HOUSE.

tem, each transformer being of 200 kilowatts capacity. One transformer is kept in reserve. The current is carried 19 miles to the Kalispel sub-station at a pressure of 12,000 volts at the generating end, by means of three No. 6 B. & S. hard-drawn copper wire. At Holt, three miles from Big Fork, the line crosses the Flathead River on a 700-ft. span. The transmission line, throughout the entire length follows the county road, thus rendering inspection easier.

The sub-station at Kalispel is a substantial brick building in which there are at present installed three 200-kw Westinghouse oil-cooled step-down transformers, with 10,500-volt primaries and 2200-volt secondaries. Through two feeder panels these transformers supply the city light and power circuit.

The Kalispel Water & Light Company has contracted for 300 horse-power to operate the pumps of the city water works, and for street and commercial lighting. Three or four hundred horse-power will also be used for the supply of induction motors for operating a cold storage ice machine, 75 horse-power for the operation of the Kalispel Roller Mills, and for other motors for operating saw mill machinery, printing presses, brewery pumps, laundry work, and a number of other industries.

Plans are already under way for the doubling of the plant, which

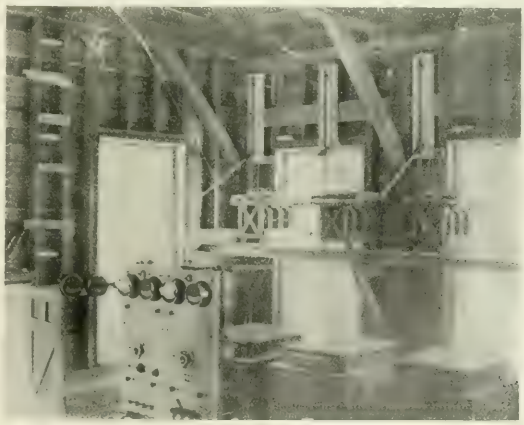


FIG. 3.—SWITCHBOARD, ETC., POWER HOUSE.

well illustrates the rapid advancement of electric transmission work in the Northwest. The hydraulic work was under the supervision of Mr. Frank B. Fish, hydraulic engineer for the company, and the electric construction under Mr. John A. Schreiner, electrician.

The Evolution of Exposition Lighting.

THREE very interesting and valuable articles have recently been contributed to the pages of ELECTRICAL WORLD AND ENGINEER by Mr. Luther Stieringer, consulting electrical engineer of the Pan-American Exposition, on the subjects of exposition ground lighting, electric towers and electric fountains. The data and expert opinion thus presented were summed up by Mr. Stieringer in a most suggestive paper, which he read last week before the Edison Association of Illuminating Companies at the annual convention in Buffalo. Having laid much of this matter before our readers lately, it is not necessary to repeat it, although the paper deserves to be read in its entirety as a masterly survey of a difficult branch of the lighting art.

Mr. Stieringer noted that the first decorative outdoor electric illumination was on the Gerry yacht "Electra" in 1883, with 200 incandescent lamps outlining the rigging about 2 ft. apart. The Paris Exposition of 1881 had some electric illumination. The first exposition lighted entirely by incandescent lamps was the Southern at Louisville, Ky., when 14 acres of floor space were lit by 7000 Edison 16-cp lamps, brought gradually up to full candle-power. At the St. Louis Exposition in 1884 the contract for the entire building required 5000 lamps. It was the first to have knife switches introduced; also the first to have the "cabinet" system of control and distribution. The feeders were bare copper in capped mouldings, the wire coverers at that time being unable to insulate heavy copper. Mr. Stieringer then reviewed the development at New Orleans, 1884 and 1885; Paris, 1889; Chicago, 1893; London, Earl's Court, 1894; San Francisco Midwinter, 1894; Atlanta, 1895; Nashville, 1897; Omaha, 1898, the first comprehensive and complete decorative and ground illumination by incandescent lamps, 21,000 of 8 and 16 candle-power being used. Mr. Stieringer came next, after an incidental mention of the mixed lighting in Paris, to the Pan-American, in regard to which he pointed out that its exterior illumination includes the largest vistas yet attempted at an exposition. Mr. Stieringer continued in part as follows:

To secure the results which are apparent at the Pan-American, a scheme of general distribution of illumination by 8-cp incandescent lamps entirely, is employed. All obtrusive or display lighting in the main vistas has been discouraged as detrimental to the general effect. For this reason no arc lamps are used, and for the same reason high candle-powers are avoided. It must not be inferred that a good illumination to selected conditions, cannot be effected with gas in its various forms, or with arc lights. The advantages, however, in placement alone would recommend the incandescent light above all other sources of light in Exposition illuminations. There is a general increase in the number of lights as one approaches the Electric Tower, which is the climax of the lighting scheme. To secure the best results it is essential in all artificial illumination to get uniform diffusion of light. This cannot be reached by the arrangement of a few extremely brilliant centers about the space to be lighted, because we cannot rival the sun; in fact, such an arrangement acts in itself to defeat the object to be attained. There will be a large portion of light immediately about the sources, while the remainder filters as it were, through space growing weaker and weaker as it recedes from the sources in obedience to the unvarying law of inverse squares. Methods of artificial illumination necessarily have some objections, whatever their form. For example, it is often necessary to locate lights in the line of vision. This difficulty must be met by the simple expedient of a more minute sub-division and uniformity of distribution of lamps. As a practical standard 16 to 20-cp lamps should be the largest used. From the structural and decorative standpoint to secure the best results we must have a lamp so small as compared with those now in common use, that they give but little light individually, but capable of being so grouped, massed or distributed as to produce the desired effects and diffusion without raising any point of space to a brilliancy disagreeable to the eye to rest upon. Until the present time, large units of electric light have been depended upon to bring into greater prominence the beauties of surrounding effects. But in thus using the light we fail to avail ourselves of the beauty which is inherent in the light itself when the light is secured from myriads of small units.

As electricity was the first medium to render comprehensive illumination of the grounds and buildings possible, it was but natural that impossibilities should be expected of it. The history of the Chicago World's Fair is full of vagaries and delusions that by turning on electricity the daylight might be loaded with rainbows and the night flooded with sunshine. Now, nature not only forbids such extravagancies, but true art as well as expediency and cost condemns them. The first duty of an expert in lighting is to emphasize the fact that we can but secure relative effects, the harmony of which will accomplish infinitely more than costly and laborious sensationalism. To an eye that has been fixed on the sun the glow of the incandescent lamp is a sickly yellow and the beam of the arc a ghastly blue, but coming out of the darkness into a room properly lighted by incandescents, we enjoy at once a feeling of cheerfulness.

In the case of the buildings and grounds the true principle is to outline and accentuate against the dark background of the night. Thus the imagination is given a chance, and this freedom is pleasant to all intelligent minds. The spectator whose eye is not dazzled moves comfortably about and the expenditure of electrical energy for a given result in illuminating effect is minimized.

In planning the illumination of the main setting of the Pan-American all spectacular effect was barred. Paris suffered in its last two expositions from the introduction of spectacular fountain and illuminating features in its main court. When such are presented all surrounding illumination must be under control to secure proper contrast. The illumination of the water basins or lakes and fountains therein was first introduced by the writer at the Atlanta Exposition of 1895 by placing 60 incandescent lamps on floats encircling the outer edges of the falling spray from two pyramid fountains in one of the lakes. The next development of this feature was at Omaha in 1898 when about 200 incandescent lights were placed bordering the fountain "Nautilus" and so arranged as to appear as floating on the water and accentuating the edges of the water figures or splash.

TOWER, WITH FOUNTAINS AND FLOATING INCANDESCENTS.

This same scheme has been followed on a more elaborate scale at the Pan-American, there being several thousand lights in the main fountain basin. Designs were also developed for the other basins. These were all designed to serve a double purpose—to light the water issuing from the jets and to illuminate the water in the basin for ornamental effect. Neither of these has been fully realized, the design of the water figures having been changed from the original plan, which would have given better results as it harmonized with the water figures, the lights being more scattered and in sinuous lines. As it now exists it is faulty from being too concentrated. It is composed of rings concentric to each water figure. Between each set of circles is a filling of lamps intended to represent an arrowhead, but undistinguishable because on the plane of vision. The effect is one of mass without definite arrangement or purpose.

There are important periods in the electrical requirements of an exposition. First, the prospectus outlining the scheme and scope; second, development of plans; third, construction; fourth, operation. The two latter are hard to appreciate unless one is familiar with all the details, for upon their execution depends success.

The engineer who designs the illumination of an exposition has by no means an easy task. It is not simply a question of circuits, though that is no child's play, for a distribution to as many lamps as there are at the Pan-American, nor is it a question of placing a light here and there for immediate use. The expert on illumination must be able to see in the mind's eye the effect he will produce when the exposition is at a stage when the grounds are barren and the architectural features are but little further advanced than in sketches. The prospectus

and preliminary report of the lighting of the Pan-American was of necessity prepared from such meager data and yet substantially all the electric and fountain requirements were anticipated therein.

It may be said success in designing illumination must depend largely on artifice. It does, but not of the kind that betrays itself. The artist upon light looks upon any subject just as a painter does upon a landscape. He has to compose a perfect picture by means of the disposal of illumiantion, and he must be judged by the resultant whole. For example, to erect huge wooden masts outside the buildings would dwarf the structures. To make each building a blaze of light would blot out the grounds. A sea of light in the paths and lawns would reduce the buildings to islands of darkness, so that the study of distribution and diffusion becomes for a lighting expert not only a severe problem, but a fascinating and absorbing pursuit. In dealing with questions of light for strictly utilitarian purposes, means must be adopted quite different from those that promise success in spectacular displays, but the result is ever a matter of guesswork. The experiment is much the same as the firing of modern artillery. Each shot is so costly and so irretrievable when fired that native genius and prayerful study must be taxed to the full in advance to insure the hitting of the mark. It will be seen at once how extremely difficult it would have been to change the plan of lighting the Pan-American after adoption, and, therefore, how much experience and forethought must have gone into it in advance.

While the building art has derived expression from the ancients, yet in our time we have few new conceptions but many poor reproductions. The illuminating results achieved at the Pan-American are the work of the scientists, inventor and engineer, without whom the old vessel of fat, the source of light of our ancient friends, would still hold sway.

Lighting is not a matter strictly for architects nor engineers, but a special art and a subject of special investigation. Whatever beauty the architecture may possess, if a funereal aspect is to be presented on occasion, the mourning colors of the country must be chosen, be they white, yellow or black. If the occasion be festive and in daylight, bunting in the skilled hands of the decorators will secure a festive transformation. To make a scene festive at night, it can only be by the aid of illumination.

Interference or meddling before the completion of the original scheme of the electrical work was avoided as much as possible at the Omaha Exposition. No one other than the designer and constructor knew what to expect of the illumination until the first trial, which then proved satisfactory to the management as well as to the public. There was considerable meddling with the work in hand by outside influences, at the Pan-American Exposition and at the Chicago World's Fair. This resulted in the abandonment of many good features and the neutralizing of others. As an instance of this, a continual harping for gas torches along the canals (a repetition of an abandoned experiment at Chicago) resulted in their being finally introduced at the Pylon embankments. This is an age of electricity, and we are not handicapped as Nero and the ancients were in their illuminations.

In closing this paper a few remarks are in order on what the future may show in exposition lighting, if the experiences of the past are heeded. Experience has demonstrated that the future successfully illuminated exposition will use a small unit of light, well diffused and of pleasing color, the unit to be well distributed. All concentrated light will be avoided unless the concentration is accomplished with the smallest practicable unit so that the volume does not exceed the general intensity established. Especially is this essential if displays of emblems or other artistic creations are introduced. These must not mar the actual illumination. Where spectacular effects are desired they must be so related to the whole as not to become obtrusive. Light is only relative. The expert on illumination must ever remember this, and never spoil the beauty and efficiency of a general scheme by objectionable lighting which dwarfs all surrounding illumination.

Another Canadian Water Power.

Messrs. Clark Bros., of New York, have purchased a water power on the St. Marguerite River, near Seven Islands, on the north shore of the St. Lawrence, and in the province of Quebec. It is the intention to build a large pulp mill at the latter point, which will be operated by electric power generated at the Falls. During the next two years half a million dollars will be expended in the work of development, and eventually $3,000,000 will be invested.

Annual Meeting New York State Street Railway Association.

The New York State Street Railway Association held its nineteenth annual meeting at Rochester on Sept. 10 when, as usual, there was an excellent attendance and the presentation of a good batch of technical papers supplemented by an admirable address from President Rogers. He stated that the street railways of this State had carried during the past year over 1,000,000,000 passengers, and that the net earnings from operation had been the same as in the previous year, $.0155 per passenger. The increase in the freight and express business on trolley roads had been nearly $50,000 over the previous year. Mr. Rogers discussed the difficulty that the smaller roads had to maintain expenses, for whereas only a decade ago a horse car with straw on the floor was accepted, now the public demanded everywhere the best accommodation that the resources of the art and of luxury could provide. He, therefore, insisted that such roads ought to be relieved as much as possible from the heavy penalties imposed upon them in the shape of burdensome taxation, paving and requirements for expensive construction, and he objected to the unfairness of the law taxing street railways 1 per cent on gross earnings while other public corporations are taxed only ½ of 1 per cent.

One interesting suggestion by Mr. Rogers was with regard to bringing the direction of travel on a street in harmony with the practice in Canada and England, so that when the travel was reversed the left hand would hold the car. He said: "I would suggest, if the tread of travel on our streets could be reversed, it would be a saving of many accidents. Nearly all persons, especially the ladies, in alighting from a car use the right hand to steady themselves, and upon alighting they find themselves facing backward. This benefit would also apply to the general public, as the same habit exists in alighting from a carriage. If travel was reversed the left hand would be used as a support in alighting and then the dress or parcel would be carried by the right hand of the passenger, who would face in the direction in which the vehicle was going. This is the custom in England and Canada, and if this radical change could be brought about in this country, I believe it would be of great benefit to our street railways in preventing accidents."

Among the papers read was one by Mr. Maurice Hoopes on the subject of third-rail construction. He recommended this as cheaper than the ordinary trolley system as well as more desirable for high-speed roads operating over their own right of way, as, for example, in the Albany & Hudson road, with which he was recently connected. Three objections are usually alleged against the third-rail system, viz., danger of accidental contact with the third rail, loss of power through leakage and the coating of the rail with sleet in winter. As to the first danger, Mr. Hoopes thinks there is nothing in it, provided the company fences in its tracks and runs its cars over cross-roads by momentum. The second objection, that of leakage, was not taken up by Mr. Hoopes, but he admitted that a good deal of trouble had been given by sleet, and that a satisfactory disposal of this trouble had not yet been found in the shape of an entirely satisfactory sleet cutter. Mr. Hoopes recommended for the location of the third rail a distance of 26 inches outside the outer track rail, as in the case of the Albany & Hudson, the insulator being mounted upon specially long ties inserted at regular intervals, 10 ft. being a good spaceing with heavy rail, and the special ties being 9 ft. 3 inches long. The rail recommended by him calls for only .09 per cent of carbon, .44 per cent of manganese, .088 of phosphorus and .08 per cent of sulphur. There had been no creeping of the rail on the Albany & Hudson, although the track had been down for some 15 months, and some of it was laid on 3 per cent grades. Mr. Hoopes said that he would advocate varying the size of the rail within the limits obtainable from the rolling mills to give the carrying capacity required. On the average high-speed interurban road an 80-lb. rail gives approximately the desired conducting capacity with sub-stations located at the usual intervals of from 10 to 12 miles, so that no overhead copper would be required in the nature of feeders, and the copper would be limited to the high-tension lines. Mr. Hoopes had been in the practice of bonding 80-lb. rail with 425,000 circ. mil. copper bonds put in the base of the third rail because of the absence of any interference from splice plates. As to the higher cost of the trolley over the third-rail system for the same work and equivalent conditions, Mr. Hoopes put it not less than 23 per cent for one mile of track, the

cost of third-rail construction being $3,410, and of trolley construction $4,421.

Mr. Alfred Green, master mechanic of the Rochester Railway Company, presented a paper which was an argument against the present system of rail bonding, and advocated the return to the use of a supplementary. In the course of his paper he said: "Thousands of dollars have been spent upon this bond system, and with all of our years of experience we are practically no further advanced than we were years ago, and in order to get the results that we desire we must do one of two things. Either make the rail itself continuous, something that can be done in paved streets by electrical welding, or else come to a continuous copper circuit without running the risk of broken joints. There is no doubt in my mind but that we will come yet to a supplementary wire, perhaps run a tile duct beside the rail, and have enough connections to that rail to make the circuit complete under all circumstances. If we would use a copper wire wherever that wire is attached to the rail, both wire and rail could be amalgamated, so that there is no possible chance for corrosion. I cannot, and never will, believe that you can bond the joints of the rail, no matter what cross section that rail may have, so that it will be a perfect success, and until we get out of our present way of doing things there will always be an opportunity for controversy. We must make our negative side of our circuit just as complete as our positive side, and when we do that we will wonder why we have not saved the many thousands of dollars that have been spent in trying to utilize that which has cost all street railway companies no end of trouble."

An interesting paper was presented by Mr. Charles R. Barnes, electrical expert of the New York State Railroad Commission, on brakes for electric street surface cars. He referred to the public tests of brakes made some time ago by the Railroad Commission, and said that to-day there is hardly a street railway in this State that has not some of its cars equipped with improved brakes, while the proportion of the 9000 passenger cars on surface railroads in this State equipped in this manner is constantly being increased. Mr. Barnes referred to a number of brakes in use, and as to electric brakes said that the only one used to any extent is that known as the General Electric, in which two disks lock magnetically. He said: "The most efficient brake for safety and economy is the one which nearly brings the wheel to a stop, and yet does not actually stop its revolution. This, in the cases of the air, the friction, the Sterling and the rail and wheel brake, depends upon the skill and carefulness of the motorman. In theory the principle upon which the General Electric brake is constructed approaches this condition more nearly than any of the others. On this theory the power for the operation of the brake decreases as the speed of the axle diminishes, to a point where it is nearly at a standstill, when there is no current produced and the braking power is removed. This allows the momentum of the car again to revolve the axle, when the same operation is repeated. If a brake could be constructed which would, in actual operation, produce the results which this theory holds forth, it would be the ideal brake as far as controlling the movements of a car by means of wheel friction. A brake which would operate in this manner would do away with that costly element in the operation of electric roads, flat wheels. With the use of the air, friction or Sterling brakes, as at present constructed, the number of flat wheels depends almost entirely upon the experience, skill and judgment of the motorman. The ideal emergency stop of an electric car, to prevent an impending accident, should be made in the shortest distance possible. This should be accomplished at a rate which will not fracture or pull out the king-pins of the car, nor throw passengers from their seats. The device which best fulfils these conditions will most nearly approach the much needed and much sought for perfect brake." This paper was discussed by a number of the members, and the importance of frequent brake inspection was very forcibly brought out.

Mr. W. J. Davis, Jr., presented a brief paper on the use of series boosters in connection with street railways, and said: "Experience has determined that the maximum departure of the booster characteristic from a straight line at fractional loads, referred to full-load voltage as a basis, should not exceed the values given below.

"To illustrate: A 300-volt booster, according to the table below, should have a characteristic departing not more than 30 volts from a straight line, so that, at partial load, the maximum potential upon the line would not exceed 605 volts, with 575 volts at the generator bus-bars. There is a practical limit to the amount of this variation, which is fixed by economical requirements in the electrical design of the booster. This limit is about 10 per cent. and consequently, where the boosting potential exceeds 300 volts, the resistance of the feeder should be made such that the IR drop is 5 per cent, or possibly 10 per cent greater than the booster voltage. This provision will result in preventing injuriously high voltage at the lamps and motor

Full-load voltage of booster. *Volts.*	Maximum variation in characteristic curve. *Per cent.*
50 to 100	20
100 to 150	15
150 to 250	12½
250 to 500	10

at the expense of a small reduction in line potential, which is not of sufficient magnitude to seriously affect the schedule speed of the cars."

He added: "Economically considered, the booster simply affords a means of saving line copper by drawing on the coal pile, and it ceases to be economical when the cost of power lost exceeds the interest on the additional copper required by a direct feed. Every case involving the permanent installation of a booster requires thorough study, and consideration should be given not only to the question of economy, but to probable future increase in the traffic and to extensions of the line. The chief objections to the booster as a permanent fixture are the inability of the machine to respond to demands greatly exceeding the requirements for which it may have been designed and the limitations to the area to be covered. In many cases full investigation of all the elements entering into the problem will show the alternating-current system employing a rotary converter sub-station to be preferable to a booster, especially where the service is to continue for several months in the year. There are even occasions when such service as that existing at race tracks, usually lasting only 10 or 15 days, may best be handled by a portable sub-station consisting of a rotary converter and static transformers mounted on a flat car and operated from a high-potential, three-phase transmission line."

An interesting paper was presented by Mr. F. E. Morse, superintendent of power, on the application of batteries on the Brooklyn Heights Railroad Company's system. The company has an equipment of three sets of Chloride accumulators, each of 248 cells, and Mr. Morse presented some curves exemplifying their utility. One of the sets is portable, installed in seven discarded passenger cars. It is used on the Brighton Beach line in summer and at East New York in winter.

Annual Meeting of the Association of Edison Illuminating Companies.

THE seventeenth annual meeting, twenty-second convention, of the Association of Edison Illuminating Companies, was held in the New York State Building, on the grounds of the Pan-American Exposition, Buffalo, Sept. 10-12, 1901. President John W. Lieb, Jr., of New York, presided, and delivered an interesting address, which embraced a resume of the minutes of the past conventions of the association, giving in this way a history of the progress of the association and the development of electric lighting. The following named new members were elected: Chattanooga Light & Power Company, Chattanooga, Tenn.; Edison Electric Illuminating Company, Hazleton, Pa.; Citizens' General Electric Company, Louisville, Ky.; Cumberland Electric Light & Power Company, Nashville, Tenn.; Norristown Electric Light & Power Company, Norristown, Pa.; Peoria General Electric Company, Peoria, Ill.; Sacramento Electric, Gas & Railway Company, Sacramento, Calif.; Trenton Light & Power Company, Trenton, N. J.

The programme of the convention carried out was as follows:

The first paper read was by Mr. Luther Stieringer on the "Evolution of Exposition Lighting." It is abstracted elsewhere in this issue. The lamp committee reported, and lunch was then served in the New York State Building. After lunch, Mr. F. W. Willcox read a paper on "Timely Lamp Topics," and Mr. C. P. Steinmetz gave a brief talk on methods of producing light. Dr. C. H. Sharp read a valuable paper on "Spherical Candle-Power of Incandescent Lamps." The evening was devoted chiefly to viewing the light effects on the Exposition Grounds.

On Wednesday at the morning session Messrs. L. A. Ferguson and A. Williams presented notes on their European trip this year.

Mr. W. S. Clark read a paper on the "Selection of an Insulated Cable for Lighting or Power Service," which was followed by a topical discussion started by Mr. A. Dow. Then came lunch and a trip to the Falls.

On Thursday morning the meter committee reported, and Mr. J. F. Gilchrist read a paper on "Competition with Isolated Plants." A paper was then read by Mr. A. S. Knight on "Modern Electric Light Accounting." After lunch the automobile and switch standardizing committees made their reports, and Dr. A. E. Kennelly discussed the Edison storage battery. Mr. P. Torchio read a paper on "The Economy of the 220-volt three-wire system," and Mr. C. D. Haskins gave one on "Progress in Electric Switch Design." This virtually closed the technical work of the convention.

Mr. A. S. Knight, in his interesting paper on "Modern Electric Light Accounting," expressed himself as not being very sanguine of success in the introduction of a uniform system of accounting for electric light companies, and that the desirability of a uniform system is at present more or less overrated. The distribution of accounts offer so many opportunities for individual opinion that he is skeptical as to the success of any effort for complete uniformity. Furthermore, local conditions will always so influence certain costs that comparisons of details can never be depended upon unless these conditions are taken into consideration. Again, many of the electric lighting companies have not yet been emancipated from the old systems of bookkeeping, and missionary work must be done in this field before the adoption is possible of an elaborate system of accounting. The paper describes in detail the system of accounting of the Boston-Edison Company, an abstract of which portion will appear in a following issue.

Mr. Clayton H. Sharp, in his paper entitled "Spherical Candle-Power of Incandescent Lamps," treated the subject under the following heads: Significance of mean spherical candle-power, mean spherical candle-power and the rating of lamps, mean spherical candle-power and illumination, approximate methods of determining mean spherical candle-power.

The results are given of photometric tests of seven different incandescent lamps, each having a different form of filament. It is shown that if the horizontal candle is the same for all seven lamps, the mean spherical varies from 12.82 candle-power to 15.72 candle-power, and the end-on candle-power from 5.06 to 15.9; also, that the ratio of mean spherical to mean horizontal candle-power varies from .802 to .983, while the ratio of mean spherical to end-on candle-power varies from .864 to 2.54. The above data indicate that the introduction of a system of rating according to end-on candle-power would only exaggerate the objections to the present method of rating. Assuming that all the seven lamps had been rated at 3.1 watts per horizontal candle-power, on this basis all but two of the types of lamps tested were rated low. On the basis of mean spherical candle-power the consumption varies from 3.12 watts per candle to 3.81 watts per candle. It is clear from these data that there must have been very considerable differences in the temperature of the various filaments tested; that the color of the light must be slightly different and their useful lives must vary widely from each other. Yet according to the present method of rating they were all lamps of 3.1 watts per candle.

After considering the various factors entering into the rating of lamps the conclusions arrived at are that the mean spherical candle-power furnishes the only entirely fair basis for comparing incandescent lamps with each other. On the other hand, we must be careful that the same source shall be used in comparing incandescent lamps with other lamps, as the former are placed at a disadvantage in nearly every case if the comparison is made on any other basis. This is particularly true in comparisons with arc lamps and also with the Nernst lamp. In one form of the latter lamp the supports, heaters, etc., are such as to furnish a fairly good reflecting surface behind the incandescent rod. This lamp shows, when measured in the direction of the maximum candle-power, a much higher efficiency than the best incandescent lamp, but we shall not know what its true value really is as a source of light until comparison is made on the basis of mean spherical candle-power.

It is pointed out that in determining the illumination on any surface from which there is reflection, the total luminous flux or the mean spherical candle-power is a factor of very great importance, as the illuminated surfaces in themselves become a source of illumination. Calling P the luminous flux and f the mean coefficient of reflection, it is shown that the total flux of light is $P/(1-f)$. In case of whitewashed walls the value of f is about .8, and the expression has the value of 5. That is to say, the available luminous flux is increased five-fold by the reflecting power of the walls.

As to the employment of a spherical reduction factor to obtain the ratio of the mean spherical to the mean horizontal candle-power, it is stated that this factor is not constant in the various types of lamps; consequently a different value must be used for each type, and the method thus offers no direct means of comparing the mean spherical candle-power of lamps of different types. The following empirical equation is given for computing mean spherical candle-power from mean horizontal and end-on readings: 0.7 mean horizontal candle-power + 0.3 end-on candle-power = mean spherical candle-power. By this equation the mean spherical candle-power of any ordinary type of lamp can be computed with a fair degree of accuracy from two measurements. This equation can evidently be used in other ways than the one indicated. If, for instance, the horizontal candle-power and the spherical reduction factor are known, the end-on candle-power can be computed approximately.

The results are given of some experiments made to test the recommendation of the National Electric Light Association, that incandescent lamps be rated according to candle-power measurements made on a rotating lamp inclined at an agle of 45 degs. The results showed that this method has little except its simplicity to recommend it, and that it consistently underrates the mean spherical candle-power of lamps so tested.

Measurements were also made to test the Liebenthal method, in which the lamp is measured inclined at two angles, one above and one below the horizontal, the angle in each case being 51.8 degs. The test was favorable for the method, and, in conclusion, it was stated that this method seems likely to furnish a practical procedure of rating lamps according to mean spherical candle-power. In practice the light emitted by the rotating lamp in two zones could be received by mirrors which would throw the images of the lamp simultaneously along the photometer bar. The measurements made would thus be twice the mean spherical candle-power of the lamp.

A much simpler arrangement which should be capable of yielding good results consists of two mirrors set at right angles to each other and inclined 45 degs. to a horizontal axis, which is so placed as to point toward the photometric center of the lamp. By inclining the angle of these mirrors properly, the required images of the lamp are visible from this position of the spot box of the photometer. A screen should be interposed to cut off direct light from the lamp, and the lamp should be rotated in the usual manner. The distribution of light by the mirrors can be taken account of by setting a working standard with respect to the reference standard placed between the mirrors, which must then be placed so the two horizontal images of the lamp are seen. With this method it is possible to get measurements of the mean spherical candle-power which will approximate as closely to the real value as actual measurements of mean horizontal candle-power.

New officers were elected as follows: President, Louis A. Ferguson, Chicago; vice-president, A. W. Field, Columbus, Ohio; treasurer, Alex Dow, Detroit, Mich.; secretary, Walter H. Johnson, Philadelphia; assistant secretary, Wilson S. Howell, New York. Executive Committee: Louis A. Ferguson (chairman), Chicago; Charles L. Edgar, Boston; John W. Lieb, Jr., New York; W. C. L. Eglin, Philadelphia; Thomas E. Murray, New York; Samuel Insull, Chicago, and the following *ex officio* members: A. W. Field, Alex Dow and Walter H. Johnson.

The Association provided luncheon at the meeting room each day, and also furnished the delegates with special cars for the "Gorge" ride, down the Canadian and up the American side, with dinner at the International Hotel, Niagara Falls, and a view of the Rapids illuminated by searchlights. The visit to the Falls took place on Wednesday afternoon and evening.

On Thursday evening the delegates were the guests of the Buffalo General Electric Company at Alt Nurnberg, on the Exposition Grounds, where a banquet was served to the ladies and gentlemen. The occasion was enjoyed by all, and remarks were made by Messrs. Huntley, acting as toastmaster, Lieb, Ferguson, Stetson, McCall, Price, Dow and Charles W. Price.

The place for the next meeting will be decided by the executive committee.

The following concerns were represented:

New York Edison Company.—T. E. Murray, J. W. Lieb, Jr., A. Williams, C. W. Rice, R. A. Carter, H. M. Edwards, P. Torchio.

Boston Edison Company.—A. S. Knight, R. S. Hale, W. H. Atkins, H. D. Kimball.

Atlanta Edison Company.—W. Bloxham, G. W. Brine.

Chicago Edison Company.—S. Insull, L. A. Ferguson, L. Stieringer, O. J. Bushnell, J. F. Gilchrist.

Detroit Edison Company.—J. H. Bissell, A. T. Hunt, A. Dow, H. Post.

St. Paul Edison Company.—H. L. Doherty, H. J. Gille, A. P. Lathrop.

York, Pa., Edison Company.—J. F. Dusman.

Brockton, Mass., Edison Company.—H. T. Edgar, A. W. Leonard.

Williamsport, Pa., Edison Company.—E. H. Davis.

Des Moines Edison Company.—H. W. Darling, R. H. MacMullan.

Buffalo General Electric Company.—C. R. Huntley.

United Electric Light & Power Company, Baltimore.—G. K. Hutchins.

Washington Power Company, Spokane.—D. L. Huntington.

Thos. A. Edison.—Dr. A. E. Kennelly.

Trenton, N. J. Edison Company.—P. Leipke.

Newport Illuminating Company, Newport, R. I.—G. R. Magner.

Philadelphia Electric Company.—J. B. McCall.

Grand Rapids Edison Company.—D. McCoy, A. F. Walker.

Renovo, Pa., Edison Company.—F. M. Noecker.

Erie, Pa., Edison Company.—T. G. O'Dea.

Indianapolis Light & Power Company.—C. C. Perry.

Kansas City Electric Light Company.—R. H. Pierce.

New Bedford, Mass., Edison Company.—C. R. Price, G. R. Stetson, F. Taber.

Rochester Gas & Electric Company.—G. A. Redman.

Tiffin, Ohio, Edison Company.—C. B. Rodgers.

Lamp Testing Bureau.—C. H. Sharp.

Brooklyn Edison Company.—W. W. Freeman.

Altoona, Pa., Edison Company.—E. B. Greene.

Philadelphia Edison Company.—W. H. Johnson, G. R. Green, W. C. L. Eglin, J. D. Israel, J. T. Maxwell.

Columbus, Ohio, Edison Company.—A. W. Field, L. G. White.

Toledo, Ohio, Edison Company.—E. J. Bechtel.

Chattanooga Light & Power Company.—B. T. Burt.

Edison Sault Ste. Marie Company.—W. Chandler.

Cleveland, Ohio, Electric Illuminating Company.—M. E. Turner.

General Electric Company.—W. S. Andrews, I. I. Baker, M. J. Bassett, W. Le Roy Emmet, E. E. Gilbert, E. H. Mullin, C. D. Haskins, W. S. Clark, F. P. Cox, J. P. Felton, H. W. Hillman, J. W. Howell, W. S. Howell, C. T. Hughes, F. M. Kimball, J. R. Lovejoy, A. C. Parsons, A. L. Rohrer, P. F. Sellers, C. P. Steinmetz, B. E. Sunny, F. G. Vaughen, F. W. Willcox, G. L. Thompson, A. G. MacAndrew.

Dr. W. M. Habirshaw was present in the interests of the India Rubber & Gutta Percha Insulating Company.

President McKinley on Telegraphy and Cables.

Last week while Mr. McKinley lay upon his bed of sickness and while hope of recovery was still strong, comment was made in these pages on his references to telegraphy and the Pacific cable, in the address which he delivered at the Pan-American Exposition, the day before his abominable assassination there by a vile anarchist. Those utterances have now a deeply pathetic and historical interest, and we believe that our readers will be glad to have them quoted in full. Mr. McKinley, with no idea that the attack on his own life would be the next confirmation of his remarks, said:

"Isolation is no longer possible or desirable. The same important news is read, though in different languages, the same day in all Christendom. The telegraph keeps us advised of what is occurring everywhere, and the press foreshadows, with more or less accuracy, the plans and purposes of the nations. Market prices of products and of securities are hourly known in every commercial mart, and the investments of the people extend beyond their own national boundaries into the remotest parts of the earth. Vast transactions are conducted and international exchanges are made by the tick of the cable. Every event of interest is immediately bulletined.

"The quick gathering and transmission of news, like rapid transit, are of recent origin, and are only made possible by the genius of the inventor and the courage of the investor. It took a special messenger of the Government, with every facility known at the time for rapid travel, 19 days to go from the city of Washington to New Orleans with a message to General Jackson that the war with England had ceased, and a treaty of peace had been signed. How different now. We reached General Miles in Porto Rico by cable, and he was able, through the military telegraph, to stop his army on the firing line with the message that the United States and Spain had signed a protocol suspending hostilities.

"We knew almost instantly of the first shots fired at Santiago, and the subsequent surrender of the Spanish forces was known at Washington within less than an hour of its consummation. The first ship of Cervera's fleet had hardly emerged from that historic harbor when the fact was flashed to our capital, and the swift destruction that followed was announced immediately through the wonderful medium of telegraphy.

"So accustomed are we to safe and easy communication with distant lands, that its temporary interruption, even in ordinary times, results in loss and inconvenience. We shall never forget the days of anxious waiting and awful suspense when no information was permitted to be sent from Peking, and the diplomatic representatives of the nations in China, cut off from all communication, inside and outside of the walled capital, were surrounded by an angry and misguided mob that threatened their lives, nor the joy that thrilled the world when a single message from the Government of the United States brought, through our Minister, the first news of the safety of the besieged diplomats.

"At the beginning of the nineteenth century there was not a mile of steam railroad on the globe. Now there are enough miles to make its circuit many times. Then there was not a line of electric telegraph, now we have a vast mileage traversing all lands and all seas. God and man have linked the nations together. No nation can longer be indifferent to any other. And as we are brought more and more in touch with each other the less occasion is there for misunderstandings, and the stronger the disposition when we have differences to adjust them in the court of arbitration, which is the noblest forum for the settlement of international disputes."

Mr. McKinley then discussed the expansion of American trade, advocated the cultivation of reciprocity and said:

"We must build the Isthmian Canal, which will unite the two oceans and give a straight line of water communication with the western coasts of Central and South America and Mexico. The construction of a Pacific cable cannot be longer postponed."

CURRENT NEWS AND NOTES.

FILAMENTS FROM REFRACTORY OXIDES.—A most interesting application of the electric arc is described in a patent issued Sept. 10 to Rasmus Anton Nielsen, of Copenhagen, the subject matter being the manufacture of filaments or threads composed of the oxides of such earth or alkaline earth metals as have proven of value for incandescing mantles. The oxide is brought to fusion by the arc and then drawn out mechanically into threads after the manner of spun glass, the threads being subsequently woven into form suitable for the mantles, and if desired further coated with a pulverulent layer of oxides by alternate dipping and firing according to known methods. Certain precautions must be observed in the operation, for if the molten oxide be subjected to the electrolytic effect of the current a separation of metal will occur, the subsequent oxidation of which in use may disrupt the mantle, and if the vapors of the arc be permitted access to the bath some carbide will be formed, with disastrous effect when the mantle is afterward exposed to moist air or to the vapor of water which is always present in the Bunsen flame. The heating means employed is simply the tube furnace of Moissan, an open-ended carbon tube traversing a cavity in a block of lime and heated by an arc formed within the cavity and above and out of contact with the tube. The oxide to be fused is molded into a rod which is placed within the tube, and subjected to a constant longitudinal pull by an appropriate tension device attached to its ends, as, for instance, a cord pasing over a roller and supporting a weight. As the temperature of that portion of the rod nearest the arc approaches the melting point, it softens and the ends of the rod are drawn rapidly apart by the tension mechanism, forming a fine thread of oxide which is then ready for weaving into mantles and such further treatment as is deemed necessary. The method is simply the one which is familiar to every chemist who has "drawn" a glass rod over a Bunsen burner, rendered applicable, through the enormous temperature of the electric furnace, to the most refractory compounds known to chemistry

ELECTRICAL ENGINEERS.—The Chief Examiner, State Civil Service Commission, Albany, N. Y., will receive applications up to Sept. 23, in regard to examinations for positions as electrical engineer ($900 a year, with maintenance), and assistant electrical engineer ($40 to $60 per month, sometimes with maintenance).

BROOKLYN BRIDGE.—It is stated that the report on the condition of the Bridge prepared by Mr. Duryea, as a result of the investigation following the break in the center of the structure last summer, which has been lodged in the District Attorney's office, eliminates, as we predicted, any consideration of electrolysis as a factor, and gives as the cause deterioration due to the excessive weight placed upon the structure. The statement of Mr. Ferdinand W. Roebling brings out the fact that the total load now borne by the Bridge is 5520 tons against a proper load of 1360 tons provided for in the calculations of Colonel Washington A. Roebling, the engineer and constructor of the Bridge.

ELECTRIC-RAILWAY PROJECT AT CARLSBAD.—Consul Mahin, of Reichenberg, reports that an electric street railway company, the Elektrische Strassenbahngesellschaft, has been formed at Carlsbad, Bohemia, and negotiations with supply and construction firms are invited. Carlsbad is as yet devoid of any kind of public conveyance, except cabs and hotel omnibuses, though it has a permanent population of 15,000, to which are added between April and October of every year 40,000 or more sojourners, many of whom are Americans. The city is spread out, along the Tepl River, a distance of several miles, from the railway station to the Posthof, between which points street car communication would prove a great boon to the permanent and sojourning population. Branch lines on side streets leading to the villas and hotels on the adjacent heights would also be practicable.

MANUFACTURE OF ACETYLENE BLACK.—Adolph Frank, of Charlottenburg, Germany, has patented (Sept. 10) a method for the production of finely divided carbon by interaction of an oxide of carbon and a carbide, the latter being either finely powdered carbide of aluminum or calcium, or gaseous acetylene, carbide of hydrogen. A moderate heat, not exceeding 250 degs. C., is sufficient to initiate the reaction, or in the case of the mixed gases an electric spark may be employed. The reactions of the process involve the reduction of the gaseous oxide of carbon by the hydrogen of the acetylene or by the metal of the carbide, the carbon being separated from both reacting bodies in accordance with the equations $C_2H_2 + CO = H_2O + 3C$, and $CaC_2 + CO = CaO + 3C$. If the latter reaction be employed, the carbon may be separated from the lime by elutriation and washing, and is said to form an excellent base for substitutes for Chinese (Indian) ink. The method recalls the proposal advanced by Schmole in 1894 to produce pure carbon by the reduction of carbon monoxide by means of the vapors of magnesium or silicon, and also the more recent suggestions of Hubou for putting into practical use the long-established fact that by the agency of heat, pressure and the electric spark, carbon is readily separated from acetylene and other hydrocarbons.

A NEW TYPE OF ROTARY CONVERTER.—A patent issued Sept. 3 to Messrs. Hutin & Leblanc, of Paris, France, describes an interesting type of rotary converter, the armature of which has no connection with the alternating-current line, and the speed is half that corresponding to the frequency. The converter consists of two distinct fields and two armatures on the same shaft. The winding of one of the fields is connected to the alternating-current line and the other field is excited, as in the case of an ordinary rotary converter, with direct current taken from the direct-current side of the machine. Any conductor of the armature within the alternating-current field is so connected with a conductor of the armature in the direct-current field, that the two conductors lie at an equal angle on opposite sides of a plane of symmetry revolving with the armature. By this method of connection and the use of two fields, the speed of the armature is but half that of a rotary converter of the usual type operating with the same frequency. This reduction in speed follows from the fact that the armature is driven in an opposite direction to that of the rotary field produced in the alternating-current side of the converter. One great advantage of this is that it permits the use of double the number of coils in the armature with a given commutator, or half the number of commutator segments with a given winding, as compared with the ordinary rotary converter. This naturally facilitates commutation and permits of the easy production of direct-current of high potential. Another important advantage is that owing to the method of winding, the armature is fed by as many distinct alternating currents having regularly displaced phases, as there are segments in the commutator, and there can consequently be no variation of flux in the armature sufficient to injuriously affect the commutation. The application of the principle of this converter to single-phase circuits is described, in this case the magnetic screen of squirrel-cage construction of the same inventors being used.

FREQUENCY INDICATOR.—Messrs. C. C. Chesney and W. J. Lloyd, of Pittsfield, Mass., have recently patented a simple frequency indicator for both constant-current and constant-potential circuits. The principle upon which it is based is that in an electric circuit containing a device having capacity or self-induction the amount of energy flowing through the circuit varies with a varying frequency; that is, other things being constant, in a circuit having capacity the amount of energy passing increases as the frequency increases, while in a circuit having self-induction the amount of energy passing decreases as the frequency increases. The changes in frequency produce changes in impedance. Making use of these laws Messrs. Chesney and Lloyd place either a device having capacity, such as a condenser, or a device having self-induction, such as a self-induction coil, in series with an indicating device which preferably is not affected by the frequency alternation—such, for instance, as the well-known hot-wire indicating device. It will be easily seen that if a condenser is placed in series with such an indicating device and the two are connected to a source of electric current it will result that as the frequency increases the volume of current passing through these two devices will increase, and, vice versa, so that the pointer of the indicating device will have a greater deflection for a higher frequency and a lesser deflection for a lower frequency. If the voltage of the constant-potential system varies, the indications of the simple arrangement above referred to will vary for that reason also, and it will be necessary to determine the voltage of the system and calculate what part of the deflection is due to increased frequency and what part is due to change in voltage or to provide means for eliminating the error. This can be done by using either the same or a separate indicating device or by employing a differential arrangement. In the first case means are provided for connecting the indicating device alternately across the mains through suitable resistances and the energy-controlling device, and in the second case an additional indicating device is permanently connected, so as to make the readings easily taken. The necessity for taking these separate readings and making the computation can be avoided by using a differentiating arrangement, whereby the tendency to deflection caused by change in voltage opposes the tendency to deflection caused by the variation in frequency and voltage combined, giving a resultant which shall be the deflection which would be due to change in frequency alone. In the drawings of the patent, one figure shows the combination used for a constant-current circuit; the next, for constant potential; the third, a combination for circuits of variable voltage, of which the next two are modifications; while the sixth figure shows an instrument in which the effect of a varying voltage is automatically compensated for, and which will, in consequence, indicate the frequency without any computation.

Letter to the Editors.

Phosphorus in Incandescent Lamps.

To the Editors of Electrical World and Engineer:

Sirs.—In a recent article on "Electric Lighting," published in Electrical World and Engineer, the writer stated that he had first proposed the use of phosphorus in exhausting incandescent lamps.

This suggestion was first made by the writer in a discussion of a paper before the American Institute of Electrical Engineers. About the same time, some experiments were made in order to give the proposd method a practical test, with good results. Later the results of these tests and of the methods used were communicated to a German chemist connected with a large electric company, and when the method was, about a year later, announced as in use in Germany, it was supposed that its introduction was connected with this episode.

My attention has, however, been called by Mr. John W. Howell, the well known expert in electrical incandescent lighting matters, who has made a special study of the history of the development of the incandescent lamp, to the fact that my statement was erroneous. Mr. Howells has pointed out that two patents were issued in England, in 1882, one to Van Cleve, describing the use of phosphorus pentachloride, the other to Cherrill, describing the use of phosphorus.

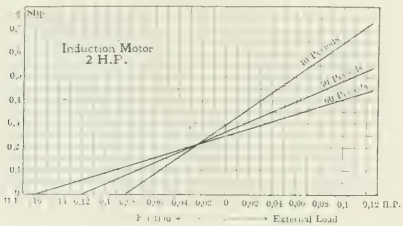
The fact that no reference to either of these patents is made in any part of the literature of the subject with which I am acquainted is the cause of the mistake. Mr. Howells has also pointed out that it is to Malignani that the credit of realizing the full advantages of the use of phosphorus is due, and that he did this in the year 1888 or 1889, though no description was published at the time. My thanks are due to Mr. Howell for putting in my hands the information which enables me to correct the erroneous statement referred to.

WASHINGTON, D. C. REGINALD A. FESSENDEN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Measurement and Calculation of the No-Load Losses of Induction Motors.—BENISCHKE.—An illustrated description of a new method for determining separately the different losses in an induction motor at no load. He makes use of his stroboscopic method for determining the slip (described in the Digest, March 11, 1899; a disk mounted on the axle of the motor is lighted by an arc lamp supplied with the same alternating current as the motor. When the motor runs as a synchronous motor, the disk appears to be at rest in space. For an induction motor the disk appears to rotate at a certain speed which bears a simple relation to the slip of the induction motor). This stroboscopic method for determining the slip is very exact and enables one to determine the slip quite accurately even for a very small load or for no load. For small values of the load the slip is practically proportional to the load, that is, when the values of the slip for different small values of load are plotted diagrammatically, the points in the diagram must be in a straight line. Let this line be prolonged until it cuts the axis of abscissas which represents the load. The distance of this intersection from the zero point of the axis of abscissas, represents the loss due to air friction and to the friction of the bearings. In the adjoining diagram the results of such tests of



NO-LOAD LOSSES OF INDUCTION MOTORS.

a 2-hp motor, are given. It was tested with three different frequencies, 40, 50 and 60. For each frequency the slip was determined for no load and for two small values of the load. These three values of the slip, when plotted in the diagram, were found to be in a straight line. In this way the three straight lines for the three different frequencies were obtained. It will be seen that the friction was thus found to be 0.084, 0.121 and 0.160 horse-power for 40, 50 and 60 periods, respectively. The friction increases with increasing frequency. In this motor the slip at no load is the smaller the greater the frequency, it is 0.25 and 0.3 per cent for 60 and 40 periods, respectively. In another motor the slip at no load was found to be independent of the frequency. When the friction of the motor has been determined in this way, and when the consumption of watts at no load has also been measured, the difference of these values gives the iron loss. He gives the results of tests made by this method and discusses at some length the reasons why other methods have given wrong results.—*Elek. Zeit.*, Aug. 29.

Twenty-two Thousand-Ampere Alternator.—A note on three single-phase alternators which have been made by the Mediterranean Thomson-Houston Company for a large Italian calcium carbide plant. The alternators are driven by turbines. Each alternator supplies four furnaces in parallel. The alternators have a stationary armature and 12 poles, the capacity being 1000 kilowatts. The normal tension is 45 volts. At normal non-inductive load they give 22,000 amperes, and at inductive load, with a power factor of 0.8, they give 28,000 amperes. The armature has two windings, which can be connected in parallel or in series, to give either 45 volts or 90 volts. A single 50-kw, four-pole, 125-volt dynamo gives the exciting current for all three alternators and the lighting current for the plant. For measuring the currents, specially designed transformers are used, the coefficient of transformation being 700 to 1. The primary winding through which the total current of the alternator flows, is formed of bars of copper, and the secondary windings are wound on a laminated iron ring which surrounds the bars of the primary circuit.—*L'Ind. Elec.*, Aug. 10.

REFERENCE.

Construction of Alternators.—LASCHE.—A continuation of his well illustrated serial on the construction and systematic manufacture of alternators. He gives the theory of the tie work and discusses the economical importance of the stiffening system.—*Eng'ing*, Aug. 30.

POWER.

Brake-Releasing Electromagnets.—A note on the construction of electromagnets used for releasing the mechanical brake of electrically driven cranes. Such electromagnets were originally wound for connection in series with the motor. This arrangement worked well, as the starting current of the motor was always sufficient to ensure the action of the magnet as long as the old pattern cranes, with worm gearing and very slow hoisting speed, were in use. With the latest improvements in modern cranes, the gearing is so perfect that it is put in motion by the load alone, and there must therefore come a time when the motor current is zero. At this moment a series-wound brake-releasing electromagnet would cause a sudden and inconvenient stopping of the gear, and the use of such winding has therefore become impracticable. A compound winding was tried, but found unsatisfactory as either the pull of the magnet was insufficient, or the shunt winding was burned out. The "Helios" shunt-wound electromgnet is claimed to overcome all these difficulties, and to have the advantages of a very great pull and a long stroke. The chief feature in this new construction of brake-releasing magnet is the use of a small switch fixed to the magnet, which short-circuits a resistance, placed in series with the magnet windings, as long as the magnet is inactive. When the magnet is brought into use, the switch is opened at the last part of the stroke-movement, and the resistance inserted in the circuit, so that the current in the magnet winding is greatly reduced. The use of this switch is based on the well-known fact that the exciting current required by an electromagnet to retain its load is far smaller than that required to attract the same load from a distance. Besides the resistance, just mentioned, there is another placed in parallel with the magnet winding to destroy the induction current at switching off. The consumption of energy by this type of brake-releasing magnet is from 200 to 300 watts. The movement of the magnet core is damped by air-cushioning at either end.—Lond. *Elec.*, Aug. 30.

REFERENCE.

Wave Motors.—WALSH.—An article on experiments which have been made by the United States Lighthouse Board with wave motors, the principal object being to generate electrical energy for buoy lighting and for lighting the lamps in the lighthouses. No details of the wave motors are given, and it appears that the experiments have not been very successful so far.—*West. Elec.*, Sept. 7.

Traction.

Storage Battery Line in New York.—An illustrated description of what is said to be the only line running storage battery cars in America. It is in New York City, and has a length of 2¼ miles double track. Current is obtained from three 300-kw generators, driven by direct-connected induction motors operated from the 6600-volt three-phase mains of the company. The batteries are moved from the cars to the charging stations by a hoisting and transfer car, operated entirely by electric motors. The batteries are stood along both sides of a long pit on which this car runs, and the transfer to the hoisting car and on to the truck is done entirely by machinery. The battery for each car consists of 72 cells, each cell having five negative and four positive plates. The negative plates are of the chloride type. The positives are made up of spirals of prepared lead ribbon, crimped, and held in place in the supporting lead plate. By the aid of the two boosting batteries there are three charging voltages which can be taken from separate bus-bars on the switchboard. These are 164, 174 and 180 volts, respectively. The battery connections are changed from one bar to the other at the switchboard by signals sent by the operator in the charging room. The practice is to charge on the low voltage until the battery takes 60 amperes, then change to the intermediate until 75 amperes are reached, then to the high bar until the battery is charged. The speed of the cars is changed by series-parallel control of both batteries and motors. The cars have been running about nine months, and at present 46 are used during the hours of greater traffic.—*St. R'y Jour.*, Aug. 31, and Int. Ed., Sept.

Comparison of Electric Traction and Steam Traction.—Cserhati.—Former comparisons of the relative merits of electric traction and steam traction have generally been based upon the assumption that direct current is used for the electric traction. He remarks that no direct-current system has so far been able to solve the problem of electric traction on main railways, but thinks that this problem will be satisfactorily solved by the three-phase alternating-current system with high-tension transmission and stationary transformers along the line. He thinks that the natural development will be that the steam locomotive will be replaced by the electric locomotive. He assumes for his comparison that the dynamos generating the electrical energy are driven by steam engines. The results of his comparison are greatly in favor of electric traction which, he finds, has the following advantages: Saving of fuel of at least 25 per cent; smaller weight of the electrical locomotive; possibility of regaining electrical energy when going down grades; saving in the cost of maintenance of the rolling stock and in the item of wages for the attendants; greater safety; possibility of running smaller trains at shorter intervals; possibility of using the present roadbed and track for higher speeds; an easy solution of the problem of electric lighting of the cars; absence of smoke; possibility of utilizing water powers. The only serious objection to the general introduction of electric traction is the high cost of the first installation.—*L'Eclairage Elec.*, July 27.

Norfolk & Atlantic Terminal Railway.—A long and well illustrated description of this line which does a passenger as well as a large freight business. The company is using a novel type of convertible car. The sides of this car can be lowered by means of a windlass, and it then is very similar to a closed car. When the sides are raised they slip under the roof. Trains of two or more cars each are run, and air brakes are employed on both motor and trail cars. They are operated by the motorman, and are much more satisfactory than when the brakes are operated separately.—*St. R'y Jour.*, Sept. 7, and Int. Ed., Sept.

Block Signal System on the Boston Elevated Railway.—Knowlton.—The main line was put in operation June 10, this year. The running time between the terminals is now 22 minutes in place of 45 or 50 on the surface, and trains have frequently made the run in less than 19 minutes, making the stops, and 16 minutes omitting the stops. There are many grades, some being 6 per cent, and several curves as sharp as 90 ft. radius. The signals are operated by compressed air, and are moved automatically by the cars. Small engravings show the local arrangement of signals at different points. A table gives a typical running time of one train.—*St. R'y Jour.*, Sept. 7, and Int. Ed., Sept.

Aeronautics and Electricity.—Hospitalier.—An article in which he first points out that a balloon, capable of being steered, cannot be realized. At its best, a successful trip can be made only in exceptionally good weather. On the other hand, it is still impossible to say whether a flying machine based upon the principle upon which the birds fly, can be realized. To decide whether such a machine is possible in practice one would have to begin an extended systematic study in the laboratory of the form and arrangement of the wings, the power required, etc., but there is no glory in such an investigation. Before these points have been carefully investigated, it is useless to construct motors for this purpose. The electric motor seems practical, as it can be made to have a light weight. The source of electric power would be on earth and the flying machine would have to be connected with it by light wires.—*L'Ind. Elec.*, Aug. 10.

REFERENCES.

Methods of Safety for the Overhead Trolley System.—Manville.—An illustrated paper in which he first discusses the precautions to be taken to ensure solid construction. He then discusses the regulations of the British Post Office authorities regarding the arrangement of guard wires for the protection of telegraph and telephone wires. Should a trolley wire break or should telegraph or telephone wires come in contact with the live trolley wire it is essential that means should be provided for immediately rendering that particular section of the trolley wire inoperative by automatically disconnecting it from the generator. Means for this purpose are described.—Lond. *Elec. Eng.*, Aug. 30.

How to Make Non-Paying Roads Pay.—Cooper.—A continuation of his long serial. He continues the subject of standardization in this issue, and speaks first of the importance of ordering all car repair parts for a standard size. He then refers to the necessity of determining the point of ultimate wear for different apparatus, and cites as an example the journal bearings of a car. He also comments on the importance of frequent inspection of all parts.—*St. R'y Jour.*, Sept. 7, and Int. Ed., Sept.

Installations, Systems and Appliances.

110 vs. 220-Volt Installations.—Wikander.—A reply to the communication of Mueller (Digest, Aug. 24), who had spoken strongly against installations with 220-volt at the consumers' terminal. The present author remarks that the saving in the line construction is not the only advantage of the higher voltage. Other advantages are that the same dynamos can furnish current for lighting and traction and that one is less restricted in the choice of the site of the generating station. For the existing 2 × 110 volt installations with insulated middle wire, it would doubtless be an advantage to make necessary extensions of the distributing network with bare middle wire, in order to save cost.—*Elek. Zeit.*, Aug. 1.

REFERENCE.

Warren.—An illustrated article on the reconstruction of the water and electric lighting station at Warren, Ohio.—*Eng. News*, Sept. 5.

Electro-Physics and Magnetism.

Magnetic Effect of Electric Convection.—Wilson.—A reply to Cremieu's criticism, recently noticed in the Digest. He maintains that his objections to Cremieu's earlier experiments hold good, and adds a remark on Cremieu's recent experiment which was supposed to prove conclusively the existence of "open currents." As has been noticed before, in this experiment a disk of ebonite 2.5 mm. thick carrying sectors on one side was rotated rapidly. Near the other side of the disk a charged metal sector was placed so as to induce charges on the sectors as they passed by it. The motion of these induced charges constituted the "open" part of the current; the charged sector was 2.5 mm. distant from the disk, and its potential was about 115 electrostatic units. The present author remarks that this potential is sufficient to produce a spark 1 cm. long, so that, of course, a brush discharge would occur to the ebonite, so that it would get a charge on the side next the fixed sector equal and opposite to that induced on the moving sectors; consequently, the total charge on the disk would be zero, and so no magnetic field would be produced.—*Phil. Mag.*, Sept.

Spark Discharge.—Guggenheimer.—A note on the spark-discharge in gases relating to a recent discussion between Swyngedauw and Warburg. The present author's results confirm the views of Warburg. A comparison of the results of experiments, undertaken from different standpoints, shows that the e. m. f. per cm. which is required to give to the negative ions a velocity such that they can produce new ions by collisions with the molecules of the gas, is very nearly the same as the e. m. f. required to produce spark-discharge in the gas at the same pressure, and with the electrodes at the

distance of 1 cm. This is, for instance, proven for air at atmospheric pressure. Starting from the supposition that air at atmospheric pressure always contains ions, and that ions are continuously produced, he develops the following idea of what happens before a spark passes. If one subjects two electrodes to slowly increasing e. m. f.'s, there will be formed immediately a very feeble current, as observed by Warburg and others. This current will, so long as no external agents are acting, remain constant within very wide ranges of the e. m. f., but its intensity will increase very quickly and tend to a maximum, as soon as the e. m. f. attains the value necessary to give to the ions the velocity required to produce new ions by impact. He therefore gives the following new definition of Maxwell's "electric strength" of a gas at a certain pressure. It is "the electric intensity required to give to the negative ions a velocity sufficient to enable them to produce other ions by collisions with the molecules of the gas." The spark itself appears to amount practically to a short circuit between the electrodes.—*Phil. Mag.*, Sept.

Resistance of Bismuth to Alternating Currents.—SIMPSON.—An anomalous property of bismuth is the change which the resistance of a filament undergoes when placed perpendicular to the lines of force in a strong magnetic field. Not only does its resistance increase very much, but with alternating currents under these conditions it is apparently different from the resistance to direct currents. He experimented with a bismuth spiral, having a resistance of 17.88 ohms at 21 degs. C. in zero field, which was placed perpendicular to the field produced by a large electromagnet, the field strength being 17,000 gauss (lines per square cm.), so that the resistance of the bismuth in the field was double its value outside. He investigated the resistance of the bismuth to alternating currents of a frequency varying between 10 and 60 p. p. s. He found that with a frequency of 20 an effect was produced which may be represented by an alternating e. m. f. in the bismuth 120 degs. behind the current. A similar "bismuth e. m. f." is obtained with other frequencies, but of different magnitude and phase. Empirical formulas are given for the magnitude and phase of this "bismuth e. m. f." for any frequency between 10 and 60.—*Phil. Mag.*, Sept.

Oscillating Discharges Through Divided Inductive Circuits.—MIGUNO.—A mathematical article in which he reaches the following conclusions. In general, when a charged condenser discharges through divided inductive circuits, the current does not take a simple form as in the case of oscillating discharges in a single inductive circuit; but, if the time constants of the divided circuits happen to be equal, then the circuits may be reduced to a single equivalent inductive circuit, giving rise, under a certain special condition, to simple harmonic discharge currents. In this case also the conditions for oscillations in the main and the divided circuits are all the same. Each inductive circuit has its own period of oscillations, whose value is definitely determined by the resistance, the self-inductance and the capacity, at the ends of the circuit; however, by joining inductive circuits of equal time-constants in parallel to a charged condenser, it is possible to reduce the effective capacities of the circuits, thereby causing the latter to have the same period of oscillation.—Lond. *Elec.*, Aug. 30.

Filings Coherers.—ECCLES.—The conclusion of his article, the first part of which was abstracted in the Digest last week. The method described there is called a true quantitative method of investigating the qualities of a coherer, as by the use of this method all the anomalies which have hitherto accompanied the manipulation of a coherer seem to disappear. Coherence is a continuous phenomenon, and there can be no true "critical voltage." Regarding the theory of coherence, he accepts Lodge's view of the coherence phenomenon due to chains of particles welded together; but he thinks that this is only the final action, and that there is a primary, purely mechanical action, namely, the orientation of particles. When a difference of potential, steady or oscillatory, is established between two opposed plane conductors separated by a distance which is small compared with their own magnitude, a fairly uniform electric field is created between them. Any conducting piece of matter, not spherical in shape, moving freely in this field, will experience a couple tending to place it, in general, with its longest axis parallel to the field. Other particles present will be similarly acted upon, and if they come to rest while the electric field is maintained, they may be expected to exhibit distinct orientation. In this state the process of chain forming by welding is easier than when the arrangement of the particles is fortuitous. The phenomenon of coherence has therefore two subsequent stages: The mechanical orientation of the particles and the formation of chains by weldings. Both actions are dependent upon the applied e. m. f. The article is discussed in a separate editorial. It is said that while Eccles' theory explains many observations made with filings coherers, there are others which do not seem to be explained, for instance, the action of "anti-coherers."—Lond. *Elec.*, Aug. 30.

REFERENCES.

Specific Inductive Capacity of Dielectrics.—LADENBURG.—An account of measurements of the specific inductive capacity of certain organic compounds by Drude's method. The results show that there is a relation between the specific inductive capacity and the chemical constitution of the compound.—*Zeit. f. Electrochemie*, Aug. 8.

Induction Coil.—EHNERT.—An article, illustrated by diagrams, on the calculation of the coefficient of self-induction of induction coils without iron.—*Elek. Anz.*, July 21.

Top Factor.—LA COUR and BENISCHKE.—Two communications continuing the controversy regarding Benischke's "top factor" (Digest, Sept. 8, 1900, and Aug. 24, 1901). It appears that Benischke's theory is correct.—*Elek. Zeit.*, Aug. 1, 22.

Resistance of Selenium.—GILTAY.—An illustrated description of apparatus for demonstrating the effect of light upon a selenium cell, by means of the telephone.—*Phys. Zeit.*, Aug. 24.

Speaking Arc.—RUHMER.—An illustrated description of apparatus for the demonstration of Simon's and Duddell's experiments with the speaking arc.—*Phys. Zeit.*, Aug. 31.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon Electrodes.—FOERSTER.—An account of an investigation of the influence of carbon anodes upon the process of the electrolysis of alkali solutions, especially of common salt. The anodes are attacked in a double way—by oxidation and by mechanical destruction. The results of measurements made with 10 different kinds of carbon, are given in a table. The graphite carbons are much superior to the amorphous carbons. The porosity is also of importance. The greater the porosity the quicker the destruction of the carbon anode. —*Zeit. f. ang. Chemie*, 14, p. 647; abstracted in *Zeit. f. Elektrochemie*, Aug. 8.

Gas Battery.—BOSE.—A brief paper on the reactions in gas batteries. He deals with the hydrogen-oxygen battery, and the hydrogen-chlorine battery, the first being obtained with platinum electrodes in sulphuric acid or in an alkaline solution, the second with platinum electrodes in a hydro-chloric acid solution. The reaction at the hydrogen electrode is simple, while at the oxygen electrode and on the chlorine electrode there are complications due to secondary reactions. At the chlorine electrode, for instance, the chlorine gas reacts with the water with the result that hydrochloric acid and hypochlorous acid are formed. The reaction at the oxygen electrode is still more complicated and not yet fully explained.—*Zeit. f. Elektrochemie*, Aug. 8.

Ferro-Silicium.—MORRIS.—He gives a brief review of the subject of the silicides of iron. The density decreases as the percentage of silicon increases, and the hardness increases as well as the fusion temperature, the range being from 1130 to 1400 degs. C. The ferro-siliciums, poor in silicon, are magnetic, but the magnetic permeability ceases when the percentage of iron no longer exceeds that of the silicon. The magnetic power can be taken advantage of to estimate roughly the composition of ferro-siliciums. He then discusses the manufacture of ferro-siliciums in the electric furnace.—*The Elec. Chem. and Met.*, Aug.

British Electro-Chemical Society.—BOUSFIELD.—Some remarks on the possibilities of the formation of a British Electro-Chemical Society, after the manner of the Inst. of Elec. Eng. He thinks that the time has not yet come for the formation of such a society, as electrochemistry hardly exists in Great Britain as an industry. Editorially it is suggested that the Society of Chem. Ind. and the Inst. Elec. Eng. should combine together in some way, for instance, by means of a special committee on electro-chemistry common to both.

REFERENCES.

Cells with Fused Electrolytes.—SUCHY.—An account of measurements of the e. m. f. and temperature coefficient of a number of cells made up of fused electrolytes, for instance, the following which is of the type of the Daniell cell: Lead, chloride of lead, chloride of silver, silver. The chief result obtained is the perfect analogy which was found to exist between Daniell cells of fused metals and salts

and those of water solutions and solid metals.—*Zeit. f. amorg. Chem.*, v. 27, p. 152; abstracted in *The Elec. Chem. and Met.*, Aug.

Transport Numbers and Constitution.—RIEGER.—According to Hittorf, the measurement of the transport numbers enables one to determine the chemical constitution of compounds, for instance, to determine the nature of the ions. He applies this method to an investigation of certain complex salts. The method of his measurements is described and the results for potassium copper sulphate are given.—*Zeit. f. Elektrochemie*, Aug. 29.

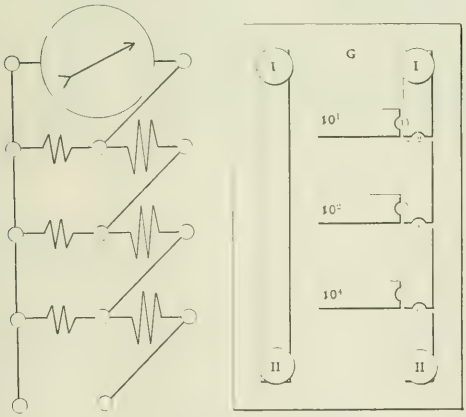
Reaction Velocity.—SIEGRIST.—A study of the velocity of electrolytic reactions. He investigated the velocity of the electrolytic deposition of copper in the presence of sulphuric acid.—*Zeit. f. amorg. Chemie*, v. 26, p. 273; abstracted in *The Elec. Chem. and Met.*, Aug.

Reduction of Nitrites.—SULER.—A long paper giving an account of an experimental investigation of the electrolytic reduction of nitrites. The paper is of interest chiefly to chemists.—*Zeit. f. Elektrochemie*, Aug. 15, 22.

Estimation of Copper in Pyrites.—HEIDENREICH.—A description of a quick and exact method for the quantitative estimation of copper in pyrites by precipitation with aluminum and electrolysis.—*Zeit. f. anal. Chem.*, v. 40, p. 15; abstracted in *The Elec. Chem. and Met.*, Aug.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Galvanometer Shunt.—VOLKMANN.—For altering the sensibility of a sensitive galvanometer, shunts are used which have a resistance equal to a certain fraction of the resistance of the galvanometer. When such a shunt is connected in parallel with the galvanometer, the joint resistance of galvanometer and shunt is smaller than that of the galvanometer alone. By adding a proper series resistance it can be accomplished that the whole arrangement has the same resistance as the galvanometer alone. To get a great increase of the range of the instrument, a larger number of shunts and series resistances is needed. He describes an arrangement which enables one to obtain with n shunts and series resistances the same number of changes of the range of the instrument, for which otherwise $2^n - 1$ are needed. His arrangement is illustrated in the adjoining diagram 1, in which the thick zig-zag lines represent the shunts, while the thin zig-zag lines represent the series resistances. Let the three shunts be 1-9, 1-99, 1-9999, and the three series resistances 9-10, 99-100, 9999-10,000 the value of the galvanometer resistance, then it will be seen that the following seven different combinations are possible with the three sets of shunts and series resistances: Either the first shunt and series resistance alone, or the second ones alone, or the third ones alone, or the first and second together, or the first and third together, or the second and third together, or all three together. This arrangement becomes very practical and easy with the use of a resistance box, as shown in Fig. 2. At the two points *I* the connections are made to the galvanometer. When plugs are inserted in the openings 2, 4, 6, the series resistances 9-10, 99-100, 9999-10,000 are short circuited. Below the numbers 10^{-1}, 10^{-2}, 10^{-4} in the figure, there are the shunts 1-9, 1-99, 1-9999. They are traversed by the current when plugs are inserted in the openings 1, 3, 5. There are altogether three plugs, the first to be inserted in 1 or 2, the second in 3 or 4, the third in 5 or 6. It will then be seen that with plugs in 2, 4, 6, the sensibility is 1; with plugs in 1, 4, 6, the sensibility is 0.1; with plugs in 2, 3, 6, it is 0.01; with plugs in 1, 3, 6, it is 0.001; with plugs in 2, 4, 5, it is 0.0001; with plugs in 1, 4, 5, it is 0.00001; with plugs in 2, 3, 5, it is 0.000001; with plugs in 1, 3, 5, it is 0.0000001. In all seven cases the joint resistance of galvanometer, shunts and series resistances between terminals II, II is equal to the resistance of the galvanometer alone.—*Elek. Zeit.*, Aug. 15.



FIGS. 1 AND 2.—GALVANOMETER SHUNT.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Cable Recorder.—JAULIN.—A description of an invention of Ader. The currents pass through a fine, long, copper wire of 0.02 mm. diameter, weighing 1 mg., placed vertically between the poles of a strong permanent magnet. The wire undergoes displacement at its center, on one side or the other, according to the direction of the current, its vertical position of rest being assured by the wire being under tension. This force can be regulated by a stretched silk thread acted upon by a weight. The wire is in a very narrow space between poles of not more than 0.5 mm. in breadth. The sensibility of this receiver is such that signals are produced by a current of one-third of a microampere. It is actuated by feebler currents and more quickly than the siphon recorder. A light shines through an orifice in one polar piece on to the middle of the wire, and through a slit in the other polar piece, the shadow of the wire being thrown upon sensitized paper. To emphasize this shadow, the wire has a little sheath of very light feather pith. A small motor actuates the tape. The inventor claims, by trial made on an Atlantic cable in 1896, that the transmission was 60 per cent faster than with the siphon recorder.—*Jour. Tel.*, June; abstracted in *Science Abstracts*, Aug.

REFERENCES.

Wireless Telegraphy.—RUHMER.—A brief illustrated account of some preliminary experiments made by him with the object of using the telephone as a receiver in wireless telegraphy. The experiments appear to have been successful.—*Phys. Zeit.*, Aug. 24.

Trans-African Telegraph.—An abstract from a recent report of the British South Africa Company. The company has carried the line up to the southern shore of Lake Tanganyka, and thence into German territory, the total length erected during the year being 325 miles. The great difficulties met with in the erection of the line are described.—*Eng'ing*, Aug. 30.

Telegraph Offices.—An illustrated description of the new Postal Telegraph offices in Cleveland and Denver.—*West. Elec.*, Sept. 7.

Munich.—The first part of a long illustrated description of the new telephone exchange at Munich, Germany.—Lond. *Elec.*, Aug. 20.

MISCELLANEOUS.

Arc Furnace for Making Glass.—BERMBACH.—A long paper, read before the Electro-Technical Society, of Cologne, on the use of arc furnaces for making aluminum, calcium carbide and glass. He gives the thermochemical data for the production of calcium carbide and aluminum and discusses the use of arc furnaces for this purpose. He thinks that the present crisis in the calcium carbide industry will cause many plants to undertake the making of glass. Several electric furnaces have been devised for this purpose, one of which is described as follows: The finely divided raw material (a mixture of silicium oxide, sodium carbonate and calcium oxide) drops from a funnel on an inclined plane, at the lower end of which the material is fused by means of two horizontal electric arcs. The fused glass which still contains some raw material then flows into a lower room where it is acted upon by another electric arc and then flows into a basin. Although fused glass is electrolyzed by direct current, it is possible to arrange the furnace in such a way that it can be operated with direct current.—*Elek. Zeit.*, Aug. 1.

Smelting of Iron Electrically.—SIMPSON.—A communication in which he takes exception to the estimate in an older article (Digest, May 25) in which the conclusion had been reached that an electrical process for smelting iron cannot be economical. He claims that this conclusion is wrong, as it is based upon the assumption that electrical power is worth anywhere from $20 upwards per horse-power-year. He says there are cases where electric power can be developed for $10 or less per horse-power-year, and claims that if iron mines and limestones are nearby steel could be produced cheaper by electric

smelting than by the old process, if a suitable electric furnace is used. In an editorial note it is said that while some figures might be changed in the original article, the former conclusion is correct that there is no possibility of an electric process competing successfully with the blast furnace.—*Eng. News*, Aug. 22. Another communication by Simpson, in which he maintains his position, in *Eng. News*, Sept. 5.

REFERENCES.

Magnetic and Electric Separators.—An article on some recent developments in magnetic and electric separators. The Wetherill magnetic separator is now being used successfully for treating the tailings of the dressing works at Broken Hill containing a mixture of galena, blende and garnet. At Lohmannsfeld, Germany, Wetherill apparatus are in successful use for treating an ore containing galena, siderite, blende and quartz. Edison's improved form of magnetic separator and Sutton and Steele's new form of electric separator are also noticed.—*The Elec. Chem. and Met.*, Aug.

Discharging Torpedoes by Electricity.—An illustrated description of the methods used on torpedo boats in directing the course of a torpedo and in firing the torpedo.—Lond. *Elec. Rev.*, Aug. 30.

Manufacturing Plant.—An illustrated description of the machine factory of the Gen. Elec. Co., of Berlin.—Lond. *Elec.*, Aug. 30.

Berlin Exposition.—RUHMER.—An illustrated description of the electrical apparatus exhibited at the present Berlin exhibition of fire protection and life-saving apparatus. The apparatus described are several systems of fire alarms, a telephone switchboard and several lamps, among them the Nernst lamp and the Regina arc lamp.—*Phys. Zeit.*, July 27, Aug. 3.

Glasgow Exhibition.—Brief illustrated descriptions of a Bellis-Peebles steam generating set, some direct-current motors exhibited by Peebles & Co., and an Evans electrically-driven ram pump.—Lond. *Elec.*, Aug. 30.

New Books.

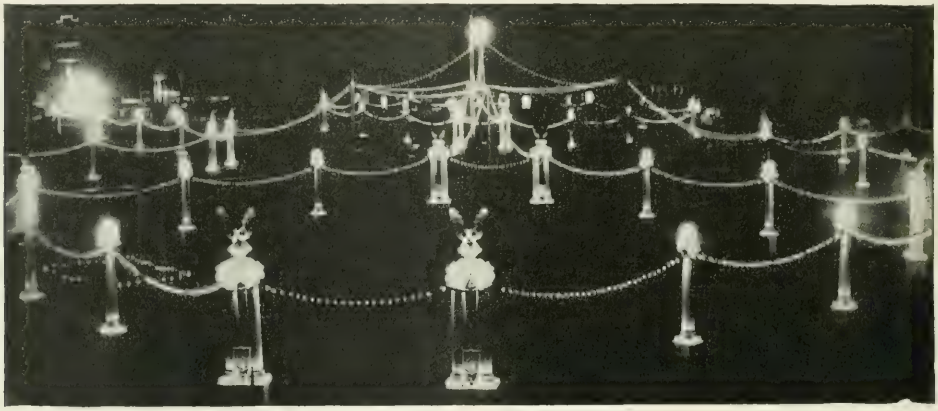
TUGMAN'S INDEX TO THE MANUFACTURERS OF THE UNITED STATES. Vol. I., Pennsylvania. Second Edition. The Tugman Company, Philadelphia, Pa. Cloth, 6 inches by 9 inches, pp. 648.

This index, which has been compiled for reference in the domestic and foreign trade, is without doubt the most complete and comprehensive work of its kind ever published. It lists nearly 10,000 lines of manufacture, and the completeness with which references are made is indicated by the fact that in the present large volume the names of only Pennsylvania firms are given. Other States will be taken up in later volumes. The name of each firm is followed by a number of symbols, indicating the firm's capital, whether or not it has a foreign office, and connections, and other matters of interest to foreign and domestic buyers.

This is probably the only work of its kind which affords the buyer abroad an opportunity to make an impartial selection of the firms who are in the best position to undertake the execution of large orders and who are accustomed to ship goods for export. The book has been placed on file with all United States consuls and boards of trade in foreign cities, and has also been supplied free to the leading commercial firms abroad. The lines of manufacture are given in English, French, German, Spanish and Portuguese, and are arranged alphabetically according to the English language. Indexes in the remaining tongues are added. A complete list of cable addresses is given and a list of the banks and lawyers in each town. The work has been compiled with great care and impartiality. The different firms were invited to submit a list of all the lines of manufacture in which they were engaged, and the entries were made accordingly and free of charge, the work depending entirely upon its advertisements and subscriptions for support. The present edition comprises 25,000 copies, which are being circulated widely and judiciously. The scope and completeness of the Index should make it eminently valuable in both the foreign and the domestic trade.

G. A. R. Electrical Display in Cleveland.

The electrical displays in Cleveland during the encampment of the Grand Army of the Republic last week were among the most attractive features of the event, and it was generally conceded by all the visitors and G. A. R. veterans that they were the finest ever arranged for a similar affair. The main group of decorations were those which adorned the Public Square in the center of the city. The four divisions of the Square were surrounded by wood and plaster pillars in imitation of marble. There were two large columns at each of the four corners of the four divisions, these being surmounted by huge eagles. The central columns were smaller and were topped with spheres. The smaller columns were ornamental, with about 100 incandescents each, while the larger ones had double that number. In the center of the Square, 50 ft. in the air, was suspended a huge sphere made up of 450 incandescents. Below this, in the form of a square, were suspended 24 emblems in various colored incandescents, representing the badges of the various G. A. R. corps. Streamers of incandescents ran from the center to the various corners, and when illuminated the whole effect was dazzling and beautiful. The plain incandescents on the columns and in the streamers numbered 1300 of 8 candle-power each, while the corps badges were made up of 1500 lamps of 5 candle-power each. The general plan and columns were designed by Hubbel & Benes, leading Cleveland architects, while the electrical work was done by the Dainz Electrical Company, under the general supervision of George S. Trippe, of the Cleveland Electrical Illuminating Company, which furnished the current. The wiring was all on the three-wire system, and all wires were concealed, those in the streamers being covered with evergreen festoons, while the column wires were all inside. All of the feed wires were also underground, the main feed wires coming from the Illuminating Company's conduits and entering the columns from below. There were 16 switching points, switchboards being placed in each of the main columns, each providing for the lights



G. A. R. ILLUMINATIONS, PUBLIC SQUARE, CLEVELAND, OHIO.

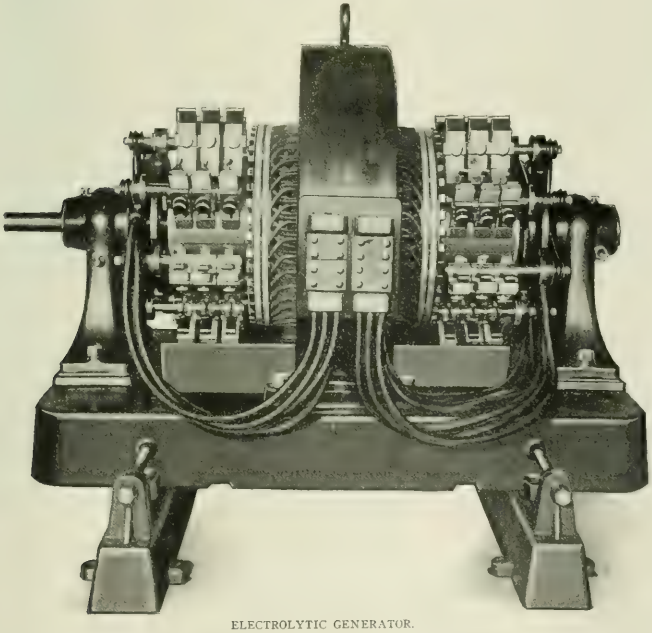
in its immediate vicinity. The entire decoration cost $15,000, the illuminations coming to about one-half that figure.

As soon as possible after the announcement of the death of President McKinley, the white columns were draped with black crepe. Several of the larger buildings surrounding the Public Square had special electrical displays for the occasion, while a number of large advertising signs added to the illumination at this point. The Society for Savings Building, a 10-story office building, presented a very pleasing effect. It was draped from top to bottom with red, white and blue incandescent streamers, while in the center of the building was a huge electrical revolving star. The May Company had incandescent streamers running to the top of its nine-story tower, while the fronts of both of its stores were handsomely decorated. All of the current in the downtown section was furnished by the Cleveland Electric Illuminating Company, and its machinery was severely taxed by the unusual loads. The Public Square decorations alone consumed over 400 kilowatts.

In installing the electrical work on the Public Square a peculiar accident occurred to P. L. McNerney, manager of the Dainz Electric Company, which did the wiring. The contract called for the completion of the work at 9 o'clock Saturday evening, Sept. 7. At 8.55 Mr. McNerney was engaged in screwing the last incandescent into the huge ball suspended above the center of the Square when a 50-ft. ladder broke beneath him. As it broke, he leaped and caught a trolley wire below him and then dropped to the ground. In dropping, however, he broke his arm. The lights were turned on exactly on time.

A New Electrolytic Generator.

The refinement or reduction of metals by electrolytic action is being carried on with very marked success in many of the mining communities throughout the world. The result has been a growing demand for an electric generator of relatively low voltage but enormous current output. The Holtzer-Cabot Electric Company, of Boston, Mass., has supplemented its line of platers with some larger generators designed more particularly for this class of work. The accompanying cut shows a generator of a capacity of 3000 amperes at an e. m. f. of from 4 to 8 volts. The machine shown is one of a pair recently built for the Imperial Ore Reduction Company, of Boston, to be used for refining purposes at their copper mines at El Paso, Tex.



ELECTROLYTIC GENERATOR.

In designing machines of this nature two unusual problems present themselves. The first is a prevention of abnormal losses due to the heating effects of the current, or C^2R losses, as they are technically called, and the second is the commutation of the enormous quantity of current. In the machine represented, the first of these problems has been solved by careful attention to ventilation and generous allowances in point of copper and iron. The second difficulty has been overcome by the use of a double armature winding with two commutators and a special conformation of field.

The field ring is of cast iron, and the poles, eight in number, are of wrought iron, cast welded into the ring, making an excellent form of magnetic joint. The poles are fitted with a special form of shoe of cast iron selected on account of its low permeability. It is saturated at the normal induction of the field, and so helps to prevent the field flux from becoming distorted by cross magnetization in the armature.

The armature core is relatively of quite a large diameter, and is built up of thin disks of soft steel, painted on either side to break up eddy currents. It is mounted upon a spider, the laminations being clamped in a special manner by end plates, doing away with bolts running lengthways through the body of the core, thus preventing local currents and reducing magnetic hysteresis. The spider is provided with a threaded projection which holds the commutator in such a way as to leave an opening between the shaft and the commutator in front. Air ducts are provided in the core, and the air, being drawn into the body of the core and thrown out centrifugally through the ducts and winding serves to keep the armature cool, notwithstanding the great quantity of current flowing. The cylindrical form of winding is used, making the armature resistance low and permitting of the replacing of a damaged coil without much difficulty. The coils are of bar copper and entirely without joint except where they are soldered to the risers of the commutator.

The commutators are of massive construction. They are made up of hard rolled copper segments, soft mica being used for insulation, and are clamped by bolts in such a way as to prevent entirely shifting of the segments. The section of the copper segments was made unusually large, to take care of heat generated by the flow of the current and the friction of the brushes, and at the same time allow plenty of wear.

The brush holder is designed especially for carrying a heavy current. It is of the tangent type, and clamps the brush with a heavy thumb screw. There is a continuous metallic circuit from the portion of the holder carrying the brush to the part clamping the stud, so that no movable or sliding contacts are depended on to carry current.

These machines are separately excited at 110 volts, and owing to the special shape of the pole shoes are able to deliver any load from 0 to 3000 amperes without its being necessary to change the position of the brushes, the diameter of commutation remaining practically fixed for these ranges of load. They are designed to be belted and run at 450 r. p. m., the speed being made purposely low to do away with as much of the friction loss as possible, and also to prevent the brushes from cutting the commutator, a difficulty often encountered in high-speed machines of this type. The two halves of the armature deliver their outputs in parallel to the terminal blocks at the full voltage of the machine. These machines will be connected in such a way that they may work separately or in multiple, giving a total output of 6000 amperes at an e. m. f. ranging from 4 to 8 volts.

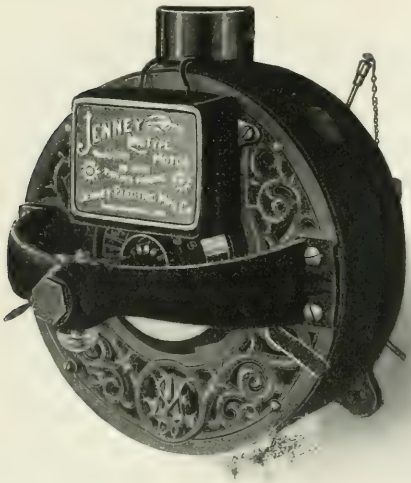
Jenney Linotype Motor.

The introduction of electricity into the printing office has opened up an inviting and profitable field for electric motors and appliances, and has resulted in a complete transformation of working conditions. The "Linotype" machine is one of the most important elements in the equipment of a newspaper or printing establishment, and consequently an economical and satisfactory drive for this machine is one of the living problems confronting the mechanical man of such a plant.

It has been the general practice to drive the linotypes from a counter-shaft, but this is open to all the objections of belting and shaft-

ing. One of the wasteful features in driving from a line-shaft is that the shaft with its driving motor, as well as the belts on loose pulleys, are in operation when but one or two linotypes are in service. When the machines are driven with individual motors they may be located in the most convenient place for light, or to economize in space, and can be moved without effecting the driving process. In order to reduce the disadvantages of driving by belt to a minimum, it has been the practice in many composing rooms to locate the linotypes on an elevated floor to provide room for driving a shaft under the said floor. The use of individual motors overcomes the necessity for such additional expense.

In order to meet the demand for an individual motor, the Jenney Electric Manufacturing Company, of Indianapolis, Ind., is making a 110 and 220-volt direct-current motor, to be mounted upon and geared to the linotype machine. The motor virtually becomes a part of the machine, making the combination a unit in itself, dependent upon nothing except the supply of current. The breaking or slippage of belts, hot boxes or other minor accidents which are liable to shut down the entire linotype plant are entirely avoided. Not only are the machines self-contained, but the regulation of speed is perfect, which is an important feature, as any irregularities in the speed of the linotype is very annoying to the operator. In order to allow for a fine adjustment of speed, there is an auxiliary field winding with five connections to a terminal board on top of the motor. By this



LINOTYPE MOTOR.

means a variation of 10 r. p. m. in the speed of the linotype machine is realized so that the operator can make the fine adjustment to suit conditions.

The motor, as a whole, is very compact and neat in appearance, and its efficiency is said to be all that could be desired, as the energy taken by the motor is only from 90 to 100 watts per hour, or less than that required by two 16-cp incandescent lamps.

The motor is multipolar and entirely enclosed, the field frame being cylindrical, with an ornamental, ventilated front head. The bearings are of phosphor-bronze and self-oiling. Two projecting lugs on the frame are drilled to receive bolts which hold the motor rigidly in place on the linotype frame. These bolts are the ones that hold the cap on main bearings of the machine, and in mounting the motor but one ⅜-inch tap is required.

As can be seen in the accompanying illustration, the gear and pinion are protected by a substantial brass guard. The regulating switch on top of the motor is also protected by a polished brass cap, while the brushes are likewise covered by an ornamental name plate. These features add materially both to the safety and to the appearance of the outfit.

Carbon brushes bear on the commutator with radial bars flush with the front head. The armature consists of form-wound coils placed on a toothed laminated core. The bronze pinion on the motor shaft and gear on the linotype have cut teeth. Every part of these motors is interchangeable and of the best material and workmanship, which accounts in part for the excellent service rendered.

The most prominent of the recent installations of Jenney linotype motors was made at the office of the *Chicago Tribune,* where 43 of these motors have been placed after a competitive test. These motors have also been placed in the offices of the *Indianapolis News, San Francisco Bulletin, Nashville News, Atlanta Constitution, Saginaw Post Zeitung, Dayton News,* and many other prominent newspaper and printing offices throughout the country.

Exhibits at Rochester Street Railway Convention.

At the Rochester meeting last week of the New York State Street Railway Association the local committee added one feature which has proved very popular at meetings of the National Association, but which has never been carried out to any great extent at State conventions. This was an exhibit of street railway supplies, which was most successfully carried out. The main floor of Fitzhugh Hall, the building in which the business sessions of the association were held, was used for this purpose. The hall was tastefully decorated with bunting, and in all some 40 exhibits were presented., in charge of F. D. Russell, of the Rochester Car Wheel Works, and to him and his fellow committee members great credit is due for the success of this portion of the convention.

THE SPEER CARBON COMPANY, of St. Mary's, Pa., displayed samples of its brushes, which are universally in successful use for street railway work.

GEORGE W. LORD, Philadelphia, maker of the famous Lord's boiler compounds, occupied a space among the exhibitors. Souvenir maps were given out.

THE FIDELITY & CASUALTY COMPANY, which insures against boiler and engine accidents, etc., occupied a booth in the convention hall, and distributed literature.

THE NEW PROCESS RAWHIDE COMPANY, Syracuse, N. Y., made a display of its pinions, which are used by over 200 electric railways, and known the world over.

THE PEERLESS RUBBER MANUFACTURING COMPANY, New York, occupied a large space with samples of its famous "Rainbow" packing and covering for pipes. A handsome pocketbook was given away to delegates.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, N. Y., had an exhibit, the most interesting feature of which was the special heater designed for the Manhattan Elevated, of New York, and for which the company has an order for over 21,000.

THE GOLD STREET CAR HEATING COMPANY had an exhibit in charge of Vice-President John E. Ward, a familiar personage at conventions. Their electric heater is well-known as one of the standard features of electric railway work, and a great many are in use in New York State alone.

THE MONARCH ENGINE STOP, made by the Monarch Manufacturing Company, of Waterbury, Conn., was shown by the Rochester Engineering & Supply Company, Jefferson Young, president. The same company had on display the New York asbestos air cell covering, the Cameron steam pump, the Merwath metallic gasket, and the Monitor water purifier.

E. C. STEARNS & CO., Syracuse, N. Y., had an operative exhibit of the Milloy automatic trolley catcher, which attracted much attention. The exhibit also contained the Green roller-bearing equalized tension, trolley base and the Milloy ball-bearing harp.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, had some samples of its central station types of Chloride cells in the exhibition hall. The members of the New York Association have many kilowatt capacity of these batteries in use.

THE LORAIN STEEL COMPANY, Johnstown, Pa., is electrically welding some track for the Rochester Railway, and delegates were invited to inspect the work going on in Parcells Avenue. Besides this, H. F. A. Kleinschmidt, superintendent of the track welding department, made a small but extremely interesting exhibit of the joints and various parts used in making an electrically welded joint, and also of the electrically-brazed bond terminal, used for connecting around special work where the track is not welded. The welding of a rail-joint takes 15 minutes, total time, of which the current is on, two and one-half minutes, 250 amperes, at 500 volts.

Collective Electrical Exhibit, Pan-American Exposition.

W. Jac Marland, the electrical engineer, of 132 Nassau Street, New York, is the curator of a collective electrical exhibit section at the Pan-American Exposition. It is an exhibit which it has taken an immense amount of work to get together, and Mr. Marland certainly deserves the thanks of the Exposition for the energy he has displayed in preparing such an extensive collection. The exhibit is devoted to the products of 44 electrical manufacturers who did not care to go to the expense of making an individual exhibit and sending a representative. It is arranged in an interesting and attractive manner. The following are the exhibits and exhibitors:

C. J. Bogue, 213 Centre Street, New York, N. Y., searchlight, pilot house projector, photo-engraving lamps and fountain lamps; Harold P. Brown, 120 Liberty Street, New York, N. Y., plastic rail bond; H. P. Cameron Electric Manufacturing Company, Syracuse, New York, assembled commutators and separate parts; Chicago Fuse Wire & Manufacturing Company, Chicago, Ill., strip fuses, etc.; Crescent Manufacturing Company, Chicago, Ill., cord adjusters; H. C. Cushing, Jr., 39 Cortlandt Street, New York, N. Y., well-known book; Diamond Arc Lamp Company, Mt. Vernon, N. Y., alternating-current lamp and automatic switch; Dunn-Martin Electric Company, 75 Nassau Street, New York, N. Y., dome massage battery; Edison-Johnson Manufacturing Company, 50 Broadway, New York, N. Y., trolley harps and wheels; Electric Contract Company, 61 Elm Street, New York, N. Y., "Light of Asia" lamps and surgical and dental sets; Ericsson Telephone Company, 296 Broadway, New York, N. Y., wall telephones, inter-communicating telephones, desk sets, switchboards, etc.; Eschwei Electric Company, 49 Centre Street, New York, N. Y., direct-current lamps; P. H. Gilbert, Scranton, Pa., up-to-date trolley pole and ice-cleaning wheel; Hart Manufacturing Company, Hartford, Conn., well-known "Diamond H" switches; Hazazer Telephone Company, 8 Dover Street, New York, N. Y., switchless inter-communicating telephones; Herzog Teleseme Company, 51 West Twenty-fourth Street, New York, N. Y., up-and-down system of elevator service, telephone annunciator, portable annunciator, etc.; Hydra Double Battery Company, 32 Broadway, New York, N. Y.; Indelectric Manufacturing Company, 131 West Thirty-first Street, New York, portable medical battery; Jaeker's well-known soldering salts and samples of work done with same; Jenkins Brothers, New York, N. Y., magnetic lamp holder; J. Jones & Son, 64 Cortlandt Street, New York, N. Y., electrical supplies; H. Krantz, Boerum Place and State Street, Brooklyn, N. Y., specially constructed switchboard; D. J. Mahler, Providence, R. I., electrical apparatus for home treatment; Montauk Fire Detecting Wire Company, 100 Broadway, New York, N. Y., demonstration of their well-known special wire products; McLeod, Ward & Co., 27 Thames Street, New York, N. Y., full line of desk shades; Oak Motor Company, 97 Reade Street, New York, N. Y.; Parsell & Weed, 131 West Thirty-first Street, New York, N. Y., Franklin model dynamo operated by motor; The Phelps Company, Detroit, Mich., well-known "Hylo" lamp and special lamp for photographers; Prentiss Clock Improvement Company, 49 Dey Street, New York, N. Y., "frying-pan" clocks, calendar clocks, time switches, etc.; Pyle National Electric Headlight Company, Chicago, Ill., locomotive headlight; Queen & Co., 1010 Chestnut Street, Philadelphia, Pa., X-ray apparatus, photometers, testing sets, switchboard instruments, etc.; William Roche, 42 Vesey Street, New York, N. Y., different sizes of the "New Standard" dry battery and new system of gas and gasoline engine ignition; Sage Brothers, 120 Liberty Street, New York, N. Y., ohmmeters; Railway Equipment & Supply Company, Cincinnati, Ohio, specially constructed poles; Socket Extension Tap Company, Boston, Mass., socket extension taps; Speer Carbon Company, St. Mary's, Pa., arc lamp carbons, telephone carbons and the well-known self-lubricating carbons; Sprague Electric Company, full line of interior conduits and appliances; Standard Electric Welding Company, Cleveland, O., electric welded samples; F. H. Stewart & Co., 35 North Seventh Street, Philadelphia, Pa.; Stow Manufacturing Company, Binghamton, N. Y., multi-speed electric motor and Stow flexible shaft; Emile J. Tardie, 221 Sixth Avenue, New York, N. Y., portable ornamental electric clock stands, portable electric candles, etc.; Thomson Electric Welding Company, Lynn, Mass., sample board of electric welded materials; Utica Drop Forge & Tool Company, Utica, N. Y., electricians' drop forges, tools, etc.; W. C. Vosburg Manufacturing Company, 296 State Street, Brooklyn, N. Y., extensive display of fixtures, brackets., etc.

Collective Electrical Exhibit, Electricity Building, Pan-American.

An electrical engineer of Mr. Marland's experience is able to present and arrange an exhibit to best advantage to be attractive to both the engineer and general public. As far as possible one device works upon another.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call was nominal, closing at 6 per cent. Time money was little called for, closing at 5@5½ per cent for all maturities. Mercantile paper closed at 5@5½ per cent for 60 to 90 days' indorsements, and choice four to six months' single names, 6 per cent for others. The same interests which supported prices in the stock market early in the week, after the news of the shooting of the President, again had large buying orders in force, and prevented the break from becoming serious. The unfavorable turn on Friday of the President's condition, however, caused selling and heavy declines in stock values. On Saturday the Exchange was closed out of respect to the memory of the deceased President. Electric and traction securities closed the week with net losses, as a result of the general drop in prices after the receipt of the news of the alarming condition of the President. These losses, however, were not so marked as many in the railway list. Brooklyn Rapid Transit on Friday reached 64¼, but dropped to 61½, the closing price being 62¾. Metropolitan Street Railway on the same day reached 162, fell to 159, and closed at 160½, the highest quotation for the week being 166. General Electric fluctuated between 251 and 264½ during the course of the week. Western Union kept comparatively steady at prices ranging between 90½—the closing price of the week—and 92¾. The sales and net losses of the leading traction and electric stocks as recorded at the close of the week were as follows: Brooklyn Rapid Transit, 60,250, net loss 2⅞; Metropolitan Street Railway, 12,410, net loss 2¼; General Electric, 3700, net loss 1; Western Union, 9210, loss ¾. On the Boston Exchange on Friday there was a slump of 24 points in Boston Elevated stock on reports of a heavy land damage suit against the company and efforts to stop the running of trains during certain hours of the night on account of noise. It is stated that suits aggregating $1,000,000 have already been filed against the company. Following are the closing quotations of Tuesday, Sept. 17, compared with those at the close of the previous week:

NEW YORK.

	Sept. 10	Sept. 17.		Sept. 10	Sept. 17.
American Tel. & Cable...	—	99	General Carriage.....	¾	¾
American Dist. Tel.....	—	—	Hudson River Tel.....	120	120
Brooklyn Rapid Transit..	68½	65⅛	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry..	165⅞	162½
Electric Boat.....	20	18	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	47	45	N. Y. Elec. Veh. Tran...	10	10½
Electric Lead Reduc'n...	2	2	N. Y. & N. J. Tel.....	168	168
Electric Vehicle.....	5½	5	Tel. & Tel. Co. of Am...	5	5
Electric Vehicle pfd.....	8	9	Western Union Tel.....	92⅝	92⅞
General Electric.....	264	260¼			

BOSTON.

	Sept. 10	Sept. 17.		Sept. 10	Sept. 17.
Am. Tel. & Tel.....	164	164	Mexican Telephone.....	2⅛	2¾
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light....	250	—	Westinghouse Elec.....	—	—
Erie Telephone.....	35	34	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Sept. 10	Sept. 17.		Sept. 10	Sept. 17.
American Railways.....	40½	40	Phila. Traction.....	97⅝	95⅝
Electric Storage Battery.	70	72*	Philadelphia Electric.....	5½	5½
Elec. Storage Batt'y pfd.	70	72*	Pa. Electric Vehicle.....	½	½
Elec. Co. of America....	7⅛	7⅛	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Sept. 10	Sept. 17.		Sept. 10	Sept. 17.
Central Union Telephone.	—	—	National Carbon pfd....	84½	84½
Chicago Edison.....	165	166	Northwest Elev. com....	39	41*
Chicago City Ry.....	206	203	Union Traction.....	17⅛	16½
Chicago Telep. Co.....	275	275*	Union Traction pfd.....	58	58
National Carbon.....	18	17¾			

*Asked.

NEW YORK METROPOLITAN.—In his evidence before Referee Earl in the franchise tax hearing at Albany, President Vreeland, of the Metropolitan Street Railway, said the company had put in electrical power at a cost of $6,000,000, which necessitated a loss of $6,000,000 in equipment. When he took charge of the roads there were only four transfer points, and at present there are 300, although there is no legal obligation on the company to grant transfers. In the present year Mr. Vreeland says the company has carried 395,000,000 cash passengers, 50 per cent of whom took transfers, so that the average fare received was 2½ cents per passenger. As an instance of the result of electric operation, Mr. Vreeland said that on the Madison Avenue line the gross receipts in the days of horse car service were $760,000, and the operating expenses 70 per cent. Under the electric system, gross receipts increased to $2,000,000 and the operating expenses decreased to 35 per cent. Mr. Vreeland pointed out that the company operates 16 systems of railroads, many of which would not pay expenses if operated separately. He sprung a sensation by saying that the question of abandoning leases and returning to the past chaotic system depended upon the action in reference to the franchise tax, at least in regard to certain lines. The company, he said, has over 90 miles of road still operated by horse power, which do not pay expenses and which will cost $150,000 a mile to convert to electric lines. Mr. Vreeland said that the wiping out of the staff of the Third Avenue system saved $100,000 a year, and that the cost of electric power to the Third Avenue Company was 6 cents a mile, whereas to the Metropolitan Company it was only 1½ cents a mile.

AMERICAN TELEPHONE.—An important conference of leading Eastern telephone people was held last week with President Fish at the Boston offices of the American Telephone & Telegraph Company. Among the conferees were President Cutler and General Manager Bethell, of the New York Telephone Company; President Mitchell and General Manager Spencer, of the Philadelphia Company; General Sherwin and other officials of the New England Company, and Vice-President E. J. Hall, of the American Telephone & Telegraph Company. It is understood that the conference was in relation to a readjustment of telephone rates. It was stated, however, that the meeting was a matter of detail in connection with the business of the company in which the public has no interest. One result has become known, however, which is of special importance. Mr. Bethell, who has made such a brilliant success of his work in New York, has been confided, it is understood, with the management of the Chesapeake & Potomac Company. He has been spending this week in Washington familiarizing himself with the situation there. The arrangement is somewhat analogous to that under which Mr. J. I. Sabin is directing telephone affairs, both in Chicago and the Middle States and on the Pacific Coast, so that Mr. Bethell will not be lost by New York. This incipient "districting" of the Bell telephone system is being watched with the deepest interest. Mr. Bethell was once a law student and Government clerk at the National capital.

DIVIDENDS.—The United Traction & Electric Company (of New Jersey) has declared the usual quarterly dividend of 1 per cent, payable Oct. 1. General Electric directors declared the regular quarterly dividend of 2 per cent on the common stock. The second installment of 1 per cent of the 4 per cent dividend on International Steam Pump common stock will be paid Oct. 1. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Oct. 15. The regular dividend of $2 per share has been declared on the Philadelphia Traction Company stock, payable Oct. 1. The executive committee of the Western Union Telegraph Company has recommended the declaration of the usual quarterly dividend of 1¼ per cent. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company a dividend rental of $1.75 per share will be paid to holders of record of West End common stock on Oct. 1. Union Switch & Signal Company declared a dividend of 2 per cent on preferred stock and 1 per cent on common.

EMPLOYMENT FOR RECEIVERS.—The following shrewd and cynical suggestion is put forward by the *Railway Age:* "A receiver has been appointed for a suburban electric railway at Buffalo—which suggests the thought that, while the prospects for the receivership business on steam roads at present are poor, there is a new and rapidly growing field for bankruptcy in connection with ambitious electrical railway projects. The long-distance transportaion of passengers and freight involves vastly greater expense in the way of road equipment, terminals, stations, employes, liability for loss and damage, and many other things, than the running of trolley cars for local passenger business, and experimenters in this new field are liable to be wrecked by unprofitably low rates. Transportation cannot long be furnished at less than cost, even by trolley roads." And yet yellow journals of the kind that helped kill Mr. McKinley are howling for three-cent fares and "municipal" roads run for nothing.

ELECTRIC STORAGE BATERY.—An officer of the Electric Storage Battery Company is authority for the statement that the business for the first half of the current year has exceeded the same period of 1900, and the dividends are being more than earned. Dividends were commenced last December, and the next quarterly dividend will be payable about Oct. 1. Action on it will be taken at the board meeting which will be called about Sept. 18. It is expected that the usual 1¼ per cent will be declared.

WESTERN UNION FINANCES.—The directors of the Western Union Telegraph Company have declared the usual quarterly dividend of 1¼ per cent, payable Oct. 15. The company issues the following statement for the quarter ending Sept. 30, the figures for the current year being partly estimated and those for 1900 actual:

	1901 (*Estimated*).	1900 (*Actual*).		Changes.
Net revenue	$1,850,000	$1,600,925	Inc.	$249,075
Bond int.	239,040	223,945	Inc.	15,095
Balance	$1,610,960	$1,376,980	Inc.	$233,980
Dividends	1,217,005	1,217,000	Inc.	5
Surplus	$393,955	$159,980	Inc.	$233,975
Prev. sur.	9,319,285	8,298,224	Inc.	1,021,061
Total sur.	$9,713,240	$8,458,204	Inc.	$1,255,036

The actual returns for the quarter ending June 30 were: Net revenues, $1,762,435; bond interest, $239,040; balance, $1,523,395; dividends, $1,217,005; surplus, $306,390; previous surplus, $9,012,894; total surplus, June 30, $9,319,284.

WASHINGTON TROLLEYS.—A committee, consisting of Geo. W. Young, president of the United States Mortgage & Trust Company, of this city, chairman; John Crosby Brown, James Timpson, William H. Hollister and Gardiner M. Lane, has prepared a plan of reorganization of the Washington Traction Company, which provides for the foreclosure of the first collateral trust mortgage and the transfer of the property either to a new company or to the Washington & Great Falls Electric Railway Company, whose name under the act of Congress passed June 5, 1900, shall be changed to the Washington Street Railways Company, or otherwise modified. The successor company will authorize the issue of mortgage bonds and capital stock as follows: Fifty-year mortgage 4 per cent gold bonds, interest payable each six months, $17,500,000; preferred stock, 5 per cent, cumulative after June 1, 1904, $8,500,000; common stock, $6,500,000.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph instrument statement for month ended Aug. 20, shows:

	1901.	1900.		Changes.
Gross output	81,144	45,555	Inc.	35,589
Returned	42,997	27,208	Inc.	15,789
Net output	38,147	18,347	Inc.	19,800
Since Dec. 20:				
Gross output	607,593	457,164	Inc.	150,429
Returned	267,807	189,961	Inc.	77,846
Net output	339,786	267,203	Inc.	72,583
Total outstanding	2,292,602	1,847,708	Inc.	444,898

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., filed notice Sept. 6 of the increase of its capital stock from $75,000 to $300,000. The assets are named as $331,000 and the liabilities $22,000.

Commercial Intelligence.

THE WEEK IN TRADE.—A satisfactory business was done in all branches of trade, while such measures of trade development as bank clearings and railway earnings all point to a steady maintenance, and even enlargement of the expansion already noted in fall trade and in leading industries. Industrially, the situation is being helped by the practical dwindling away of the steel strike. The features of the week were the continued good reports as to trade and collections received from the West, Northwest, Southwest and some parts of the South, all reflected in good advices in turn from the leading Eastern centers of trade and manufacture. The total earnings of 96 roads in August aggregated $67,889,217, a gain of $7,938,919, or 13.2 per cent over last year. The smallest gain, that reported by the Southern roads, is nearly 10 per cent. The business failures for the week, as reported by *Bradstreet's*, numbered 182, as compared with 169 the week previous and 167 the same week last year. In the copper market there is no change. Some of the Lake mines, it is said, sold to home consumers for delivery up to the end of the year at 16½ cents. Lake is quoted at 16½ cents and electrolytic and standard brands of casting 16¼ cents up to 16⅜ cents.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed several contracts for the installation of batteries of "Chloride Accumulators" in lighting and railway power houses. Among these are noted the installation of the St. Paul (Minn.) Gas Light Company, which is to consist of 166 elements having a capacity at normal rate of discharge of about 1300 kilowatt-hours, but capable of a much higher discharge rate for the peak work for which it is principally required. The power for the Gas Light Company is obtained from a water-power plant 27 miles from the city, from which place it is transferred at 25,000 volts to a rotary sub-station in St. Paul, and thence distributed at 120 volts on each side of the three-wire system. The battery located at the St. Paul station is for the purpose of obtaining additional capacity, increasing the reliability of service, and as a reserve in any emergency that may arise. The Laclede Power Company, of St. Louis is installing a Chloride battery consisting of 336 elements having a discharge rate for one hour of 500 amperes on each side of the three-wire system. The Minneola, Hempstead & Freeport Traction Company has contracted for the installation of a battery consisting of 270 elements, having a discharge rate of 120 amperes, for regulating the rapid fluctuations on the railway circuit. The containing jars are of sufficient size to allow of 50 per cent increase in capacity.

RAPID TRANSIT CONTRACTS.—Last week contracts of a heavy nature were made by the Subway Construction Company, who are constructing and will equip the New York Rapid Transit Railroad. One order for the engines was given to the Allis-Chalmers Company, and provides for eight units each of 7500 horse-power at best efficiency, and developing a maximum of 11,000 horse-power, 75 r. p. m. at 175 to 200 lbs. steam pressure. Each engine will consist of two combined component engines operating on one shaft, and will have a vertical low-pressure cylinder and a horizontal high-pressure cylinder, both cylinders connecting to one crank pin. The other order was awarded to the Babcock & Wilcox Company for 48 horizontal water tube boilers, in 24 batteries, each boiler of 1200 horse-power (15 lbs. basis), of the regular B. & W. type, with slight alterations, to allow for adaptation to superheating. Each engine is to be direct connected to a generator, rated at 5000 kilowatts, of the revolving field flywheel alternator type. Specifications will soon be prepared for the stokers, condensers, pumps, etc., and will be in shape in November. The generator contracts will soon be due. The size of the units is remarkable.

WATERTOWN ENGINE COMPANY.—The strike at the shops of the Watertown Engine Company has terminated in the complete surrender of the men, who have returned to work at the old wages and the old orders. For the 14 weeks during which the strike lasted the Engine Company entered no new orders, employing the small force of non-union men entirely in finishing up orders previously entered. With the resumption, orders have come in with gratifying promptness, and its shops are again full of work. The company has just completed an installation of 1000 horse-power for the Oxford Paper Company at Rumford Falls, Me., and is now at work on an 800-hp plant for the Remington-Martin Company, at Norfolk; a 400 horse-power for the Eastern Lumber Company, of Tonawanda; 300 horse-power for the Raymondville Paper Company; 400-hp vertical cross compound high-speed engine for the Mare Island Navy Yard; 250-hp horizontal tandem compound for the Ohio State University and a considerable number of other smaller high-speed engines.

THE TOOLS BEHIND THE GUNS.—As an illustration of the effective manner in which the piping times of peace heal the wounds of war, the Spanish Government has placed an order with the Niles Tool Works Company for engine lathes to be used in the Government gun works for the manufacture of large ordnance. This also goes to show that our good friends, the Spaniards, have not failed to learn the lesson which the war so palpably contained. They realize that their European guns were inferior to those in use in the American ships, and they believe that one of the ways in which to obtain as good guns as the Americans have is to use American machinery in the manufacture of them. They might go a step further and have American brains control the operation of the machinery. At any rate, the order demonstrates the fact that the Spaniard is willing to pocket his prejudice and learn a practical lesson, and the man who is willing to learn need not worry as to his future.

PLANT FOR ARMOUR ELEVATOR.—Armour & Co., Chicago, are installing in their new elevator at New Orleans, La., an electric plant, consisting of 125 and 60-hp engines, built by the Ball Engine Company, Erie, Pa., direct connected to Triumph Electric Company generators. The Triumph Electric Company, Cincinnati, Ohio, is obliged to run its factory with its full complement of men 24 hours a day in order to take care of the business which it has on hand.

NEW YORK ELEVATOR APARTMENTS.—Manhattan Island has about 450 apartment houses with elevators, all being six or more stories. Many of these elevators are electric, and the number tends to increase as additional circuits go in, making a good source of income in the residential districts, where electric light is also continuously gaining.

CATALOGUES of electrical apparatus are requested by Wilkinson & Richardson, electrical contractors, Middletown, N. Y.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, of Warren, Ohio, has just completed one of the most modern and up-to-date lamp factories in the United States, with equipment of the very best. Its main building is 60 by 80, three stories, and is equipped for an output of 1,000,000 lamps per year. It will manufacture all kinds of incandescent lamps, but lay stress on its "Sterling Special," made by a process strictly its own, with a double spiral filament so constructed as to give an equal radiation of light from all points around the bulb and from the bottom of the bulb. The filament of this lamp is thoroughly and firmly anchored. The company has advance orders for many thousands of them, some of which are to be used in Government work. It will be able to fill orders any time after Oct. 1. The factory management will be in charge of Glenn C. Webster, who for 10 years past has been active in the management of incandescent lamp factories, and has been general superintendent of the Warren Electric & Specialty Company, the Economy Electric Company, of Warren, and the Colonial Electric Company, of Ravenna. The city of Warren is one of the finest shipping points in the Middle States, as it has a daily express train service of about 40 trains. The Adams, Wells Fargo and United States Express companies have offices in Warren, operating over three trunk line divisions, viz., Pennsylvania, Erie and Baltimore & Ohio. The officials of the company are: W. A. Smith, president; C. G. Denison, vice-president; Glenn C. Webster, secretary and superintendent; William Coale, treasurer.

IMPORTANT ELECTRICAL EQUIPMENT CONTRACT PENDING.—Some further data is to hand regarding the Pacific Coast Portland Cement Company's projected plant to be erected at Vancouver, B. C. The works, which will be operated entirely by electricity, were at first intended to have a capacity for turning out 500,000 barrels of cement per annum. In view of the fact, however, that besides the plant being the only one engaged in the manufacture of Portland cement on the Pacific Coast, the promoters have just made arrangements with a well-known export house which guarantees to take yearly 500,000 barrels of cement for the China and other Far Eastern trades, it is anticipated that the initially planned factory will be largely increased. The electrical portion of the contract—as originally decided upon—will mean an expenditure of about $90,000. Should the suggestion of a larger plant be carried out, of course, these figures will have to be increased. In addition to the electrical machinery all the other equipments to be installed in the Vancouver plant will be purchased in the United States. Mr. J. Keith Fisher, who is primarily interested in the enterprise, has just sailed for Europe with a view to perfecting some financial details relating to the project. On his return, which will be inside of six weeks, it is expected that the contracts for the equipment of the factory will be determined on. The New York offices are at 66 Broadway.

STRIKES AND INVENTION.—It is stated that one marked effect of the machinists' strike was noticed in the factory of the American Graphophone Company, at Bridgeport, Conn. As a result of the disaffection among the workmen this company found it necessary to close one of its most important departments. Operations were suspended for a fortnight, but during that time it was once more demonstrated that necessity is the parent of invention, and special machinery, designed by ingenious men, was quickly supplied, through the use of which one man was enabled to do the work of three, then four and finally nine machinists. The result of this was that the special machinery, evolved under stress of circumstances, and which might never have been forthcoming under ordinary conditions, was operating so effectively long before the strike was over, that the need of many of the former employes had ceased to exist in that department.

LARGE ORDER FROM PARAGUAY.—Hon. J. N. Ruffin, United States Consul at Asuncion, Paraguay, who is spending his leave of absence in the United States, has succeeded through his unceasing and patriotic efforts in bringing with him many important orders from the Paraguayan government. Among others a large order has been placed with the American Steel & Wire Company for steel wire, and the Western Electric Company for telegraphic appliances to the amount of $7,000 for a new telegraphic line from Asuncion to several important forts on the Bolivian frontier. The Paraguayan Board of Education has also ordered several hundred school desks from a prominent Ohio manufacturer for the sum of $3,000. The above orders have been financed by the Export Shipping Company, of New York, who act as the disbursing agents for the Paraguayan government.

CRANE COMPANY.—On account of the fact that the space devoted to floor molding has been entirely inadequate to the demands of the business, and in order to relieve the works at Canal and Judd Streets, Chicago, of some of the heavy work, Crane Company has this summer erected at its works at Jefferson, Van Buren and Desplaines Streets, a foundry which is to be devoted exclusively to very heavy work, i. e., flanged fittings and large valves. It is a one-story brick building with a slate roof, and is equipped with two cupolas, an electric traveling crane, and every other modern convenience. This new foundry will increase Crane Company's capacity for very heavy work about 50 per cent, and it is expected to be in operation in about 30 days.

EXPORT TRADE GAINS.—The exports of the United States for the eight months ending Aug. 31 show an increase of $22,668,298 over those for the same period last year, and the aggregate for the 12 months ended the same date for the first time passed the billion and a half mark. The balance of trade in favor of the United States shows an increase of $106,607,166 for the year, aggregating $656,931,876. For the month of August the imports of merchandise were valued at $72,906,840, being an increase of $11,086,352 over those for the same month last year, and the exports aggregated $107,426,417, an increase of $3,850,452. The imports for the eight months increased $14,531,646, while for the 12 months a net decrease of $4,994,456 is shown.

WATER POWER DEVELOPMENT IN CHILI.—Mr. Santiago Sotomayor, of Chili, South America, is in Ottawa, Ont., on railway business, and is representing the Chilian Government in connection with certain electrical enterprises in that country. Mr. Sotomayor states that he has visited Ottawa in order to examine into the utilization of water power for electrical purposes. In Chili, all of the electric railway power is developed by steam, but there is abundance of water power available, and the use that is made of such power in Canada, when reported upon by Mr. Sotomayor, may lead to a change in the Chilian methods in this respect. Mr. Sotomayor is a railway contractor, and his general manager is Mr. Charles Symmes, formerly of Aylmer, Que.

CHARLES E. DUSTIN COMPANY is the name of a new engineering and electrical concern just started at the Bowling Green Building, 11 Broadway, New York City. It will make a special feature of its business the purchase and sale of all kinds of electrical apparatus, boilers, engines, etc., and will also engage in construction work. The president and general manager, Mr. C. E. Dustin, has long been favorably known in the electric lighting and supply field, and the company has retained Mr. W. S. Barstow, formerly general manager of the Brooklyn Edison Company, as its active consulting engineer. The capital of the new company is $250,000. A large amount of business already opens up before the concern.

THE WATSON-STILLMAN COMPANY, of New York, has recently built 16 presses for shipment to Germany, in addition to which they have lately received an order for 14 hydraulic presses to go into the Manchester plant of the British Westinghouse Company. These are intended for various purposes, and although it was understood originally that the presses would be ordered in England, the conditions were such that the Watson-Stillman Company finally obtained it. This company reports that it is extremely busy with both domestic and foreign trade.

TRADE WITH JAPAN.—Mr. E. C. Bellows, United States Consul General at Yokohama, writes that this country stands first in Japan in imports of rails, electric light wire and telegraph wire, and leads in electric lighting and mining machinery. Belgium leads in telephones. He adds: "Electric street cars are in use in Kyoto, and are constantly filled; are, in fact, so well patronized by the working classes that the wealthier people still employ the jinrikisha to avoid the crowding. An electric car line has been projected at Tokyo and at Yokohama, but work has not yet begun."

NEBRASKA POWER.—Mr. J. P. Morgan and others are said to be interested in a project to spend several millions in developing power on the Loup River, near Fremont, for transmission to Omaha, 28 miles away. The amount to be spent may, it is asserted, reach $20,000,000, and some 30,000 horse-power is named. This is certainly a "large" project. Mr. F. A. Nash, president of the New Omaha Thomson-Houston Company, Omaha, is among those interested.

BELTING ORDERS.—The veteran Colonel J. H. Shay, of the Chicago Belting Company, 76 South Canal Street, Chicago, while in New York this week, reported securing large orders for belt from the Harrisburg Light, Heat & Power Company, and from J. P. McQuaide for the new factory of the National Conduit & Cable Company at Hastings-on-the-Hudson. He has also received some other good orders from electrical concerns. The Harrisburg belts run up to 40 and 54 inches in width.

TELEPHONE APPARATUS WANTED.—The Home Telephone Company, of Jamestown, N. Y., is to begin immediately the construction of an exchange of 1500 telephones. It is now in the market for the entire equipment necessary. The work will include several miles of underground construction. J. Vautrot is president, P. H. Hoyt vice-president, C. B. Selby secretary and M. M. Skiff treasurer. The capital is $200,000.

COPPER CONSUMPTION.—Mr. H. L. Casey, lately a salesman for the United States Selling Company, alleges that the concern holds 135,000,000 lbs. of copper, or about 20 per cent of the American production, and is stacking it up at the rate of 20,000,000 lbs. a month because of decreased consumption. We doubt extremely whether consumption has decreased. It certainly has not in the home electrical field. Mr. Lewisohn says Casey is "'way off."

General News.

THE TELEPHONE.

TEXARCANA, ARK.—S. F. Richardson has a franchise for the installation of a telephone system.

CARROLTON, GA.—Lewis K. Smith, manager of the Gainesboro Telephone Company, is looking after the building of lines to Hiram and Dallas, Ga., from Powder Springs, which will be connected soon with the Bell system.

DIXON, ILL.—The Lee County Telephone Company has petitioned for a franchise.

FREEPORT, ILL.—A franchise has been granted to the Independent Telephone Company.

BLOOMINGTON, ILL.—The Farm & City Telephone Company has accepted the Clinton franchise.

MONARCH, ILL.—Jacob Smith, of this place, is putting in an independent telephone line at Belleflower.

SPRING VALLEY, ILL.—The Bureau County Independent Telephone Company is now building a line between Princeton and Bureau Junction.

PEARL CITY, ILL.—Dr. Clay has organized an independent telephone company and has been granted a franchise in the village of West Freeport.

ROCKFORD, ILL.—Bills & Wortham have let the contract for the construction of the new telephone system at Rockford to the Jones & Winter Company, of Chicago, for the sum of $133,610.

JERSEYVILLE, ILL.—The Calhoun County Telephone Company has increased its capital stock from $5,000 to $15,000. The company may consolidate with the Pike County Telephone Company.

KEYESPORT, ILL.—The City Council has granted a franchise to the Southern Union Telephone Company to construct a line. Work will begin at once, running wires to Carlyle to connect with the Bell system.

WOODSTOCK, ILL.—The Woodstock Exchange & Telephone Company, of Woodstock, has been incorporated, capital $20,000, to operate heat, light, cold storage, and telephone system. Incorporators: C. H. Donnelly, G. W. Field, D. R. Joslyn.

TUSCOLA, ILL.—The farmers living in the northern part of this township and the northwestern part of Camargo Township are organizing a mutual benefit telephone company and propose to connect Villa Grove, West Ridge and Hayes with this city.

ALTON, ILL.—The Kinloch Telephone Company officers have given out a positive statement that they will start their new exchange Nov. 1. The Bell Telephone people are also making great improvements in their service. Both companies are charging the same for service.

DUNKIRK, IND.—A new telephone company is being organized here by citizens to compete with the Central Union.

VALPARAISO, IND.—The Porter County Telephone Company has filed articles of incorporation, with a capital stock of $10,000.

INDIANAPOLIS, IND.—It is reported in this city that the Eel River Telephone Company will build a new telephone line through the counties of Wabash, Whitley, Marion and Fulton. The capital stock is $10,000.

GASTON, IND.—The Central Union Telephone Company is arranging to put in a branch exchange at Gaston. It expects to accommodate the farmers as well as the town. The rate will be $1 a month on party lines.

INDIANAPOLIS, IND.—The American Telephone & Telegraph Company, of New Jersey, has capital to the amount of $509,391 represented in this State, according to affidavit made when complying with the foreign incorporations act. The total capital stock is $94,237,500.

LA GRANGE, IND.—The Griffith & Long Telephone Company has sold its entire plant to the Northern Indiana and Southern Michigan Telephone, Telegraph & Cable Company, and the two systems, including a thousand telephones, and exchanges in every town and village in the county, will be under one management.

RADCLIFFE, IA.—A mutual telephone company is being organized here.

DES MOINES, IA.—The Lost Nation and Keystone Telephone Company has filed articles of incorporation. It has $1,000 capital. L. W. Crane, Dan Kommer, H. C. Borgert, E. B. Read, L. Schultz and Freeman Current are the incorporators.

LOUISVILLE, KY.—Louisville Home Telephone Company will erect a three-story brick addition to its exchange building, to cost $30,000.

NICHOLASVILLE, KY.—The Fiscal Court has passed an order requiring the County Superintendent of Roads to remove all poles set presumably by the East Tennessee Telephone Company, a third organization seeking an entrance to the city. The two companies which enjoy the legitimate right to so operate are the Nicholasville Telephone Company and the Jessamine Home Telephone Company.

NICHOLASVILLE, KY.—The Home Telephone Company, of this city, is meeting with phenomenal success. Commencing with a switchboard with 100 numbers, and a dozen outside connections, it now has about 300 subscribers, and nearly a hundred different towns and cities for connections. The latest additions are Lancaster, Burnsides, Crab Orchard, Danville, London, Mt. Vernon, Stanford, Barboursville, and Williamsburg.

FRANKFORT, KY.—A few figures show the activity of the independent telephone companies in the State of Kentucky. There are to-day over 20,000 telephones in use; five years ago there were 500. The capital invested is $3,000,000. There are 83 independent telephone exchanges in the State, and eight in course of construction. The gap has just been closed between Lancaster and Nicholasville, making connection with a dozen towns in the State.

LOUISVILLE, KY.—The organization of the Independent Long Distance Telephone & Telegraph Company here with $1,000,000 capital is another step in the conflict going on between the new Home Telephone Company and the Cumberland, which is the Bell organization. The Home Company is backed by outside capital, but has influential local managers, and it proposes to absorb all the independent lines in the State, the Independent Long Distance Company being organized for that purpose. The Home Company is putting in substantial improvements and promises to begin business Jan. 1.

PORTLAND, ME.—The New England Telephone & Telegraph Company is announcing new and lower rates at the present time. A few free residence telephones will be installed during the month of September for trial until Dec. 31.

BALTIMORE, MD.—The Hughes Telephone Manufacturing Company, capital stock $100,000, has been incorporated by Charles C. Hughes, Edward L. Ward, Wm. Hutcheson, and others.

BALTIMORE, MD.—The Winchester Telephone Company, whose line extends through this city, has been sold to a Pennsylvania syndicate composed of Messrs. S. L. Jones, H. N. Gett, G. D. Gett and T. J. O'Neill, of Hanover, Pa. The line extends over territory in Virginia, West Virginia and Maryland.

HAGERSTOWN, MD.—The Maryland Telephone system in Hagerstown has been bought by the Hanover syndicate, which got control of the telephone systems at Gettysburg, Chambersburg, Westminster and Winchester. Copper wires will be strung to Westminster, where connection will be made with Philadelphia and Baltimore, and with the Virginia long-distance system.

BOYDS, MD.—The Boyds Telephone Company, which has its lines in Montgomery, Frederick and Carroll counties, has sold out a majority of its stock to another company. The purchasers were George D. Gitt, Harry N. Gitt and Thomas J. O'Neil, of Hanover, Pa., and Samuel L. Johns, of McSherrystown, Pa., owners of lines that connect Frederick, Westminster, Gettysburg and Hanover, Pa. This fall they will make connections with the Maryland Telephone Company, of Baltimore.

BOSTON, MASS.—The Erie Telephone system reports a net gain of 1246 subscribers in August, making a net gain since Jan. 1 of 11,448. The number of instruments connecteed on Aug. 31 was 153,047, and those waiting connection 2522.

CITY OF MEXICO, MEX.—Heavy rains have caused much damage to the Federal telegraph lines in the States of Guerrero, Jalisco and Colima, Mexico.

CITY OF MEXICO, MEX.—The cable and telegraph system of Mexico is to be greatly extended in the Western part of the country. The Mexican Government has begun the construction of a cable across the Gulf of California to connect the port of Guaymas with Santa Rosalia, an important town in Lower California. From Santa Rosalia telegraph lines will be constructed to various points on the peninsula. It is also proposed to construct a number of new telegraph lines from Guaymas to points in the States of Sonora and Sinaloa.

PONTIAC, MICH.—It is stated here that the People's Telephone Company of Detroit will soon absorb the Oakland County Telephone Company, of this city.

SOUTH HAVEN, MICH.—E. C. Bickle, of Elkhart, Ind., has purchased of W. E. Herron the Oak Telephone plant. It is said that he proposes to make many improvements.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has installed an exchange at Grattan. The company now has 120 telephones in service at Lowell, a gain of 50 per cent since Jan. 1.

SAUK CENTER, MINN.—The Central Minnesota Telephone Company is building a four-wire line west from this city.

MORRIS, MINN.—The Stevens County Telephone Company has been incorporated by Dr. H. L. Hubbard, Mr. and Mrs. R. C. Johnson, George E. Dading and George D. Farling, all of Morris. They will control the franchises at Morris and Hancock and will put in a system at Chokio.

BILLINGS, MONT.—L. L. Moffett, who owns the Yellowstone Valley and Bridger telephone line, has leased the Musselshell telephone system.

LOUISIANA, MO.—A new telephone company is being organized to build a system between Hannibal and Ralls County.

CLINTON, MO.—The Mutual United Telephone Company has been incorporated, with a capital stock of $15,000. The incorporators are George R. Lingle, S. T. Neill, W. F. Hall and others.

OMAHA, NEB.—The Southern Iowa Telephone Company has filed articles of incorporation, with an authorized capital stock of $60,000. R. T. Wellslager, L. M. Grimes, J. D. Whisenand and D. N. Smith are the incorporators. The incorporation is the result of a consummated deal between the members of the new company and D. N. Smith, owner of the toll lines in the southwestern part of the State. The company expects to extend its lines to all cities and towns in southwestern Iowa.

RALEIGH, N. C.—The Bell Telephone Company is completing arrangements for placing a part of its overhead system in underground conduits. Mr. F. W. Cutts has the work in charge.

BURLINGTON, N. J.—The Standard Telephone Company was granted a franchise by the City Council.

JERSEY CITY, N. J.—The Eastern Massachusetts Telephone & Telegraph Company has been incorporated in New Jersey, with a capital of $25,000,000. The incorporators are Albert E. Bailey, Almon E. Carpenter and Washington Lithgrow, all of Jersey City.

LITTLE VALLEY, N. Y.—The Independent telephone line from Salamanca to this place and thence to Cattaraugus is rapidly nearing completion.

NEWBURG, N. Y.—The Hudson River Telephone Company's lines have just been extended from Monticello to White Lake, Narrowsburgh, N. Y., and Honesdale, Pa.

MEXICO, N. Y.—The Empire State Telephone Company has erected the poles for a new line between this village and Oswego. The line will be continued to points East.

TROY, N. Y.—At a meeting of the stockholders of the Rensselaer Telephone & Telegraph Company, it was decided to increase the capital stock from $150,000 to $300,000. The company also entered into a contract with the Eastern Electric Construction Company of Philadelphia through its president, Edward Davis,

of Philadelphia, to construct and equip a plant, the principal office being in this city.

HOWARD, OHIO.—A telephone route from here to Gambier has been established and will be built in October.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Company of this city is arranging to equip its plant throughout on the common battery system.

FINDLAY, OHIO.—Efforts are being made by F. E. Kerr and others to establish a farmers' mutual telephone company in and around McComb.

NEW VIENNA, OHIO.—The Central Union Telephone Company is constructing a new toll line from here to Wilmington through New Antioch.

GLOUSTER, OHIO.—The Union Telephone Company has acquired the rights, franchise and lines in Perry County of what is known as the United States Hunnings Telephone Company, and will build a line from this city to Corning.

FINDLAY, OHIO.—A. C. Morse, heretofore manager of the Findlay Home Telephone Company, has accepted a position as constructing engineer for the Federal Telephone Company, of Cleveland. He will be succeeded by Charles Duval, a well known Cleveland telephone man.

MANSFIELD, OHIO.—The Central Union Telephone Company (Bell) is rebuilding its lines from Mansfield to Loudonville, and is building a toll line from Mansfield to connect with an exchange at Savannah. The Mansfield exchange of the company is to be enlarged and new boards added.

CLEVELAND, OHIO.—Following is a statement of the gross and net earnings of the Cuyahoga Telephone Company, of this city, for July, 1900 and 1901: July, 1900: Gross, $17,029.68; $199.28 deficit. July, 1901: Gross, $26,584.38; net, $13,106.18; net increase, $13,305.46.

CLEVELAND, OHIO.—The following statement shows the gross and net earnings of the United States Telephone Company, Cleveland, for July, 1900 and 1901: July, 1900: Gross, $4,543.85; net, $1,973.68. July, 1901: Gross, $14,378.35; net, $6,802.21; net increase, $4,828.53.

TOLEDO, OHIO.—Toledo investors are being offered the bonds of the Toledo Home Telephone Company. The company is building an independent telephone exchange in Toledo, and it is backed by Brailey & Barber, of Wauseon, and Parks & Foster, of Elyria, among the best known independent telephone promoters in the country. It is stated the company will be capitalized at $2,500,000, and that the actual cost to the stockholders will be $650,000. It is claimed that the company has already secured about 5000 subscribers, which at the lowest rate of $24 per year would yield $120,000 per year to start with.

CLEVELAND, OHIO.—The presence in the city of 300,000 G. A. R. visitors had a remarkably enlivening effect upon the business of the telephone companies. General Manager Mark Davis, of the Cuyahoga Company stated that the number of calls over their lines had made an average increase of 25 per cent. The Cuyahoga Telephone Company is improving its service by taking care of outlying villages. This week an exchange is being connected up at South Brooklyn, and next week an exchange at Dover will be cut in. Each will start with about 100 subscribers. Contrary to the usual practice of the independent companies these exchanges will be equipped with party-line telephones if desired. The party line will cost $12 per year, five on a line, while the unlimited service will be $36.

TOLEDO, OHIO.—The Toledo Home Telephone Company has commenced the work of erecting its exchange building on Huron Street. The building will be four stories high, of brick and stone, and will be 120 feet deep and 40 feet wide. It will cost $30,000. The site cost $15,000. The first floor will be used for the offices and counting room and long-distance toll booths. The second floor will be set aside for the comfort and convenience of the operators. There will be a sitting room, dining room, kitchen and toilet room. The long-distance operating room will occupy the rear of this floor. On the third floor will be the local exchange, in which will be located the central energy multiple switchboard of 12,000 capacity, provided by the Kellogg Switchboard & Supply Company, of Chicago. The front of the third floor will be devoted to hospital purposes and to the offices of the matron. The fourth floor will be occupied by recreation, gymnasium and store room. Waxchter Hudson & Company, of Toledo, are the architects.

DAYTON, OHIO.—The Home Telephone Company of this city is now at work on its new building, at the corner of Fourth and Jefferson Streets. The structure will be four stories high, and modern in every respect. The company's system is now under construction. There will be about 100 miles of pole line within the city limits and eight miles of subway. After the city plant is completed the lines will be extended throughout the county, embracing farmers, and the smaller towns desiring to be connected with the Home service. The company states that it now has a list of 2000 subscribers within a radius of two miles of the courthouse, and by the time it is ready for operation it expects to have 5000. Its rates are $40 for business instruments, and $24 for residences. The new exchange, it is expected, will be ready for business by April, 1902. The officers of the company are: John T. Barlow, president; H. D. Critchfield, vice-president; Jas. C. Reber, secretary and treasurer; Maxime Reber, consulting engineer. Mr. W. C. Rickett is superintendent of construction.

BRIDGETON, PA.—The Bell Telephone Company has secured new quarters and will introduce an entirely new system here.

WESTVILLE, PA.—The township committees of Deptford and West Deptford have given franchise rights to the Interstate Telephone Company.

HARRISBURG, PA.—The officials of the Dauphin County Telephone Company will in the near future begin the work of constructing the lines in this place.

PITTSBURG, PA.—The Pennsylvania Railroad Company in this city is making arrangements to have telephones installed in the homes of trainmen, engineers, conductors, brakemen, etc., so as to make it easier for the company to communicate with these men when they are wanted in a hurry. "Call boys" are doing this work now.

PHILADELPHIA, PA.—Plans and specifications have been completed by Architects Paul A. and Seymour Davis, of this city, for the large new telephone exchange building to go up for the Keystone Telephone Company, at Nos. 231, 233 and 235 North Sixteenth Street. It is to be built by George Kessler, at a cost of $54,000. Specifications call for passenger elevators, steam heating, electric lighting, hard-wood finishing.

PARKSTON, S. D.—A company is being organized to put in a telephone exchange at this place.

CHATTANOOGA, TENN.—The American Bell Telephone Company has reached Chickamauga Park in the building of a direct line between Atlanta and Nashville.

DENTON, TEX.—J. D. Carmichael, of Nocoma, has purchased the Denton telephone exchange at a price above $10,000 from S. W. McClure.

AUSTIN, TEX.—The Texas Telegraph Company, of El Paso, has been incorporated; capital stock, $3,000. Incorporators: N. de Bree, P. A. Angus and J. B. de Bree.

GALVESTON, TEX.—At a meeting of the County Commissioners some time ago an application was made by the Texas Construction Company for the privilege of erecting telephone poles along the country road.

MT. PLEASANT, UTAH.—The Rocky Mountain Bell Telephone Company has decided that the branch line from this city to Scofield will not be constructed until next spring.

SALT LAKE CITY, UTAH.—The Bell Telephone Company has completed the Point Lookout branch north of Brigham, and the construction gang is now working on the line to Knudsen duck camp at the mouth of Bear River. The Evanston line to Fort Bridger is completed, and the Lone Tree extension is being pushed.

ELKHORN, WIS.—Permits in the nature of franchises have been granted Company, which will have its offices either in this city or Evansville, will re-Company.

JANESVILLE, WIS.—At a meeting to be held Oct. 11 the Badger Telephone Company, which will have its offices either in this city on Evansville, will report on a plan to refund its debt.

MADISON, WIS.—The Oregon Telephone Company has been incorporated; capital stock, $5,000. Incorporators: W. H. Jones, William Soden, J. M. O'Brien, S. J. Barry, W. L. Ames, J. W. Emmons and H. M. Haskell.

MENASHA, WIS.—At the City Council meeting a communication was read from the Fox River Valley Telephone Company asking that its franchise be transferred to the Independent Telephone Company, which will absorb the Wolf River, Little Wolf River and the Fox River Telephone companies.

FRANKSVILLE, WIS.—A company has been organized here for the purpose of constructing a telephone line from Thompsonville to Racine, running through Franksville. At Racine the intention is to connect with the Bell Telephone Company, or with the Citizens' Telephone Company. At Thompsonville connection is made with several local lines, upon which there are some fifty telephones. Work has already been commenced on the Franksville and Thompsonville branch. The organization comprises the following officers: G. J. Ellis, president; G. G. Adams, vice-president; F. W. Morris, secretary; Dr. J. T. Corr, treasurer.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—As a result of the grain handlers' strike in Port Costa, the grain shipping port of San Francisco, Eppinger & Company have installed electric conveyers, which enable one man to do the work of seven in loading grain. Electric apparatus for the same purpose has been in use in Tacoma, Wash., for some time.

ATLANTA, GA.—One of the principal bills coming up before the next session of the Legislature will be one to impose a tax on all corporations securing franchises granted by the State.

HARMONY GROVE, GA.—Dr. G. L. Hardman has secured the services of Prof. Charles Strahan to examine the water power at Hurricane Shoals. A big power plant may be erected here.

DECATUR, GA.—The Georgia Electric Light Company is protesting against the granting of a 20-year franchise to another concern represented by Mr. T. W. Martin. Mr. Martin desires an exclusive franchise from the city for 20 years, the city to have the right to purchase the plant at the end of ten years. Collier & Brown, of Atlanta, have drawn plans for the proposed system.

ALTAMONT, ILL.—The city has awarded the contract to build an electric light plant to T. C. Reed, of Chicago, the cost not to exceed $12,875.

BLUFFTON, IND.—The city of Bluffton has been struggling over a year with the problem of municipal ownership. It owns the street lighting plant and the City Council has refused to grant franchises to private companies, who wanted to put in plants for incandescent lights. The City Council has practically placed an order with a Cincinnati company for a dynamo with which to supply both arc and incandescent lights.

INDIANAPOLIS, IND.—The question of a new electric lighting contract is expected to come up soon after election. The present board, having been once enjoined from opening bids on a new contract, and being threatened with another injunction suit, both the old and new specifications having been complained of as unfair to the Indianapolis Light & Power Company, finally post poned the receiving of bids until after the city election.

TOPEKA, KAN.—T. W. Roby, of Amherst, N. H., will build an electric light plant in Topeka costing $100,000.

NEW ORLEANS, LA.—The Tunica Electric Light & Power Company, Tunica, capital stock $2,500, has been incorporated by Lee Lesser, J. T. Watson, A. I. Dorsey, J. W. Brown, Z. T. White, R. C. Irwin, J. T. Lowe and others.

AUGUSTA, MAINE.—The Standard Light Company of Kittery has been incorporated with a capital of $500,000. F. A. Ray, of Boston, is president, and A. H. Gallagher, Boston, treasurer.

FANNINGTON, MO.—The electric lights were turned on Sept. 5 the first time for six weeks, the plant having been entirely renovated.

HELENA, MONT., in addition to installing 8000 horse-power, further capacity in water-wheels and generators, is constructing a double-pole line between

its plant at Canyon Ferry on the Missouri River and the city of Butte. The distance covered will be about 65 miles, and the company will transmit at 50,000 volts. It will have two circuits of three wires each, and in addition thereto will have a telephone line of two wires, placed on one of the lines of poles. For the power transmission it is using approximately No. o seven-strand copper cable. It is now actively in the midst of the construction work, and is in the market for linemen and climbers. Mr. M. H. Gerry, Jr., is general manager.

MERIDA, MEX.—The electric lighting plant of this city has been turned over to the municipal authorities, who will conduct its operation.

CHARLOTTE, N. C.—The property of the Catawba Electric Power Company was sold on Sept. 11 at public auction at Dallas, N. C. The property was bid in by certain bondholders for $175,000.

COLUMBUS, OHIO.—The Columbus Electric Company has submitted a proposition to the Columbus Council to furnish 700 lights at the rate of $74.50 per year each. The city only requires 650 lights, as the municipal lighting plant, soon to be placed in operation again, will furnish 350 lights, 1000 being the total number required. The Columbus Electric Company, however, will not agree to furnish less than 700. A counter proposition will be made by the city.

GUTHRIE, OKLA.—The Mangum Electric Light & Ice Company, of Mangum, Greer County, has been chartered; capital stock, $160,000. The incorporators are J. A. McGeagh, M. Mathews, and J. R. Lone, all of Mangum.

MEYERSDALE, PA.—The electric light plant at Berlin was purchased by C. P. Shupe, of Mt. Pleasant. The price was $5,400, and the plant will be improved.

PITTSBURG, PA.—The People's Natural Gas Company of this city, intends to enter the field of electric lighting as a competitor of the Philadelphia Natural Gas Company, also of Pittsburg, which also controls the Allegheny County Light Company. An ordinance has been introduced in city councils on behalf of the People's Company granting the right to enter upon and occupy all of the streets and alleys in the city for the purpose of constructing and operating poles, conduits, wires, cables and other apparatus, etc., necessary for the supply of electric light, heat and power. The company was chartered some time ago under the name of the City Electric Company of Pittsburg, Pa. I. N. Pew is president of the company.

PHILADELPHIA, PA.—Little has been heard in the past year concerning the patented electric incandescent light which Dr. Auer von Welsbach, the inventor of the Welsbach light, has been working upon, and reference to which was made in the annual report of the Welsbach Company about three years ago. That the matter has not been dropped is confirmed by a director of the company. He says: "This invention, however, and its position so far as the Welsbach Company is concerned, are somewhat removed, and stockholders had best bank on what the company is doing to-day in increasing the volume of its sales of gas mantles, rather than to lay any great stress just now on what may come out of this electric light. The invention itself we consider complete. The difficulty and chief cause for delay has been to find a supply of osmium, one of the rare earths, in sufficient quantity to make it of value commercially."

MONTREAL, QUE.—The recent fight in the Montreal City Council over the granting of the civic lighting contract, which culminated in the Royal Electric Company, getting the contract at $60 per lamp for a period of five years, gives promise of winding up with the disclosure of the methods which were probably used to secure the contract. In the early days of the fight, Alderman Clerihue publicly stated that he had been offered a bribe of $3,000 to vote for the Royal Electric Company. He has now given notice that he will ask the City Council to appoint a committee to investigate the whole matter, and he states that he will, at the same time, give such a committee a full version of the attempt to bribe him.

SALT LAKE CITY, UTAH.—Utah is to have another large electric-power plant. The company has been organized and articles of incorporation will be filed, probably in New Jersey. The manager of the enterprise is W. C. Weaver, receiver of the Bear River Irrigation Company, and his associates comprise New York, Chicago and Salt Lake capitalists. The power-house will be built just south of Collinston in Box Elder County. It is the intention to erect a plant that will generate 5000 e. h. p. Pole lines will be run to Salt Lake, Ogden and Park City, as well as to Bingham. The plant will cost $1,000,000, and, it is stated, arrangements have been completed to float the bonds in the East.

FREDERICKSBURG, VA.—The new electric light plant built for the city was started up recently.

MORGANTOWN, W. VA.—The Morgantown Electric Light & Power Company has sold its plant and franchise to a syndicate of citizens composed of I. O. White, R. D. Hirschman, Frank Cox, W. E. Glasscock, Joseph H. McDermott, and R. E. East for $14,000. The plant will be enlarged and an electric railroad is in contemplation.

PETERSBURG, VA.—The Southside Railway & Development Company proposes to develop a water-power, two miles from the city, on the old canal. It is stated that a fall of 100 feet can be secured, and that with contemplated improvements sufficient electric power can be obtained to supply the electric light and electric railway system. The company contemplates building an electric railway between this city and Richmond.

SEATTLE, WASH.—The Montesano Light & Water Company, Montesano, Wash., was organized in March last, with a capital stock of $100,000. Mr. C. H. Kiehl, of Seattle, is president and purchasing agent, and Mr. A. H. Dimock secretary. The company uses Stanley equipment, including one 50-kw alternator and Stanley transformers of 500-lights capacity. This plant is operated by a 75-hp Stilwell-Bierce & Smith-Vaile turbine.

SEATTLE, WASH.—The Northwest Light & Power Company was organized June last to conduct an electric light service at Skaguay, Alaska. The capital stock of the company is $200,000, Mr. C. E. Shepard being secretary. Mr. C. H. Kiehl, Seattle, is purchasing agent of the company. Stanley Electric Manufacturing Company apparatus is used, the equipment consisting of one 100-kw alternator, and Stanley converters of 1200-lights capacity. The power-house is constructed of wood and corrugated iron. The steam equipment includes one Babcock & Wilcox boiler of 150-hp capacity and one Ideal engine of the same rating.

THE ELECTRIC RAILWAY.

MOBILE, ALA. The consolidation of the two street railways of Mobile has gone into effect.

VANCOUVER, B. C.—It is the intention of the British Columbia Electric Railway Company to double the capacity of its power-house in Vancouver, and to put in a complete lighting plant. Mr. Horne Payne is the managing director of the company.

WILMINGTON, DEL.—The United States Traction Company, of New York, has been chartered here; capital stock, $3,000.

ALTON, ILL.—A new 750-hp engine and a 90-kw dynamo were placed in the power-house of the Alton Railway & Gas & Electric Company, Sept. 9. The new dynamo is three times the size of the old one.

LA PORTE, IND.—A franchise has been granted by the La Porte County Commissioners to the Chicago, Valparaiso & Michigan City Railway Company.

INDIANAPOLIS, IND.—The Cincinnati & Indianapolis Traction Company, organized for the purpose of building an electric railway from Indianapolis to Cincinnati, has been incorporated; capital, $10,000.

GOSHEN, IND.—The Goshen Southern Traction Company, with a capital of $50,000, has been incorporated. The following are the directors: L. W. Vail, L. M. Latta, M. V. Starr, J. A. Beane, C. A. Wehmeyer.

AURORA, IND.—With the exception of the crossing at Wilson Creek, the Cincinnati, Lawrenceburg & Aurora Electric Railway Company has obtained all the rights of way for the extension of its line from Aurora to Vevay, via Rising Sun.

PLAINFIELD, IND.—There will be an electric railway between Plainfield and Indianapolis within eight months if plans for it are carried out. The Plainfield & Western Company has awarded a contract to an Eastern firm for the construction of the road. The power-house will be located at Plainfield.

LOUISVILLE, KY.—The United States Traction Company, of Louisville, Ky., has been incorporated; capital, $30,000.

NEW ORLEANS, LA.—The board of directors of the New Orleans City Railway Company have agreed to accept the offer of H. H. Pearson, Jr., acting for Brown & Company, of Philadelphia, and representing Philadelphia capitalists, for the lease or purchase of their lines, thirteen in number, and to recommend the stockholders to accept the offer.

AUGUSTA, ME.—The Augusta & Warren Electric Railway Company has been organized. The company is capitalized at $300,000. The promoters are Governor John F. Hill, J. Manchester Haynes, G. E. Macomber, H. P. Vickery and T. J. Lynch.

MONTEREY, MEX.—Negotiations looking to the purchase and consolidation of the street railway systems of Monterey are pending. If the deal is consummated the new owners will introduce the electric system.

CITY OF MEXICO, MEX.—Ramon Miranda y Maron, who was granted a concession for the building of a street railway in the suburb of the City of Mexico, known as the Colonia Americana, has been granted an extension of time by the Government in which to complete the line.

CITY OF MEXICO, MEX.—The Belt Railway Company, which was organized about a year ago with a capital stock of $600,000, will soon begin the construction of an extensive street railway system in this city, the Mexican Government having recently granted it a concession to build and operate the proposed system. This concession covers two hundred streets. The company has already built a short suburban line in the Federal District, in which the City of Mexico is located. Arthur E. Stilwell, president and general manager of the Kansas City, Mexico and Orient Railroad, is said to be a heavy stockholder in the company.

BATTLE CREEK, MICH.—The Michigan Traction Company has sold the Battle Creek and Kalamazoo Interurban road and the lines within the city of Battle Creek and Kalamazoo, consisting of forty-seven miles of track, to W. A. Boland, promoter of the Detroit & Chicago Traction Company.

BILOXI, MISS.—The stockholders of the Biloxi Street Railway Company have unanimously agreed to dissolve the corporation and divide the moneys on hand. The company determined to retain its charter, however, in view of the possibility of reorganization.

DURHAM, N. C.—The Durham Traction Company has let the contract for the construction of eight miles of electric lines within the city limits.

CONCORD, N. H.—Articles of agreement have been filed with the Secretary of State for the formation of the Dover & Eliot Street Railway Company. The capital stock is $25,000.

NEW YORK, N. Y.—The contract to construct the recently incorporated New York and Portchester Railway has been awarded to John B. McDonald, who is building the New York Rapid Transit subway.

NEW YORK, N. Y.—The contract for the construction of the proposed trolley line from the Annadale railway station to Richmond Beach, Staten Island, has been awarded to L. W. Serrell, of Manhattan, for $30,000.

ALBANY, N. Y.—The Oneida Traction Company has been incorporated, to build an electric road, ten miles long, from Canastota to Sherrill, Oneida County. The capital stock is $500,000. The directors are Henry C. Stone and others, of Oneida.

JAMAICA, L. I.—A new trolley line, under the title of the South Jamaica Electric Transportation Company, is being organized. John A. Anderson, Brooklyn, is the legal representative of the corporation. Some of the incorporators will be James F. Tibbits, of Syracuse; T. W. Mandover, Manhattan, and C. J. Shaw, of Far Rockaway.

CAMDEN, N. J.—Articles of incorporation were filed in the County Clerk's office by the St. Louis & Illinois Suburban Railway Company, with an authorized capital of $3,000,000. The new company will absorb the St. Louis Traction Company and several small suburban roads.

HAMILTON, OHIO.—Peter Schwab, of Hamilton, promoter of the Eastern Indiana Traction Company, has secured a franchise through Winchester, Ind.

CLEVELAND, OHIO.—Rumors are again numerous to the effect that the Everett-Moore syndicate will soon gain control of the Cleveland City Railway Company.

KENTON, OHIO.—The Hardin County Commissioners have granted a franchise through this county to the Toledo, Columbus, Springfield & Cincinnati Railway Company.

MAUMEE, OHIO.—An ordinance has been presented to the Council of Maumee asking for a franchise through town for a line which will parallel the Toledo & Maumee Valley.

MARYSVILLE, OHIO.—Representatives of the Toledo, Columbus, Springfield & Cincinnati Railway are securing right of way through Union County for the line to Columbus.

YOUNGSTOWN, OHIO.—Official announcement has been made of the organization of the Youngstown, Sharon, Sharpsville and Wheatland street railway, lighting and heating properties.

CLEVELAND, OHIO.—The Findlay & Southern Railway has placed a contract with the Ohio Construction & Financing Company for the construction of the road through Union County.

BOWLING GREEN, OHIO.—The Wood County Commissioners have granted franchises through the town to the Toledo, Bowling Green & Southern Railway and to the Lake Erie, Bowling Green & Napoleon Railway.

LEBANON, OHIO.—The Hamilton County Commissioners have granted a franchise along the Montgomery Pike to the Rapid Railway Company, of Cincinnati, for its line from that city to Dayton by way of Lebanon and Mason.

CLEVELAND, OHIO.—A report comes from Toledo to the effect that the Everett-Moore syndicate has acquired the Toledo & Maumee Valley Railway, running from Toledo to Perrysburg. It is said that $750,000 was paid for the property.

MANSFIELD, OHIO.—Work has been started between Crestline and Mansfield on the Galion, Crestline & Mansfield Railway. Considerable track has been laid on the line between Galion and Crestline, and it is claimed the entire road will be in operation by January 1.

HAMILTON, OHIO.—The Mill Creek Valley Electric Railway Company has started its new power-house at Hartwell, and the plant and headquarters at St. Bernard are to be abandoned. The road is now in first class running order from Cincinnati to Hamilton.

CHILLICOTHE OHIO.—Contracts for the electrical equipment, power-house and sub-station machinery of the Chillicothe & Hillsboro Traction Company have been let. All other contracts are to be let in a few days. R. A. Crandall, of Chicago, is at the head of the syndicate controlling the road.

CLEVELAND, OHIO.—The Toledo & Western Railway has filed a mortgage in Toledo in favor of the Western Reserve Trust Company, of this city, securing payment of an issue of $1,250,000 of 5 per cent gold bonds. It covers all the property of the company in Lucas and Fulton counties, Ohio and Lenawee County, Mich. The road is already in operation in these counties.

LISBON, OHIO.—Hait & Smith, Cleveland attorneys, who some time ago secured franchises for a line from Salem to Lisbon and East Liverpool, but who permitted them to expire through failure to commence work, are again in the field and claim they have secured Eastern backing sufficient to carry out the project. They are endeavoring to secure extensions of the old franchises.

CLEVELAND, OHIO.—A newspaper report from Steubenville intimates that the Everett-Moore syndicate has secured control of the Steubenville, Mingoe & Ohio Valley Traction Company. The report probably arose from the fact that Mr. Moore is a director in the Wheeling Traction Company, which is planning a number of extensions into Ohio, among them a road to Steubenville from Bridgeport.

CONNEAUT, OHIO.—The Conneaut & Southeastern Railway, which was recently incorporated, has organized as follows: Directors, F. J. Cheney, G. M. Brown, George J. Chapman, A. M. Cox, G. W. T. Watson and George Cleveland, G. J. Chapman, president; W. F. Stanley, vice-president; George H. Cleveland, secretary; G. M. Brown, treasurer. Right of way between Conneaut and Pierpont is being secured, and it is stated that construction work will start in the spring.

CLEVELAND, OHIO.— A dispatch from Detroit quotes H. A. Everett as saying that stock is rapidly being deposited for the bonds in the new Michigan corporation promoted by the Everett-Moore syndicate, and that within thirty days the consolidations will be completed and the properties of the Detroit United Railways will be turned over to the new company. Mr. Everett stated that the Toledo & Detroit Shore Line between Toledo and Monroe will be equipped with electricity in place of steam.

OTTAWA, ONT.—The luxurious electric car which has been provided by the Ottawa Electric Railway Company expressly for the use of the royal party, upon the occasion of the visit to Ottawa, is 50 feet in length, is vestibuled at both ends, and has a full monitor roof of the Pullman type. The interior is finished in antique polished oak. The car is brilliantly illuminated by five clusters of incandescent electric lamps, twenty-one in all. The electric equipment consists of four Westinghouse, 50-horse-power motors. The car is also fitted with the Westinghouse air brake, and is capable of attaining a speed of fifty miles per hour. This is the first electric tram car ever provided exclusively for the use of royalty.

WILLIAMSPORT, PA.—A charter has been granted to the Whitemarsh & Upper Dublin Street Railway Company, which is capitalized at $36,000.

DOWNINGTOWN, PA.—The Town Council passed an ordinance allowing the Tennis Trolley Company to use the streets of the burg.

BLOOMSBURG, PA.—The Berwick Town Council has granted the Columbia & Montour Electric Railway the right of way through the town's streets.

WILLIAMSPORT, PA.—A charter has been granted to the Whitemarsh & Upper Dublin Street Railway Company, which is capitalized at $36,000.

BLOOMSBURG, PA.—The Catawissa Council has granted the Columbia & Montour Electric Railroad the right of way through the streets of that borough.

DOYLESTOWN, PA.—The stockholders of the Quakertown Traction Company have authorized an increase in the capital stock of the company from $150,000 to $300,000 and an increase in the bonded indebtedness from $150,000 to $300,000.

HARRISBURG, PA.—The Cambria Street Railway Company has been incorporated by Frank G. Harris, Clearfield; F. L. Snyder, of Kylertown; W. H. Sandford and E. C. Brown, of Patton; J. E. Hedding, of Morrisdale; A. E. Patton, of Curwensville; James Kerr, of Clearfield; I. A. Sweigard, of Philadelphia; A. G. Palmer, of Corning, N. Y.; Fred. G. Harder, of Harrisburg, and T. Stewart Pierce, of Saltsburg.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company will expend $80,000 in general improvements.

FORT WORTH, TEX.—The North Texas Traction Company, which is building the interurban line to connect Fort Worth and Dallas, has closed a contract for the erection of the power-house at Handley, to cost $250,000.

MILWAUKEE, WIS.—The Milwaukee, Burlington & Lake Geneva Railway Company has been granted a franchise for the Milwaukee end of the line.

WAUKESHA, WIS.—The Milwaukee Electric Railway & Light Company will build a new power plant in this city to handle the Waukesha Beach line, and half of the Milwaukee-Waukesha line. The present power plant is poorly located, and has become inadequate.

ELKHORN, WIS.—A franchise has been granted to George J. Hurd, of Janesville, Wis., for the construction and operation of an electric railway through this city. This is the Janesville, Elkhorn & Lake Geneva line. H. H. Clough, promoter of the Janesville, Beloit & Delavan Lake electric railway, has also applied for a franchise.

THE AUTOMOBILE.

THE MOBILE TRANSIT COMPANY has been organized in McKeesport, Pa., and will operate a number of automobiles and carry passengers at 5 cents per fare from the downtown district to the residence portion of the city on the surrounding hills. Mr. James Evans, president of the National Bank of McKeesport, is the promoter of this new enterprise.

ELECTRIC OMNIBUSES.—The Western Navigation Company, which operates steamers between San Francisco and Alviso, has ordered six electric omnibuses from an Eastern firm. On their arrival an electric 'bus line will be put into operation between Alviso and San Jose, making close connections with the San Francisco steamers. The service will later be extended beyond San Jose.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC LIGHT AND RAILWAY EQUIPMENT COMPANY, of Newburg, N. Y., has been incorporated, with a capital stock of $60,000.

THE MAYAGUEZ ELECTRIC COMPANY, capital $100,000, has been incorporated by Cecil D. Giles, New York; Oscar L. Gubelman, Jersey City, and Frank H. Lord, New York.

THE HOGAN MOTOR COMPANY, of West Haven, Conn., has been incorporated in New Jersey; capital, $75,000. Incorporators: Frederick Brown Wells, Edwin S. Thomas, John J. Hogan.

THE CENTRAL ELECTRIC & CONSTRUCTION COMPANY, Princeton, N. J., has been incorporated; capital, $5,000. Incorporators: Chas. P. Fitch, Wm. W. Parsons, George B. Parsons.

THE MOBERG ELECTRIC CLOCK COMPANY, of New York City, has been incorporated; capital, $350,000. Directors: A. E. Schatz and George Meder, of Mount Vernon, and J. M. Lincoln, of New York City.

THE ELECTRICAL PORCELAIN COMPANY has been organized at East Liverpool, Ohio, with $30,000 capital. The incorporators are William Erlanger, William Erlanger, Jr., S. C. Dyke, Harry Peach and R. J. Marshall.

THE MANUFACTURING ELECTRICAL NOVELTY COMPANY, of New York City, has been incorporated at Albany, to manufacture and deal in electrical apparatus and electrical goods of all kinds. The capital stock is $10,000.

THE YOST-MILLER COMPANY, of Toledo, Ohio, has been incorporated, with $25,000 capital stock, to manufacture electrical supplies and novelties. The officers are: J. L. Yost, president; George F. Miller, Sr., secretary; Charles A. Yost, general manager. Directors, the above and L. P. Dickinson and O. E. Kennedy.

THE BANKERS' AND TRADERS' COMPANY, of New York City, has been incorporated to do a general contractor's business, to operate foundries and rolling mills, to supply electricity, to deal in real estate, and to promote business enterprises; capital, $250,000. Directors: Horace C. Hunt, Rockland, Mass.; James J. Allen, and Charles A. Decker, New York City.

LEGAL.

PAN-AMERICAN.—The Pan-American Exposition Company, of Buffalo, has been sued in the Supreme Court, New York City, by the Mayo & Rohrer Company, dealers in electrical supplies. In addition to the action here, a mechanics' lien for $2,929.65 has been filed by the plaintiffs in Erie County. This lien is for the amount said to be due, and is placed on all the buildings of the Exposition.

PERSONAL.

MR. N. WETMORE HALSEY, for many years connected with N. W. Harris & Company, the bankers handling electric railway and lighting securities, has formed the firm of N. W. Halsey & Company, to deal in railroad bonds and other securities at 49 Wall Street.

MESSRS. NORMAN C. SAWERS and D. McNaught, of the India Rubber, Gutta Percha & Telegraph Works Company, Limited, of Silvertown, England, sailed by the "Umbria" on Saturday last for home after a most enjoyable month in this country, including the Institute meeting, the Pan-American, and a trip West.

MR. D. L. HUNTINGTON, secretary and manager of the Washington Water Power Company, of Spokane, Wash., is one of the few far western men that came east to attend the Edison convention. This year Mr. Huntington came not only to Buffalo for that convention last week, but to New York, and paid the ELECTRICAL WORLD AND ENGINEER a visit. Mr. Huntington has one of the best maintained systems of street railway and electric lighting the far northwest.

MR. R. C. P. HOLMES, the purchasing agent of the Chicago Edison Company, met with a most serious accident on Sept. 6 while riding on an Illinois Central suburban train. He was on the last car of the train and fell off the platform, both hands being engaged in lighting a cigar. He struck his head, receiving a severe scalp wound, while his collar bone and three ribs were broken. These injuries are fortunately not fatal, but Mr. Holmes will be an invalid for some time to come.

MR. W. WAMPLER, lately with the Peckham Manufacturing Company, has undertaken to handle the railway supplies of the Stuart-Howland Company, Boston, in New York, Pennsylvania, Delaware, New Jersey and Maryland. He has been connected for twelve and a half years with street railway work. He was one and a half years mechanical superintendent for the Union Railway Company, of New York, and then in the same capacity with the Atlantic Avenue road in Brooklyn. He resigned to become superintendent of rolling stock and equipment for the Union Traction Company of Philadelphia, remaining four years, when, in 1898, he became associated with the Peckham interests.

MR. H. L. SHIPPY, New York manager for the Roeblings, had one of the "closest calls" of his life last week, when the fine 120-foot McCormick steam yacht "Rapidan" was wrecked in a northeast gale off Cape Henlopen, Delaware. The party and crew were landed with great difficulty in surf boats, after it was found that the breeches buoy could not be used by the Life Saving Corps. The yacht was to have been employed by the Roeblings for the entertainment of their friends during the cup races. Mr. Shippy is one of the most popular and highly esteemed men in New York in electrical and mechanical circles, and his office on Liberty Street has been visited by a host of friends desirous of expressing to him in person their heartfelt congratulations on his narrow and lucky escape.

EDUCATIONAL.

COOPER UNION DAY SCHOOLS.—A prospectus of the free day classes in civil, mechanical and electrical engineering and chemistry has just been issued by Cooper Union, New York. These classes were started last year, and afford many parents the opportunity of sending their sons to some engineering institution of learning.

Trade Notes.

CHANGE OF NAME.—The Electric Heat & Power Company, Chicago, has changed its name to Pearce Construction Company.

THE STANDARD TOOL COMPANY, Cleveland, Ohio, has issued a neat pamphlet in Spanish describing and illustrating its lines of drills, taps, etc.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has just closed several large contracts for hotel telephone equipments. It has a special catalogue covering this work which it is sending upon application.

OIL FILTERS.—The Calumet & Hecla Copper Mining Company, the largest copper mining company in the world, has ten Cross oil filters in successful use in its mines. They were furnished by the Burt Manufacturing Company, of Akron, Ohio.

STEAM SPECIALTIES.—The Wright Manufacturing Company, Detroit, Mich., in an 18-page pamphlet describes and illustrates its steam specialties, including safety water columns, feed water controller, steam traps, etc. Price lists of the various goods are also included.

DROP HAMMERS AND TRIMMING PRESSES, as manufactured by the E. W. Bliss Company, Brooklyn Borough, New York, are illustrated, and their principal features pointed out in a 24-page pamphlet just issued by the company. The Bliss Company makes a very complete line of standard machines and tools.

DRILL PRESSES.—The Knecht Brothers Company, Cincinnati, Ohio, is making a friction drill press, for which many points of excellence are claimed. The driving mechanism consists of two cones and a friction roller. The power is transmitted from the lower cone to the friction roller, which transfers the power to the upper or spindle cone, and the speed of the drill spindle is increased or diminished instantly without stopping the machine or shifting belts.

STEAM HOT BLAST APPARATUS.—Included in the extensive line of manufactures of the B. F. Sturtevant Company, Boston, Mass., is a steam hot blast heating and drying apparatus, which forms the subject of a special pamphlet of recent issue by that company. This apparatus has been developed to a point where it can be readily built in any proportions and adapted to the most peculiar requirements. The entire heating surface is massed in a fireproof casing in connection with the fan, which can be driven by belt, engine or electric motor, as desired. Several illustrations show the different styles of apparatus. At the back of the pamphlet are given some tables for calculations in pneumatics.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is introducing a new "S. L." arc lamp hanger board with absolute cut-out, for series direct or series alternating arc lamps, for use both indoors and outside. It regards this board as by far the strongest and practically the best it has ever seen, and its success with it has been more than satisfactory. The body of the board is made of extra heavy, solid porcelain, with very handsome black enameled hood. All the exposed parts have a highly glazed surface, and there is no fibre or mica on it to give out. It has a closed top, and the switch is perfectly air and water tight, and it has ⅞-inch break. The company has gotten out a very handsome bulletin illustrating this, which is mailed on application.

TROLLEY TRIPS are becoming the subject of a special branch of travel literature, and have led to the production of some excellent Murray and Baedeker guides in miniature. The latest of these to reach us is "Trips by Trolley Around Hartford," in handsome yellow paper cover, which for 10 cents gives an admirable idea of the parks, roads, historical haunts, fine homes, monuments, etc., of the whole region. It is profusely illustrated with half tones and maps, and, as usual, can be slipped in the coat or hip pocket for consultation. An interesting feature are the trips laid out from Hartford south to New York and north to Boston. The compilation is due to Mr. Herbert O. Warner, and the enterprising publishers are White & Warner, Hartford, Conn.

INTERCHANGEABLE ARC LAMPS.—The General Electric Company has just issued a handsome pamphlet, No. 1032, on the subject of interchangeable arc lamps. It points out the manner in which central stations called upon to furnish alternating and direct low-tension current and to operate at least three different kinds of enclosed arc lamps, can carry a supply of a few parts by means of which lamps installed for alternating-current service can be readily changed over for operation on direct-current; while lamps can also be changed from 110 to 220-volt multiple service with equal facility. The pamphlet shows in detail the various parts necessary to effect such changes and explains the mechanism, and is illustrated also by a variety of cuts showing the application of the enclosed arc in interior spaces, show windows, etc.

INSULATED WIRE EXHIBIT.—The Hazard Manufacturing Company, Wilkesbarre, Pa., is making an attractive exhibit at the Pan-American Exposition, of its complete line of insulated wires and cables, also samples of its wire rope manufactures. The company was established in 1848, but recently extended its works to include the manufacture of electrical conductors. The range of these latter products includes weatherproof and rubber covered wires and cables, magnet wires of all shapes, cotton and silk covered, and special conductors. The company is distributing at its Pan-American booth two handsome pamphlets descriptive and illustrative of its products, in both of the above-named lines. Views of the various departments of the electric wire mill are shown, together with illustrations of wire samples. The pamphlet on wire rope products is completely and attractively illustrated.

"STEAM."—One of the best known trade catalogues is that with the above title issued by the Babcock & Wilcox Company, of New York and London, a thirty-second edition of which has recently reached us. The book appears in its time-honored cloth cover of deep blue and gold, and comprises some 130 pages of technical matter and illustrations, and lists of plants, in which the well-known water tube boiler of the B. & W. make has been installed. It is needless at this late date to comment upon the value of the excellent technical data as to boilers, steam engines, etc., brought together in this valuable pamphlet, but one becomes more and more impressed in looking over the pages to note the growing variety and magnitude of the plants and buildings in which these boilers have been installed, not only in this country, but throughout the world. The book is prefaced with a very handsome half-tone illustration of the large new works of the company at Bayonne, N. J.

RECONSTRUCTED ARMATURES.—A very interesting pamphlet issued by the Gregory Electric Company deals with "reconstructed armatures," a specialty to which it has been devoting considerable attention with corresponding success. It must not be understood that these armatures are merely rewound. They are "created anew," old surface wound being made, for example, into the latest improved toothed and slotted types, with consequent increase in efficiency. The changes made in this way on some of the earlier alternating current machines are quite remarkable, and the pamphlet contains explanations and a large amount of data. Details are also given as to rewinding transformers, direct current armatures, refilling commutators, making repairs on street railway machinery, etc. The concern is also putting in self-oiling bearings to take the place of oil cup bearings in the old surface wound generators. In short, as an exposition of the manner in which apparatus that would otherwise grace the scrap heap can be made over into efficient modern mechanism, the booklet deserves to be very widely read and acted upon.

ORDERS FOR HARRISBURG ENGINES.—In addition to the foreign and domestic orders, reported last week, Mr. W. P. McKenzie, New York agent for the Harrisburg Foundry & Machine Works, notes the following: The North Milwaukee Vulcanized Rubber Company, of Morrisville, Pa., has ordered a 40-hp standard simple engine for direct connection to a Stanley 25-kw generator. The Townsend & Downey Shipbuilding & Repairing Company, of Shooters Island, is to have a 150-hp standard simple engine, direct connected to a 100-kw generator, built by the Westinghouse Electric & Manufacturing Company. The Arlington (N. J.) Manufacturing Company has ordered a 120-hp standard simple engine to be direct connected to a 75-kw Eddy generator. The Edward Malley Company, of New Haven, Conn., has ordered two 120-hp Ideal engines for direct connection each to a 75-kw generator manufactured by the Bullock Electric Company. An order has also been received from the Thomson-Starrett Company, of 51 Wall Street, for one 115-hp and one 75-hp Harrisburg standard simple engine to be installed in the building to be erected corner of William and Cedar Streets, New York City. These engines will be direct connected to 75-kw and 50-kw generators of Westinghouse manufacture.

THE RISDON-ALCOTT TURBINE COMPANY.—The well-known firm of T. C. Alcott & Son, of Mount Holly, N. J., have acquired by purchase the entire plant, including all patterns, patents, etc., of the John W. Taylor Manufacturing Company, formerly and better known as the T.

H. Risden & Co., manufacturers of the celebrated Risdon turbine and the Taylor sleeve gate turbine. The combined plants of these companies will be hereafter operated to their fullest capacity by the incorporators, Thomas J. Alcott and his two sons, Edgar A., and Howard E. Alcott, under the name of the Risdon-Alcott Turbine Company. Their product will be turbines and appurtenances almost exclusively, comprising the large assortment of patterns of the Risdon turbine, in cylinder and outside register gate styles, the Holyoke test records of which have never been excelled. Also the high duty turbine of inside register gate pattern, which has been recognized for years as a first class wheel in every particular, and one that could always be depended on to give satisfaction; also the Taylor sleeve gate turbine, which is a wheel of very large capacity. This is one of the newer wheels, and has yet to establish its name, but with the recognized ability of the Alcotts as water wheel builders this is assured. The wide range of power and speed covered by the different sizes and patterns controlled by this company makes it possible for them to fulfill the requirements of almost any situation. The greatly increased facilities of this company in the way of new buildings and new tools and appliances enable them to handle work of large magnitude with considerable dispatch. The new company will be glad to send their catalogues to any users of water power who may be interested in high-grade turbines.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED SEPT. 10, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

682,165. CONTACT DEVICE FOR ELECTRIC RAILWAYS; W. M. Brown, Johnstown, Pa. App. filed Jan. 8, 1901. Details of construction of a sealed box in the roadbed, the contacts in which are brought together by a magnet carried by the vehicle.

682,184. ELECTRIC LIGHTING BY LOW FREQUENCY CURRENTS; W. C. Fish, Lynn, Mass. App. filed Jan. 26, 1901. (See Current News and Notes.)

682,187. TROLLEY WIRE SUPPORT; W. Gerard, St. Bernard, Ohio. App. filed Jan. 17, 1901. The trolley wire is deflected in its passage through the clip and is clamped therein.

682,203. STATIC MACHINE; T. B. Kinraide, Boston, Mass. App. filed March 5, 1901. The machine is provided at the receiving terminal with means for preventing discharge, and at the opposite terminal with means for freely permitting discharge.

682,204. DEVICE FOR INDICATING LEAKS IN INSULATION OF ELECTRIC CONDUCTORS; I. Kitsee, Philadelphia, Pa. App. filed Jan. 24, 1900. An indicating device, one terminal of which is connected to the circuit proper and the other to a conductor insulated from, but in close proximity to, said circuit.

682,205. RECORDING DEVICE; I. Kitsee, Philadelphia, Pa. App. filed March 16, 1900.

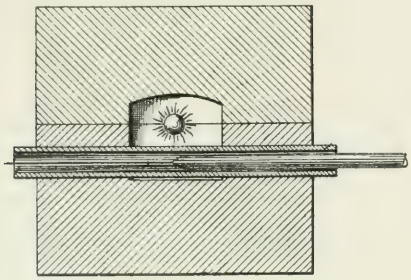
682,215. BUSHING FOR ELECTRICAL CONDUITS; M. Mauer and W. J. Billings, New York, N. Y. App. filed Feb. 19, 1901. The bushing is eccentric in shape, and passes into an eccentric hole through which the conduit projects, and is locked therein by a slight rotation.

682,217. CIRCUIT BREAKER; F. A. Merrick, Johnstown, Pa. App. filed Jan. 18, 1900. Details.

682,219. ELECTRIC REGULATOR; M. Moskowitz, New York, N. Y. App. filed Sept. 27, 1900.

682,220. AUTOMATIC REVERSING SWITCH; M. Moskowitz, New York, N. Y. App. filed Sept. 27, 1900.

682,233. OUTLET BOX FOR INTERIOR CONDUITS; W. F. Bossert, UTICA, N. Y. App. filed July 20, 1901. A metal outlet box, having one or more partially formed openings in its walls, each opening being circular in configuration, the peripheries of the openings and of their partly-expelled blanks being mutually indented.



682,337.—Manufacture of Incandescing media for Incandescent Lighting.

682,300. ELECTRICAL POWER TRANSMISSION SYSTEM; N. G. Warth, Indianapolis, Ind. App. filed Feb. 11, 1900. To generate direct currents of high potential by utilizing the output of a number of direct-current generators without causing the generated current to pass through each generator, a number of secondary batteries are serially connected with each other and with the transmission line, and operated simultaneously with the generators.

682,324. ELECTRIC HEATER; J. P. Erie, New York, N. Y. App. filed Sept. 22, 1900. Mechanical arrangements for uniting heater sections.

682,332. MEANS FOR AUTOMATICALLY REVIVING EXHAUSTED TELEPHONE PULSATIONS; M. C. Mengis, Sheepshead Bay, N. Y. App. filed Aug. 31, 1899. Details of a telephone repeater.

682,333. TELEPHONE TRANSMITTER; M. C. Mengis, Brooklyn, N. Y. App. filed Feb. 15, 1900. A button on the diaphragm fits into a cavity in a number of contact sections.

682,337. MANUFACTURE OF INCANDESCING MEDIA FOR INCANDESCENT LIGHTING; R. A. Nielsen, Copenhagen, Denmark. App. filed July 14, 1900. Oxids of the rare earths are subjected to the heat of the arc while shielded from the electrolytic decomposing action of the arc, until the said oxids are melted, whereupon they are drawn out into threads.

682,351. FREQUENCY INDICATOR; C. C. Chesney and W. J. Lloyd, Pittsfield, Mass. App. filed May 25, 1901. (See Current News and Notes.)

682,377. ELECTROMAGNET; T. H. Wurmb and R. Baumann, St. Louis, Mo. App. filed April 9, 1900. Details.

682,380. ELECTRIC BELT; W. M. Davis, Springfield, Mo. App. filed April 9, 1900. Details.

682,381. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed Jan. 28, 1901. The system is of that class in which the conductor is lifted by magnetism into contact with an exposed stud in the roadway.

682,392. TROLLEY; J. A. Thompson, McDonald, Pa. App. filed April 18, 1901. Details.

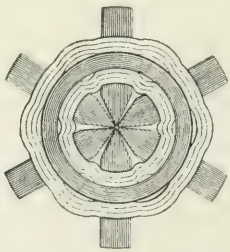
682,417. ELECTRIC BATTERY; W. Mills, Elizabeth, N. J. App. filed Oct. 3, 1900. The carbon cylinder is provided with radial insulated pins which prevent contact with the zinc cylinder.

682,428. STATION INDICATOR; E. A. Russell, Newark, Ohio. App. filed Aug. 16, 1900. A belt carrying the station names, is moved by the action of a solenoid.

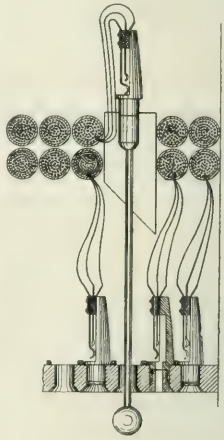
682,433. RESONATOR; J. F. Skirrow, East Orange, N. J. App. filed Feb. 15, 1901. A resonator for telegraph sounders adapted to increase and direct the sound to the ear of the operator.

682,458. TELEPHONE PROTECTOR; A. Deck, Franklin Township, Montgomery County, Ind. App. filed June 12, 1901. Details.

682,475. PRIMARY BATTERY; S. W. Maquay, Chertsey, England. App. filed Aug. 6, 1900. The carbon electrode is provided with a number of recesses, into which projections from the zinc electrode extend.



682,520.—Electrical Transformer.



682,566.—Mechanism for Removing or replacing Switchboard Jacks.

682,520. ELECTRICAL TRANSFORMER; A. F. Berry, London, Eng. App. filed Jan. 23, 1901. As a new article of manufacture, a laminated iron block adapted to form part of a transformer-core and composed of long straight parallel strips of sheet iron of different widths held side by side with the ends of alternate strips arranged to overlap the corresponding ends of the intermediate strips.

682,540. ELECTRIC SWITCH; C. E. Gaffney, Pawtucket, and F. A. Tibbetts, Providence, R. I. App. filed May 20, 1901. Improvements in the switch tongue to reduce the friction in motion.

682,554. REGULATING DEVICE FOR ELECTRIC ARC LAMPS; P. Kassbauer, Vienna, Austria-Hungary. App. filed June 1, 1900. Details.

682,566. MECHANISM FOR REMOVING OR REPLACING SWITCHBOARD JACKS; W. S. Paca, Erie, Pa. App. filed Dec. 26, 1900. A tool for removing jacks from telephone switchboards comprising substantially a rod screw-threaded on one end so as to screw into a jack from the front of the switchboard and the jack moved back, thereby through the opening between the switchboard cables and returned through said opening to its place in the board.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, OCTOBER 5, 1901. No. 14.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 5, 1901.

CONTENTS.

	PAGE
Editorial	[illegible]
Programme for the American Street Railway Convention	530
Electrical Engineers of the Day—XIV. W. L. R. Emmet	530
The Power-House and Distribution System of the Metropolitan Street Railway of New York	531
The Influence of Polyphase Apparatus on the Design of Railway Power Stations, by J. E. Woodbridge	532
The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour, by Walter Reichel	536
Automobile Storage Batteries	538
Tangential Traction Electric Railway System	546
Changing a Magneto Drop to a Central Battery System, by Charles L. Goodrum	547
The Inductor Alternator—I, by Edward Heitmann	548
An Improved Apparatus for Arc-Light Photometry	549
Electric Automobilism in the Sandwich Islands	551
Electricity and the Royal Visit to Canada	553
New York Rapid Transit's Power Plant	554
Telephoning to Hospice of St. Bernard	554
Independent Telephone Development	555
Current News and Notes	555
LETTER TO THE EDITORS:	
Shaft Oscillation, by Alphonse A. Adler	557
Digest of Current Electrical Literature	557
New Books	561
Compound Engine Controller, by Ralph J. Patterson	562
The Lincoln Synchronizer	562
Electric Water Heater	563
Halsey Direct-Current Meter	563
Telpherage Ash-Handling at Elizabethport, N. J	564
The Sterling Incandescent Lamp	565
A Recent Type of American Electric Mining Locomotive	565
Eureka Telephone Apparatus	566
Electro-Mechanical Railway Switch	566
"Twin" Type of Trolley-Wire Hangers	567
Telephone System in Private Houses	567
Electric Canal-Towage	568
Motor for Electro-Hydraulic Plant	568
Compact Generating Set	568
Belt Conveyors as Ash-Handlers	569
Storage Battery for Telegraphic Use	569
D. & W. Fuses at Buffalo	569
DEPARTMENTS:	

AUTOMOBILE STORAGE BATTERIES.

Elsewhere in this issue we print an article giving an account of the principal storage batteries designed more especially for automobile work. With one or two exceptions the list is inclusive of all the batteries for automobile service now commercially available in this country. It is quite significant that applications for information concerning automobile storage batteries for which sensational newspaper claims have been made, were in every case fruitless. The data of batteries described have been obtained from the several manufacturers, and the claims in descriptions as to points of superiority are also those of the makers. Such an *ex parte* presentation has at least the advantage that the reader has placed before him the best that can be said of each battery considered, and by comparison of the claims he can, in connection with the descriptions given, form some sort of a personal opinion as to relative merit. It is only fair to say that too much stress should not be laid upon the comparisons given upon the basis of a three-hour discharge. If each battery were designed for precisely the same service, and there were a definite standard of durability, such a comparison would be proper. In the present stage of the automobile batteries, however, this is not the case, and even when the automobile has become thoroughly established commercially in the great field open for it, the requirements of different services will result in battery differentiations that will continue to preclude such a comparison. In considering the comparisons given, the reader should, therefore, have due regard to the constructional and other details of the different batteries considered.

At present there is in this country no disinterested source to which one, in case of need, may have recourse for data upon which to base an opinion as to the capability of different types of storage batteries for a given service. We firmly believe that in no manner could electric automobilism be so well served and as rapidly advanced in this country as by service trials of storage batteries patterned after those which are annually conducted in France by the Automobile Club of that country. If a corresponding American body were to institute similar trials here, it would perform an infinitely greater service than by effort wasted in encouraging racing contests, which are of practically no value in the advancement of the art as a whole. While the French trials may not have had any remarkably beneficial effect, we believe that such trials here, but conducted along somewhat different lines would, by powerfully directing the attention of our manufacturers and inventors to the really essential points of the storage battery as applied to automobile work, accomplish wonders in perfecting batteries for such work. There does not appear to be any uniformity in such service trials as are at present made, and scarcely any deductions can be drawn from the results obtained, which remark also to some extent applies to the French trials. What appears to be called for is a system whereby trials may be made with storage batteries on the basis of several tractive efforts and speeds to be fixed by the conditions of the different services, the capacities of batteries to be determined by the distance run on a single charge, and a sufficient number of runs being made to give some indication as to the rate of depreciation. A battery making a favorable showing under such conditions would then be known to be worthy of the more extended tests to determine its true practical value on the basis of the cost per tractive unit per mile in terms of investment, depreciation and up-keep.

AN IMPROVED APPARATUS FOR ARC-LIGHT PHOTOMETRY.

The paper on this subject by Professor Matthews, read last week before the A. I. E. E., is an interesting contribution to the literature of photometry. The special problem under consideration in the paper is the measurement of the mean spherical candle-power from a single observation of an enclosed arc lamp, or of an arc lamp in a glass globe. This is such a large luminous source that special apparatus has to be employed for automatically determining the spherical candle-power. The plan is to place a mirror at each 15 degs. of a vertical circle including the arc lamp, representing 24 mirrors in all, and interpose a smoked screen in the path of the reflected beam from each mirror in such a manner that the ratio of the light thrown by the mirror towards the photometer screen, to the light thrown by a mirror at zero elevation, is approximately equal to the cosine of the angular elevation of the mirror. Thus the mirrors 60 degs. above or below the horizontal plane should reflect to the photometer just half the light that is thrown by the mirrors on the horizontal plane. Theoretically, of course, the number of mirrors should be very large, but, practically, one for each 15 degs. is allowed, and these, if correctly calibrated, would no doubt supply a fair approximation to the actual mean spherical candle-power.

The principal objection to the apparatus is the large amount of labor required to adjust the absorption of the 22 mirrors actually used, and the liability of the absorption to increase unduly or irregularly with age. Moreover, the total light thrown on the photometer screen is 15.2 times as strong as that which a single mirror reflects at the horizontal plane, or 15 times as much light as the most favorably situated mirror, into the path of which no absorption is introduced. For this reason, the illumination at the photometer screen is very great, unless the photometer is to be of unusually great length. Professor Matthews inserts a revolving sectored disk into the composite beam so as suitably to reduce the total intensity of illumination at the photometer screen. Of course, once the instrument has been set up and properly calibrated, there can be no doubt of the advantage of obtaining the mean spherical candle-power from a single measurement, instead of from a considerable number of successive measurements at different elevations, followed by calculation.

Although the spherical candle-power determination of any source of light is the only reliable basis of comparing dissimilar and dissymmetrical light sources, yet it seems inadvisable to rate or estimate lamps in commercial practice by their mean spherical candle-power. For example, an incandescent lamp of 16 mean horizontal British candle-power, is a lamp which in a mean horizontal direction emits within a very small solid angle 16 times as much light as a British standard candle through the same small solid angle. Such a lamp might have a mean spherical candle-power of 13 candles, which is the same as saying that the lamps emit 13 times as much light in all directions, as a British candle would emit if it were a glowing point capable of emitting light equally in all directions. If spherical candle-power determinations became frequently necessary in order properly to compare lamps of different filamentary shapes, we might thus fall into the liability of confusing the spherical with the horizontal candle-power, and when we spoke of a 16-cp lamp it might become a matter of doubt as to whether we meant a lamp of 16 mean horizontal candle-power, or a lamp of 16 mean spherical candle-power, which latter would correspond to some 19.5 mean horizontal candle-power.

In order to avoid this confusion, it would be far preferable to refer all mean spherical determinations to the quantity of light emitted, and state the result in lumens instead of in candle-power. Since a British candle, assumed as a point-source, emits 4π or 12.567 British lumens, or a Hefner-Alteneck lamp emits similarly 12.567 Hefner lumens, all we have to do is to multiply the mean spherical candle-candle-power of a lamp, as measured in Hefner's or British candles by the factor 12.567, and the result is the total quantity of light emitted by the lamp in all directions, expressed in the corresponding lumens. Thus a 12-cp lamp would be a lamp of 12 mean horizontal British candle-power, but probably of about 125 British lumens. The advantage of this plan is that not only would all confusion in rating be avoided, but that so long as we use the word "candle-power" in defining a lamp, we should understand that we refer to its luminous intensity in a horizontal direction, whereas when meeting the term lumen we should know that the light emitted is referred to, and this would naturally mean the total light emitted, or the spherical emission of light.

CLUTCH VS. RHEOSTAT IN ELECTRIC TRACTION.

The discussion which has been so actively going on for the past few months on the relative merits of alternating and direct-current motors for long electric railway lines does not appear to take into account some of the possible solutions of the problem of doing away with rotary converter sub-stations and supplying alternating-current direct to the car motors. The discussion so far has been based on the assumption that the present system of gearing the motors to the car axles is to be preserved. It is, of course, natural to assume that the present method of gearing the motors directly to the axles—a method which is the survival of the fittest after numerous experiments made when street railway motors were being first developed—is the one to be followed in all future work. It does not, however, necessarily follow that the arrangement which early experiments determined to be the best for street railway service with direct-current motors will fit itself to long-distance alternating-current work as well as some other. This is a point, however, upon which at the present time it would be unwise to express a decided opinion one way or the other. There are a number of difficulties in connection with the use of alternating-current motors for railway purposes that would be so nicely wiped out by the adoption of a clutch connection between motor and car axle in place of the present gears or direct mounting, that it would by no means be surprising if some attempts were made in the near future to work out a successful plan whereby the motors could be run continuously and the car or electric locomotive started by means of a magnetic or friction clutch.

In view of the unsatisfactory outcome of early experiments with clutch mechanism for street railway motors as compared with rheostatic control, there are plenty of engineers who will not be enthusiastic on the clutch proposition. The electrical advantages made possible by it, however, are tempting enough to induce the expenditure of considerable money and thought on such a plan in spite of past decisions in favor of the rheostat as against the clutch. The manifest advantage offered by a continuously running motor on the car is the possibility of making that motor a single-phase motor and transmitting current at high voltages over a single trolley line direct to the motor. This is the same advantage offered by the polyphase railway motor, but lacking the drawback of the double trolley needed for the polyphase motor. The equipment of a motor car or locomotive with a single-phase motor would, of course, require complications not found on a direct-current locomotive, but it is fair to assume that in many cases where alternating-current motors are most desirable for transmission reasons, the extreme simplicity of a street car electrical equipment would not be essential. A little more complication on the locomotives could be indulged in for the sake of eliminating sub-stations with rotary converters. The main point at issue would be the success or failure of the plan of starting the train through the medium of magnetic or friction clutches.

This leads us to a consideration of the fundamental differences between starting a car by means of a rheostat and motors geared solidly to the axles on the one hand, and starting it by clutches with motors constantly running at fixed speed on the other hand. The essential differences are by no means as radical as might at first sight be supposed. In both cases the torque of the motor necesary to start the train is the same if the equipment of motors and ratio of the reduction gears are identical. Hence, the current flowing during acceleration would be the same in the two cases. In one case the surplus electrical energy not taken in train acceleration is dissipated as heat in the rheostat. In the other case it is dissipated as heat in the clutch. The main problem would, therefore, seem to be in the design of a clutch which should be able to dispose of a large enough quantity of energy during the starting of the train without destroying itself too rapidly. This would not seem to present any insurmountable difficulties, especially when the efficiency ease of control and indestructibility of some of the magnetic clutches designed within the past few years is considered. The results obtained, for example, with the magnetic clutch designed for power house uses by Mr. Bion J. Arnold are almost astounding in the small quantity of energy consumed for clutches of great power. The selection of the clutch rather than the rheostat for roads of the kind here discussed may ultimately prove to be impracticable for reasons not now apparent, but it is extremely probable that such methods will at least be given a trial even though they mean such a radical change from methods now in common use. Incidentally, it may be noted that the grips on cable roads have for twenty years past offered examples of successful power transmission through clutch mechanism which should be encouraging to the experimenter along this line.

A Hundred and Twenty-Five Miles an Hour.

In this issue we print a continuation of the account from authoritative sources of the initiation of the remarkable high-speed experiments for the Berlin-Zossen experimental electric road. This is by far the most determined attack on the high-speed problem that has yet been made on either side of the Atlantic, and if skill and experience count for anything, success may fairly be predicted. The only factor in the work which seems somewhat uncertain is the character of the track and roadbed. Although these are constructed with the thoroughness to be expected in a Prussian military road, grades up to 3 per cent and radii of curvature even as short as 1000 meters can hardly be considered as unduly favorable to the attaining of transcendental speeds. As a preliminary to the design of motors and car equipment, Siemens & Halske made an independent series of experiments with whirling bodies to obtain the air resistance to be allowed for at the speeds under consideration. The method employed is substantially that used by Crosby a decade since, but there is a somewhat interesting divergence from Crosby's results. These, somewhat to everyone's surprise, showed that the resistance due to air pressure was quite nearly a linear function of the speed. The German tests seem to show a marked increase of resistance as the speed rises. In the tests with flat surfaces the apparent resistance per square foot from the Berlin results was at 125 miles per hour nearly double the resistance found by Crosby, while the results from a short body bluntly parabolic was as great as Crosby obtained from a body with plane surfaces. The discrepancy is so great as to require investigation. In the German work the bodies were much larger in proportion to the radius of the whirling arms, and the latter were absolutely shorter than in the earlier American tests. If, as has been supposed, the air currents and eddies established in the whirling test tend to lessen the apparent resistance, then the recent results should be smaller instead of larger. It looks very much as if in operating at relatively small radii with a tangentially directed body the eddies, perhaps in the rear, actually increase the resistance very considerably. At all events, results obtained from whirling tables seem open to some doubt, and we shall await the result of the track tests with great interest, although all the American results, however obtained, seem to show that the resistances actually found will be materially smaller than those allowed for in the Zossen work. This, happily, is an error in the right direction.

As regards the general methods used, it will be noted that they run exactly counter to the opinions lately emitted by some American engineers. The two great German firms charged with the electrical equipment of the motor cars have already built and tested polyphase motors to go directly upon the car axles and to deliver a nominal output of 250 horse-power and a maximum output of 750 horse-power each. They have put aside both rotary converters and low frequencies, and are going to work at 50 cycles, taking the energy from a 10,000-volt trolley line. They propose to employ rheostatic regulation in the secondary circuits and to use side running trolleys. We are inclined to think that in the main the German engineers will succeed, although probably not without many minor difficulties cropping out when and where least expected. Of course, there is much to be demonstrated beyond the conditions of operation at 125 miles per hour or more, much that will be perfectly smooth sailing in the way of the collection of data. As to the mere attaining of the speed in question there is substantially no doubt even now, provided the track and roadbed will permit. The actual conditions of operation in the running contacts, the regulating appliances and the brakes are far more serious subjects for consideration than the mere power and efficiency of the motors, on which depend the reaching and maintenance of very high speeds. And most of all, is it important that the conditions of station operation when handling such traffic as the purpose of the tests contemplates be accurately ascertained.

Many of the minor features of the two experimental cars described are of great interest. For example, the use of wind sails on the roof to furnish ventilating blasts for the high-tension transformers, thereby greatly reducing their weight, is an ingenious touch of no little practical value. Likewise, the adaptation of a liquid starting resistance with its cheapness and great delicacy of control through forced circulation of the electrolyte, is a daring solution of what otherwise might be a very troublesome problem. The motors seem to have been very shrewdly designed, although many details of their structure and performance are as yet wanting. Yet a total weight of less than 29 lbs. per horse-power of normal output, with a capacity for working up to an output of a horse-power for barely 10 lbs. of weight, shows that our German confreres know a thing or two about the efficient utilization of material. Although differing in many details, the cars of Siemens & Halske and of the A. E. G. follow the same broad lines to conclusions anything but wide apart so far as the preliminaries show. It is safe to say that both the equipments will perform well, although it will be very interesting to note the difference, for instance, between liquid and metallic rheostats, the *pros* and *cons* of shifting from star to mesh connections, and the relative efficiency of the braking devices. All these matters are material in settling upon the lines to be followed in the practical equipment of a high-speed road, but they are subordinate to the broad facts on which the commercial side of the matter depends. We shall await with the most profound interest the results of the track experiments, with confidence in the ultimate success of the attempt for high speed. We hope, too, that the reports of the progress of the work will be full and complete, for the engineering details will be most interesting, and will go far towards making or marring the future of high-speed traction.

Programme for the American Street Railway Convention.

The twentieth annual meeting of the American Street Railway Association will be held at Madison Square Garden, New York City, Oct. 9, 10 and 11, accompanied by a display of fine exhibits, which will more than fill the great arena. The programme is as follows:

On Wednesday, Oct. 9, 10.30 a. m., the meeting will be called to order, and Walton H. Holmes, president, will deliver his address.

Papers will be presented on Wednesday and Friday on the following subjects: "Street Railways; a review of the past and a forecast of the future"; "The adoption of electric signals on suburban and interurban railways, single or double track, and their economy of operation"; "The value of storage batteries as auxiliaries to power plants"; "The public, the operator and the company"; "The best manner and mode of conducting the return circuit to the power house"; "The American Street Railway Association; The purposes of its organization and the benefits accruing to investors in and operators of street railway properties by membership therein"; "The economies resulting from the use of four motors instead of two on double motor equipments"; "The best form of car for city service; A consideration of the various types of car as to size of car and arrangement of seats, including best types of brakes and wheels"; "Practical results obtained from three-phase transmission power on railway lines"; "Relations of Interurban and city railways"; "The modern power house, including the use of cooling towers."

Thursday, Oct. 10, will be Supply Men's Day. The entire day will be given to the examination of the exhibits.

Friday, Oct. 11, 1901, the convention will meet at 10 a. m. and the election of officers for the ensuing year will take place.

At 7.30 p. m. the annual dinner will take place at Sherry's, Forty-fourth Street and Fifth Avenue, New York City. The installation of the officers-elect will take place at the dinner.

On Saturday the Bethlehem Steel Company has extended to members the hospitalities of its works at South Bethlehem, Pa., running a special train. During the week, the Street Railway Accountants will be in session, also in one of the rooms at the Garden, and several interesting papers will be discussed. Headquarters of the association for the week will be established at the Murray Hill Hotel and at the Garden. The Bell telephone system has been put at the free disposal of members, the New York Telephone Company placing also a telephone in the space of each New York exhibitor. The New York Edison Company will furnish current free to exhibitors during the week. Free street railway fare, honoring badges, will be given on all lines in Greater New York and suburban New Jersey.

Electrical Engineers of the Day—XIV.

W. L. R. Emmet.

William Le Roy Emmet was born in New Rochelle, N. Y., July 10, 1859. Mr. Emmet is of Irish descent, being a great-grandson of the Irish patriot, Thomas Addis Emmet, brother of the famous Robert Emmet, who was executed in 1804. After a preparatory education in various schools in this State and in Canada, Mr. Emmet entered the Naval Academy, from which he was graduated in 1881. After serving two years in the navy he was honorably discharged by enactment of Congress in 1883, with the majority of his class. During the late Spanish-American War Mr. Emmet served as a naval volunteer officer.

Mr. Emmet's advent in the electrical field was in the year 1887, when he became connected in a subordinate capacity with the old United States Illuminating Company, and was thus identified with some of the earliest electric light work in New York. After a year with this company, he joined the Sprague Company, with which he remained until 1890, being actively connected with all the more important electric railways installed by that pioneer organization. At different times and for short periods, Mr. Emmet, acting on behalf of the Sprague Company, was superintendent of the original railway installations in Cleveland, St. Louis, Pittsburg and Harrisburg, Pa., and many other places. On the absorption of the Sprague Company by the Edison General Electric Company, Mr. Emmet joined the staff of the Westinghouse Company, where he remained for a few months, continuing the work of superintendence of installations of railway plants. Mr. Emmet then engaged for a period of about a year, in the manufacture of various railway appliances invented and developed by himself. After a short engagement as the electrical engineer of the Buffalo Railway Company, he accepted an offer of the Edison General Electric Company to become the engineer of its Chicago office, which position he occupied until the consolidation of the Thomson-Houston and Edison General Electric companies, when he was assigned to the general office in New York City. His work here was of a general consulting nature. Mr. Emmet came to Schenectady in January, 1894, on the removal of the general office to that place, and was soon after made engineer of the lighting department, which position he still holds.

Mr. Emmet has taken out a great many patents protecting his inventions. Among these may be mentioned improvements in railway appliances, methods of insulating cables and of coil windings, anti-hunting devices for rotary converters, oil switches and a great variety of types of switches and fuse blocks. Mr. Emmet has also secured patents on air blast transformer construction, especially relating to the separate control of the cooling air for the iron laminations and for the copper conductors; oil transformers of large size, including a method of cooling by running water in a tubular secondary; also methods of cooling transformers by insertion of water vessels between the windings; a method of cooling by enforced circulation of oil; a method of supplying neutral current to a three-wire system by means of a rotary converter; a patent upon automatic regulators, etc., etc.

Mr. Emmet has been prominently identified with the establishment of the system of rotary converters for the distribution of power in cities for railway and lighting purposes. Among the first plants of this character were those of the Chicago Edion Company and

the Brooklyn Edion Company, Mr. Emmet being the directing engineer for the General Electric Company in both cases. The Brooklyn plant is the prototype of many of the existing large central power distribution schemes for railway lighting and power, such as the Metropolitan, Central London, New York Edison and Manhattan systems. The engineering for the General Electric Company around Niagara Falls has been in the hands of Mr. Emmet.

Mr. Emmet was perhaps the first to explain the principle of the parallel operation of engine-driven alternators and to demonstrate his theory by practice. He proved that the difficulties heretofore encountered were incorrectly assigned to the design and proportions of the dynamos; that the engines were the real source of trouble, and that almost any two or more dynamos of equal frequency and voltage may be successfully run in parallel if the engine governors are properly fitted with devices which will sufficiently retard governor movements for a brief period, and then freely yield to continued pressure, due to change of load.

Mr. Emmet is the author of a widely known pioneer treatise on alternating-current wiring and distribution. He has read a number of papers before the American Institute of Electrical Engineers (of which he is now a manager), the National Electric Light Association, and the Edison Association of Illuminating Companies. Mr. Emmet's contributions have been marked by great originality, a wide grasp of the subjects treated, and have been invaluable on account of his extended practical experience.

The Power House and Distribution System of the Metropolitan Street Railway, of New York.

THE interest of electrical men who will attend the Convention of the American Street Railway Association next week will probably center about the great power house of the Metropolitan Street Railway Company, located on the East River at Ninety-sixth Street. As this is the largest electric generating station yet put in operation, and the generating units contained therein are also the largest yet put in operation, considerable interest attaches to the performance of this plant. The economy obtained so far in the operation of the plant is probably not equal to what it will be ultimately when the plant is fully loaded, but is, nevertheless, very gratifying. For a full description of this power house, and especially of the switchboard and circuits of the power house and distributing system, readers of this article are referred to the Electrical World and Engineer, Vol. XXXV., Nos. 13, 14, 15, 16, 17, 19, 21 and 23, a series of eight articles on this subject by Mr. J. E. Woodbridge. These covered the ground so thoroughly that it is not necessary to go into any extended description of the plant here.

It contains at the present writing eight 3500-kw units and the plant is designed to contain three more, which are now being installed. These units are driven to Reynolds-Corliss vertical cross-compound condensing engines, which are supplied with steam from 72 B. & W. boilers located on three floors of the adjoining boiler room. Of course, all operations where it is possible are conducted by automatic machinery, including the handling of coal and ashes, stoking and the oiling systems of the engines.

The generators are 6600-volt, 25-cycle, three-phase machines, and the 6600-volt current is conducted directly to seven sub-stations by means of underground feeders. Before passing to the electrical equipment of the station it may be well to note that the coal consumption of this plant is reported by Mr. M. G. Starrett, chief engineer, to be 2.65 lbs. per kilowatt-hour. This is in actual all-day practice and includes steam taken by all the auxiliary engines, including those driving conveyers and stokers. The water used by the main engines per ihp-hour is given as between 13 and 14 lbs. in actual practice, which is probably as low, or lower, than in any electric generating station now in operation. The coal used is one-half buckwheat anthracite of a low grade, and one half bituminous. Very careful records are kept of every detail in the operation of this plant. The anthracite is burned under half of the boilers and bituminous under the other half.

Switchboard of Metropolitan Street Railway Company, New York.

The electrical output of the station is controlled by means of oil switches with electro-pneumatic operation. Great precautions are taken, as was noted in the previous series of articles referred to, that a short-circuit or failure to interrupt the circuit at one point may not spread so as to cause other short circuits. The switch in each leg of each circuit is confined in a brick cell. Two switches are placed in series in each generator and feeder circuit to insure that the circuit can be broken at all times. Between each generator and the bus-bar there are two three-pole oil break switches in series. When these are opened they are both opened at once by the electro-pneu-

matic relay circuit-controlling switches. The accompanying engraving shows the generator controlling board at this power house in the foreground, with the feeder controlling board in the background. The only circuits brought to the controlling board are those of the low-pressure circuits which operate the electro-pneumatic valves, which in turn control the air to throw the switches. As said before, there are two switches in series for each generator, which are opened simultaneously, but in closing them to throw in the generator it is necessary to close one of the switches first, leaving only one to be thrown in at the instant of synchronism, as it would be difficult to know the time element of the two switches acting together and there might be considerable trouble through the throwing together of generators when not in synchronism, due to the attendant's inability to judge the time element.

The generators are grouped on four sets of bus-bars, each set being independent of the other sets to guard against trouble with one set of bus-bars interfering with the entire station. Feeders also are grouped on four bus-bar sections. An oil circuit-breaker, operated either automatically or by hand, is put in each individual feeder, and also in the circuit supplying each group. Thus there are four oil switches in every circuit between the generator terminals and the conducting feeders. The two or more feeders supplying any given sub-station are taken from different sections or groups on the feeder board, and as far as possible take different routes to the sub-stations which they supply, so that no sub-station draws its current entirely from one portion of the feeder board or from feeders running in the same conduit.

It is gratifying to note that the operation of the oil switches in this station has been very satisfactory, and that they have never failed to open the circuit in any emergency, although at times it is estimated that not less than 2000 amperes at 6600 volts were flowing at the time the circuit was broken.

The high-tension feeders connecting the power house with the sub-stations are naturally the weakest part of the distributing system because of the danger that a defect in one cable will cause a short circuit which will damage neighboring cables. Danger of shutting down any sub-station from this cause has been practically eliminated by the plan just mentioned, but, nevertheless, some other more than ordinary precautions have been found advisable in connection with these high-tension feeders in the conduits. Vitrified conduit seems to possess the requisite amount of heat-resisting material to best prevent the spread of short circuits from one cable to another. However, the most likely location for trouble is at the manholes, and here the high-tension cables are run straight through and are covered with a sheet steel case which is large enough to allow a one-half inch air space between the lead covering and the steel case. The case is made in two parts and held together with binding wire. Wooden bushings over the cable at the ends of the sheet steel protectors hold the case so as to maintain the one-half inch air space around the cable. This air space is found to be of value in preventing the spread of trouble from short circuits, and the casing, of course, tends to prevent mechanical damage. The high-tension feeders used on new work have a paper insulation 7-32 inch thick, it having been found that paper insulation stands the test of time better than rubber at this voltage. All feeders, transformers and other apparatus are tested at 25,000 volts for five minutes, after being put in place and before being put in service. The high-tension feeder cables are all of one size, and contain under one lead sheath three standard conductors equivalent each to a 0000 B. & S. gauge wire.

The seven sub-stations are equipped with a varying number of rotary converters of a capacity of about 1000 kilowatts each. In connection with each sub-station is a storage battery of about 25 per cent of the capacity of the rotary converters at the sub-station. This is for the purpose of taking momentary fluctuations, and it also carries the owl car-load when the alternating current part of the plant is shut down once a week for the cleaning of the high-tension switchboards. Rotary converters are run with plain shunt-wound fields, because by so doing the necessity of reactance coils is eliminated. The drop in voltage on the direct-current feeders is small enough so that series field coils which raise the voltage as the load increases, are not necessary. Later, when these rotary converters are installed they are tested to determine at what field strength their power factor is unity, and the field strength is always kept the same.

The efficiency of the distribution is given by Walter A. Pearson, electrical engineer of the company, as from 90 to 91 per cent. This comes very near the maximum efficiency that could be expected from the efficiencies of the various pieces of apparatus which enter into the distribution. This figure of efficiency just given is the difference between the readings of the wattmeters in the 6600-volt generator leads at the power house, and the wattmeters in the direct-current bus-bars at the sub-stations, and therefore includes the loss in high-tension feeders, transformers and rotary converters. The loss in the low-tension, 500-volt feeders is given as from 3 to 7 per cent on the different lines at various hours of the day. The total efficiency of the distributing system from the power house to the cars is therefore very high as compared to common American practice. These figures, of course, do not include what loss takes place through the current which is used in the charging of the storage batteries, and is not recovered again upon the discharge. As the relative amount of energy delivered to or from the storage batteries is small as compared with the total, this probably does not have any great effect on the total efficiency.

The task of keeping switchboard instruments calibrated on an electrical distribution of this kind is not a small one, as there are over 750 instruments in the power plant and sub-stations. Two men are kept constantly employed recalibrating and checking these instruments.

The output of this power house at present reaches about 2200 kilowatts at the highest point, which occurs a few minutes before 7 o'clock each evening.

The Influence of Polyphase Apparatus on the Design of Railway Power Stations—I.

By J. E. Woodbridge.

THE designer of a railway power plant containing direct-current generators need pay little or no attention to the electrical apparatus when laying out his building. So far as the space which they occupy is concerned, the generators are usually a part of the engines, hence the provision of sufficient space for the engines allows for the generators. The engine foundations also, as a rule, support the generators. Outside of the generators the electrical apparatus in a direct-current station consists of a switchboard, which generally is, and can be, placed almost anywhere alongside a wall.

In a polyphase railway plant, on the contrary, the electrical apparatus includes exciters, transformers, converters, blowers, etc.; and the switchboard and station wiring become much more elaborate, for which reasons a much better plant is obtained by modifying the structural design to suit the electrical apparatus to a far greater extent than is necessary in direct-current plants.

As the effect of these electrical auxiliaries on the structural design are not generally familiar to engineers of direct-current plants, the following comments may be of interest to the many engineers of such plants who contemplate polyphase and rotary converter extensions.

SUB-STATION DESIGN.

As the influence of the electrical apparatus on the structural design is not disturbed by steam considerations in sub-stations, these will be considered in advance of the main stations.

In order to illustrate most clearly the influences of the electrical apparatus on the station design, actual designs will be presented, based on assumptions fitting as nearly as possible usual practice.

The sub-station most often required in the present state of the art is used for supplying a single section of a long interurban or suburban line. For determining the size of the apparatus in the sub-station let us assume that this line gives half-hourly service, with cars each equipped with four motors rated at about 50 horse-power each. For such service, supplied from sub-stations about 10 miles apart, a converter of about 300 kilowatts will be required in each sub-station, and a second machine of the same size may well be put in as a reserve, and to help at times of peaks caused by excursions, etc.

CONTENTS OF SUB-STATIONS.

We will assume, then, that the sub-station contains one or two 300-kw converters, and is made of sufficient size to accommodate a third and located in such a way that it may be extended in case of the addition of more converters or other apparatus, such, for instance, as boosters, lighting motor-generator sets or other machines. We will assume that each converter is supplied through three air-blast step-down transformers; the group of transformers having a slightly larger rated capacity than the converter in order to provide for the internal losses of the latter. On this account each transformer will

be rated at 110 kilowatts. The station will also contain a reactive coil connected in the low-tension circuits between each group of transformers and the corresponding converter, in order to assist the compound winding of the converter to give automatic voltage regulation. Since 25 cycles is recognized as a desirable frequency for rotary converter work, we will assume that the system operates at this frequency. Since duplicate lines are not often used for such small sub-stations, we will assume that there is one high-tension, three-phase, incoming line with accompanying high-tension lightning arresters. The voltage most commonly adopted for such a system is the highest which can be safely generated in the usual sizes of alternating-current generators without recourse to step-up transformers. This voltage is between 10,000 and 15,000 volts. We will assume that our sub-station operates at some pressure between these limits. For the air-blast transformers blowers will be required. Centrifugal steel-plate blast fans with downward discharge, standing over a blast box extending under the transformers, are generally used for this purpose. We will assume that these are direct driven by induction motors, as induction motors are preferable to direct-current motors for this purpose, since they require no starting boxes with low-voltage release attachments, which automatically shut down direct-current motors every time the current supply fails momentarily, as in case of a station blowout.

SUB-STATION SWITCHBOARD.

The sub-station switchboard needed for these two machines consists of two alternating-current high-tension converter panels; two alternating-current low-tension converter panels, and two direct-current converter panels. There are also some direct-current feeder panels, usually two in number, one feeding the trolley wire or third rail in each direction. We will assume that each high-tension converter panel is equipped with automatic oil switches, removed from the panel and inclosed in brick compartments; these switches being operated by hand, but fitted with relays and tripping coils for opening automatically in case of overload, thus doing away with the need of fuses.

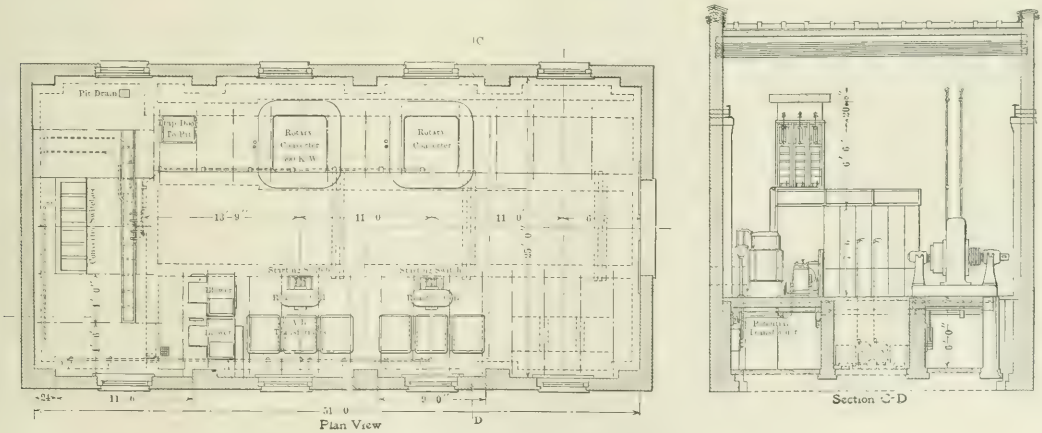
ARRANGEMENT OF SUB-STATION APPARATUS.

The apparatus outlined above can be arranged in an almost infinite number of ways, as may be seen by cutting out cards representing to scale the plans of the various pieces of apparatus and grouping these in various ways. Advantages for and against many of these arrangements can be found. After studying the expense of many of these arrangements and the comparative ease of operation of the sub-station, the grouping shown in Fig. 1 appears preferable for a sub-station of this kind. The machines here shown are all to scale for apparatus made by the General Electric Company. From this plan and the elevations shown in Figs. 2 and 3 it will be seen that the switchboard panels are arranged across one end of the sub-station room, with oil switches in brick compartments on the same floor level behind the panels. The step-down transformers are arranged in a single line along the left-hand wall of the station as one faces the switchboard, each converter being immediately opposite its own group of transformers on the other side of the station. The panels in the switchboard are arranged in the order which has become customary in American practice; that is, the sequence of the panels from left to right is the same as the sequence of the connections on the panels in the power circuits through the sub-station, beginning with the high-tension alternating-current incoming power, and ending with the outgoing direct-current feeders. It will readily be seen that the route of the power through this sub-station is a sort of loop, starting at the entrance of the incoming line, passing down through the high-tension bus-bars to the converter oil switches, thence down the left-hand side of the sub-station to the step-down transformers, from them through the reactive coils and straight across the station to the converters, from them back along the right-hand side of station to the switchboard, from the direct-current feeder panels of which the power passes out in any desired direction. Thus there is no crossing or intermingling of the different classes of wires, which are quite numerous in sub-station work.

FIG. 3.—SECTION OF SUB-STATION.

It should be noted that the low-tension alternating-current panels are in this station divorced from the main switchboard, and located directly on the route of the power from the transformers to the converters, these panels being mounted either on the floor in front of the reactive coils or, preferably, on top of the latter. These panels in the system described are small affairs, each carrying a throw-over switch for starting the converter by means of alternating currents at a low voltage derived from intermediate taps in the transformer windings. There are no instruments or other devices than switches on these panels, all indicating, synchronizing and similar alternating-current apparatus being mounted on the high-tension converter panels in the main switchboard.

It should also be noted that in this sub-station the direct-current panels are single pole, thus doing away with the danger of short circuits or any bad flashes occasioned by working behind the direct-current switchboard when the plant is in operation. The polarity of the feeder panels is, of course, the same as that of the trolley, which is customarily made positive for electrolytic reasons. The polarity of the converter panels is made the same, making the whole direct-current switchboard of positive polarity. On this account the series winding on each converter is connected on the ground or negative



FIGS. 1 AND 2.—PLAN AND SECTION ELEVATION OF SUB-STATION.

side. The negative and equalizer and series shunt switches are in this station mounted on a small panel fixed to the frame of the converter, thus doing away with the pedestal customary in direct-current generating stations. These switches are all of ground potential, and hence may with perfect safety be mounted on the frame of the machine, which is, or should be, grounded. This switch panel is mounted on the left-hand side of the frame of each converter as looked at from the commutator end, the commutator being turned toward the central passage of the station, as one of the sectional elevations shows. The switches are therefore visible from the switchboard attendant's usual position. The field break-up switches are also mounted on the commutator front of the machine, where they will be visible from the attendant's usual position. The alternating-current starting switches are also visible from this position, and easily accessible with a few steps.

Every device which the attendant handles in the ordinary course of operations faces the central passageway of the station running from the switchboard to the main door between the reactive coils and the converters. This central passageway of the sub-station is made sufficiently wide for the removal or replacement of the converter near the switchboard, between the converter near the door and its reactive coil, if such removal ever becomes necessary. The blowers are located near the switchboard, where their stoppage will be noted by the sound. Each blower motor is equipped with a small panel, by means of which the blower can be connected to the step-down transformers of either of the rotary converters. One of the blowers, that nearer the wall, is fitted with an air intake from out of doors, thus running the transformers at a considerable lower temperature during a large part of the year. The lightning arresters are located immediately below the line entrance, in such a position with relation to the converter oil switches that a line oil switch can be erected and connected into the line immediately below them in case the lines are duplicated, thus calling for a switch in each. The lightning arresters are carefully kept away from the floor level, where they might be a risk to visitors. A slate covering over the high-tension bus-bars serves, however, as a convenient flooring for the sub-station attendant when cleaning the arresters. Fireproof barriers are built into the wall between the several single-pole arresters to prevent an arc set up by violent lightning discharges from jumping from one arrester to another.

CONSTRUCTION OF BUILDING.

It will be noted from the plans that the sub-station throughout is of fireproof construction. It has been customary in the past to house railway sub-stations in wooden structures, but this custom is dying out. Sub-stations are, as a rule, located where there is little or no fire protection, and are incapable of protecting themselves as are generating stations. The added cost of fireproof construction per kilowatt capacity installed is no greater in a sub-station than in the generating station. The loss of revenue due to a line being shut down in case of the loss of a sub-station by fire warrants the added cost of the non-combustible construction. Where a sub-station is combined with a car house or other structure it should be isolated from the latter if possible or separated by fire wall. Since the duties of the sub-station attendant are light, many roads prefer to combine the sub-station building with the attendant's quarters; since in this case one man can attend the sub-station during both shifts of the usual electric railway day. The attendant's quarters should not be built as a second story over the sub-station for two reasons, one being the heat of the sub-station apparatus during the summer season, the other being the fire risk. As a rule, the cost of land is low where these sub-stations are located, and quarters on the other side of a fire wall with a fire door between these quarters and the sub-station are to be advised. In case the sub-station is located at a point of traffic importance it may be combined with a passenger station, the sub-station attendant being able to serve as ticket and baggage agent. In this case a fire wall should divide the waiting room, ticket office, etc., from the sub-station proper. The quarters of the sub-station attendant may in this case be made a second story over the ticket office, waiting room, etc. Such a design is indicated in Fig. 7.

For convenience in installing the apparatus, the cost of even a hand crane is not usually considered as warranted in such small sub-stations, but the main door should, if possible, be toward the track, so that the machines may be readily skidded into place

BASEMENT PLAN.

It will be noted from Figs. 1, 2 and 3 that there is below the sub-station floor a U-shaped excavation, one leg of the U being under the transformers, the bottom of the U being under the switchboard and the other leg under the converters. This excavation serves in part as a blast box, in part as a wire tunnel, and in part to receive the field rheostats, starting rheostats, switch operating mechanism, trip coils and other switchboard details, which are preferably placed out of the way below the floor level. This excavation should be made of ample depth for convenient work, one of the greatest mistakes in many sub-station designs being the lack of sufficiently large pits or basements. The transformers in such a sub-station are preferably wired entirely from the blast box, both the high and low-tension wires entering the transformer casing from below, no wiring being brought in at the top. This greatly improves the appearance of the station and reduces somewhat the cost of installation. The primary windings of the transformers are provided with taps for varying the ratio of transformation and thereby the resulting direct-current voltage. These taps are at the bottom of the transformers, and may require occasional changes of connections. Ample head room should be allowed for working at these details, and also at the several low-tension connections from below. The blast box is made of ample width to carry the reactive coils, which are also air cooled and preferably wired from the bottom, all wiring to the low-tension alternating-current converter panels which stand on top of the reactive coils being carried down through the reactive coil casing, thus keeping all wiring around transformers, reactive coils, etc., out of sight.

Entrance to the blast box can be made by means of a door from the pit under switchboard end of station, instead of by means of a

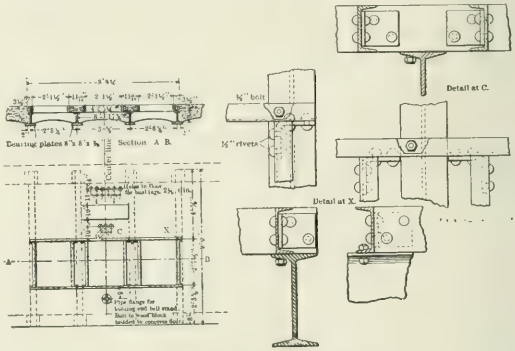


FIG. 4.—DETAILS OF FRAMEWORK.

trap door, as has been the usual practice in the past. If there is sufficient room this door may be provided with a small equalizing chamber, thus avoiding the difficulty of opening a door of reasonable size in order to enter the blast box, as well as reducing the air leakage by virtue of the two doors in series.

FLOOR CONSTRUCTION.

It will be noted that in this station the usual wooden floor around transformers and over blast box has been replaced by a non-combustible construction of steel floor beams and concrete arches, a steel framework being utilized to support the transformers as well as to form a frame for the openings in the concrete beneath them. This framework is shown in detail in Fig. 4. No steel work of this kind should be located under the reactive coil, as the latter in some forms has an open magnetic circuit projecting downwardly, which will heat any iron work placed immediately under the coil. A cast-iron frame may be set around the opening under each transformer, but the combination steel frame for three transformers shown in Fig. 4 is preferable if suitable steel sections can be obtained without too serious delay. The floor beams in this part of the station may in many cases be made of discarded T or girder rails. A similar floor construction is to be advocated under and behind the switchboard in place of the usual wooden beams and planking.

A 12-inch slot is left behind the panels for the passage of all cables, rheostat operating chains and switch operating levers through the floor, this slot being preferably closed after the installation of the board by slate slabs, cut away to clear the parts passing through the

floor. This slot is surrounded by a steel frame, to which the angle or T bars behind the switchboard panels are fastened through fibre insulation, which prevents a short-circuit in case the positive direct-current bus-bars or leads upon the panels become crossed with the switchboard steel work.

It should be noted that all alternating-current connections to the alternating-current panels are made through potential and current instrument transformers, the secondary circuits of which are solidly grounded, so that there is no danger of high-potential currents reaching the switchboard frame and no necessity of grounding the latter in order to prevent high-potential shock to any one touching it.

Some engineers prefer building a square foundation pit under each converter, connecting these pits by tile ducts, but the writer advocates the continuous pit indicated in the sub-station here described. This pit allows the attendant to approach the machines from below, and gives easy access to the brushes and brush holders or other parts beneath the commutator while a machine is running. With an individual pit under each machine the attendant must climb through the machine frame to reach parts beneath it, thus necessitating the shutting down of the machine. The opening under the machine frame should not be floored over, since such a floor, with the bushings and cables passing through it, is soon covered with an accumulation of oil, waste and dirt, which should not be allowed in any sub-station, and which it is very difficult to avoid. Without the floor, this accumulation falls to the bottom of the pit, which may be readily cleaned at any time. The converters rest on the side walls of the pit, and any concrete, brick or other arched floor may be readily bounded at the converter openings by a construction similar to that shown in Fig. 5, where a channel section is used at the sides of the openings of sufficient height to reach the floor level and serve in part as a stiffener for the converter base. Since the converter frame should be grounded, there is no further need of the wooden foundation which has been handed down from the days of the arc machine. There seems to be no good reason for elevating the bases of converters above the level of the finished floor, although tastes differ on this point.

WIRING OF SUB-STATIONS.

Although these small sub-stations usually contain no cranes to interfere with overhead wiring, it is preferable to carry all wiring below the floor for the sake of appearances. The high-tension wiring from each coil switch to the step-down transformers may consist of

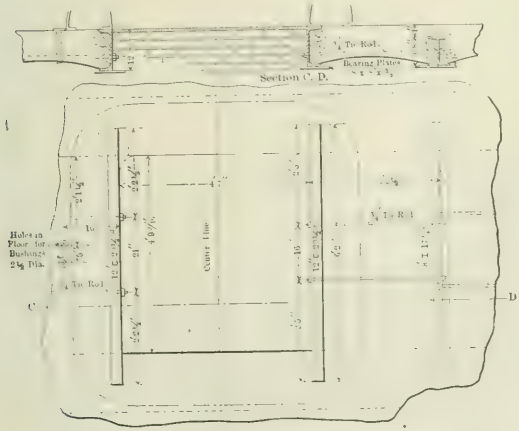


FIG. 5.—DETAILS OF CONSTRUCTION OF CONVERTER PIT.

either three single conductors, rubber covered to a suitable thickness and braided, or one triple-conductor cable, lead covered, with end bells. The latter is probably the preferable arrangement, as the number of cables becomes quite large when the sub-station extends, unless the leads are grouped in triple-conductor cables. Lead-covered cables, with rubber insulation, can be made satisfactory for small conductors at this voltage, in spite of considerable opinion to the contrary. A triple-conductor lead-covered cable is preferable to three single-conductor lead-covered cables. A triple-conductor high-tension cable for 10,000 volts or over should not be run in the sub-station basement without lead covering, owing to dampness, which is bound to exist in that part of the basement outside of the blast box. On account of the continual current of air through the blast box, this part of the station may be depended upon to be dry, unless water actually stands in it. It might be well to note here that careful attention should be given to prevent water from standing in this chamber under any circumstances, since the insulation of the apparatus is liable to serious injury if operated in this way. From the step-down transformers and reactive coils to the converters the leads pass through tile ducts, for which reason they had best be lead covered, although of low voltage. There is, however, some difference of opinion on this point, some engineers preferring rubber covered

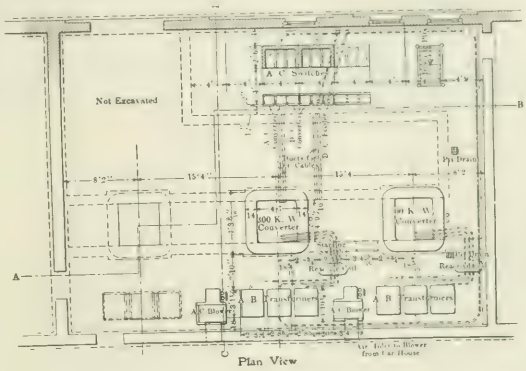


FIG. 6.—PLAN PROVIDING FOR EXTENSION.

and braided cables in such locations, provided the ducts are well joined and sloped for drainage. The direct-current cables from the machines to the switchboard need not be lead covered, since they are of low voltage and do not run through ducts. They are best run in the usual porcelain rack insulators. The negative and equalizer bus-bars are run in the pit under the converters, and may well be of bare copper bar not insulated with any care, since they are on the ground side of the circuit. The leads from the switches on the machine frames to the negative and equalizer bus-bars may also be of bare copper strap if desirable.

ROOM FOR EXTENSIONS.

It will be noted that the arrangement outlined above locates all machines in line, so that the sub-station can be extended by simply adding to the length of the building, without rearranging the apparatus. This feature is one of the most important considerations in station arrangement, since the traffic on a road supplied by such a station is morally certain to increase, as has the traffic on urban roads, to an extent never contemplated at the time they are started. One of the greatest faults of almost all arrangements of the apparatus, admirable in all other ways, is the inability to extend satisfactorily. It may be argued that the arrangement outlined above runs the switchboard across the station, while the machines line up lengthwise of the station, thus calling for an extension of the building in two directions when more machines are installed. The width shown in Fig. 1, however, provides space for sufficient switchboard and oil switches for four converters and duplicate incoming lines with a reasonable number of direct-current feeders. This is as many machines as the usual interurban sub-station will contain. If the load becomes too great for four machines, they should be replaced by larger ones, or more sub-stations should be installed at intermediate points.

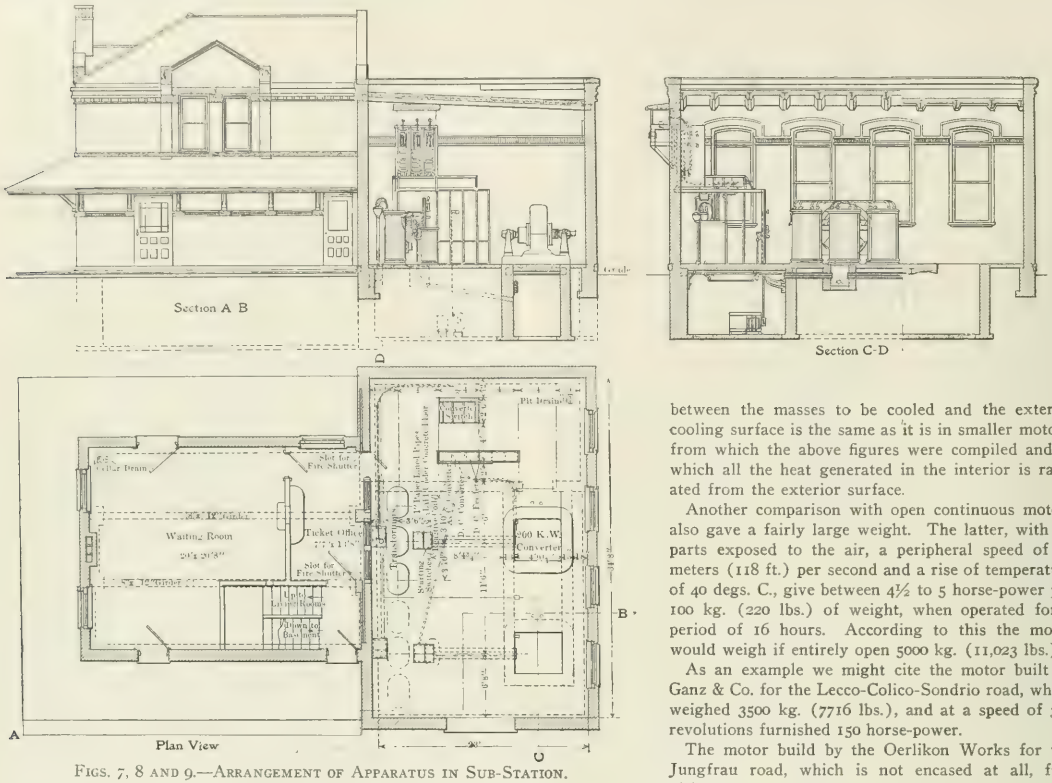
It is difficult to find a satisfactory arrangement with the switchboard paralleling the lines of machines, owing to the depth of the board and the fact that it becomes much shorter than the rows of machines, thus wasting some space. Fig. 6, however, shows what can be done with all lines of apparatus of this character arranged in parallel lines.

SUB-STATIONS WITH OIL-COOLED TRANSFORMERS.

Sub-stations containing converters smaller than 300 kilowatts operate, as a rule, with oil-cooled transformers, since in small sizes the oil-cooled transformers can readily obtain a large ratio of surface to

volume, and the cost of blowers is not warranted in small installations.

Figs. 7, 8 and 9 show an arrangement of apparatus in an oil-cooled sub-station with two 200-kw converters and appropriate transformers, reactive coils and switchboard.



FIGS. 7, 8 AND 9.—ARRANGEMENT OF APPARATUS IN SUB-STATION.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.*

By WALTER REICHEL.
(*Chief Engineer Siemens & Halske Company.*)

THE ELECTRICAL EQUIPMENT OF THE CAR.

As has been previously stated (Sept. 7, 1901, page 367), each motor has to satisfy the requirement that when the car is going at the regular speed under normal conditions, 250 horse-power must be furnished and that at starting three times that power, or 750 horse-power, must be developed. Furthermore, the motors must be supported between the wheels, and the latter being 49 inches (1250 mm.) in diameter, sufficient space must be left between the motors and the roadbed, and also the springs of the car and the motors. The latter condition is the more important as it determines the size of the motor, and consequently its weight and maximum output. This is so extraordinarily large that when compared with existing types of dynamos and motors having the same output the weight and size would be greater than the space would permit. Allowing a rise of temperature of 75 degs. C., good, enclosed railway motors have an output of about 1.7 horse-power for each 100 kg. (220 lbs.) in weight for any considerable length of time for a peripheral speed of 12 meters (39.3 ft.) per second, or for a speed of 36 meters (118 ft.) per second, about 5 horse-power. For 250 horse-power the weight of the motor would therefore be 5000 kg. (11,023 lbs.) under the supposition that the relation between the masses to be cooled and the exterior cooling surface is the same as it is in smaller motors, from which the above figures were compiled and in which all the heat generated in the interior is radiated from the exterior surface.

Another comparison with open continuous motors also gave a fairly large weight. The latter, with all parts exposed to the air, a peripheral speed of 36 meters (118 ft.) per second and a rise of temperature of 40 degs. C., give between 4½ to 5 horse-power per 100 kg. (220 lbs.) of weight, when operated for a period of 16 hours. According to this the motor would weigh if entirely open 5000 kg. (11,023 lbs.)

As an example we might cite the motor built by Ganz & Co. for the Lecco-Colico-Sondrio road, which weighed 3500 kg. (7716 lbs.), and at a speed of 300 revolutions furnished 150 horse-power.

The motor build by the Oerlikon Works for the Jungfrau road, which is not encased at all, furnishes 120 horse-power, and weighs 2200 kg. (4850 lbs.). These figures show that a motor weighing less than about 4000 kg. (8818 lbs.) will not only be too small, but it cannot operate for any great length of time without heating unduly. It has been suggested to employ some artificial means for cooling, as it was not deemed advisable to cool the motor by removing the casing, on account of the presence of a great deal of dust and moisture, and, furthermore, the outside area is not sufficient to dissipate the heat.

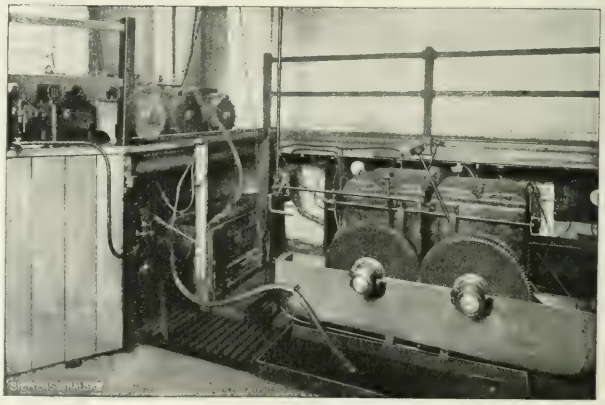


FIG. 10.—EXPERIMENTS WITH GEAR WHEEL TRANSMISSION.

The car wheels are to have a diameter of 1250 mm. (49 inches), and the motor, which is to have six poles, will have a speed of about 900 r. p. m. This permits the motor to be mounted directly on the

*The first part of Mr. Reichel's article appeared in our issue of Sept. 7. The delay in presenting the following portions has been due to late receipt of the remaining manuscripts and illustrations, which only arrived in time to be available for the present issue.

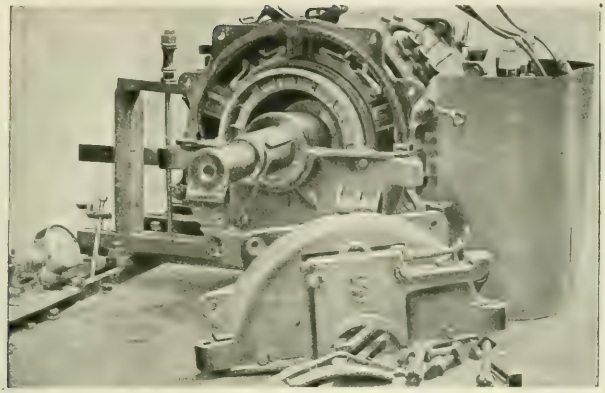


FIG. 12.—MOTOR OPEN, WITH TOP BEARING REMOVED.

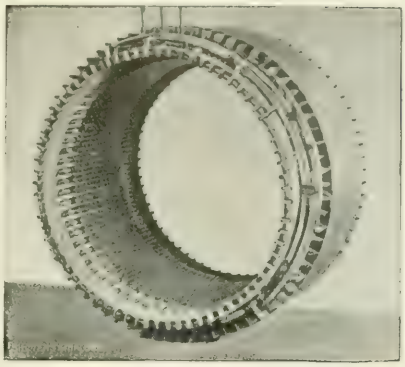


FIG. 11.—THE STATOR.

axle, without the use of any gear wheels. That this is possible, even at a train speed of 25 meters (82 ft.) per second, has been demonstrated, but a description of this would lead us too far in this article. Fig. 10, however, shows the arrangement which transmitted, without materially heating the gears and the oil projected in streams between the gears by means of air pressure, 120 horse-power for three hours at a speed of 850 r. p. m.

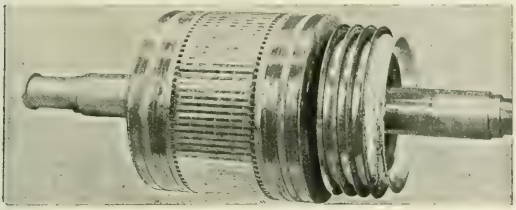


FIG. 14.—THE ROTOR.

After it was decided, therefore, to mount the motor directly on the shaft, the question came up as to whether it was advisable to employ springs similar to those used on the B. & O. locomotives, and the motors furnished by Ganz for the Lecco-Colico-Sondrio road, using a hollow shaft. On account of the great peripheral speed at the bearings, however, and the fact that the shifting of the axis of the hollow shaft with respect to the running axle occasioned by the use of springs, might cause disturbances at such high speeds, it was not deemed advisable to use springs.

The revolving part of the motor or rotor, was therefore firmly mounted on the shaft by means of a key, and the stationary part or stator was also mounted on the shaft without the use of springs.

The core of the stator is undivided, as shown in Fig. 11, as splitting the same in the case of a six-pole motor would necessitate too

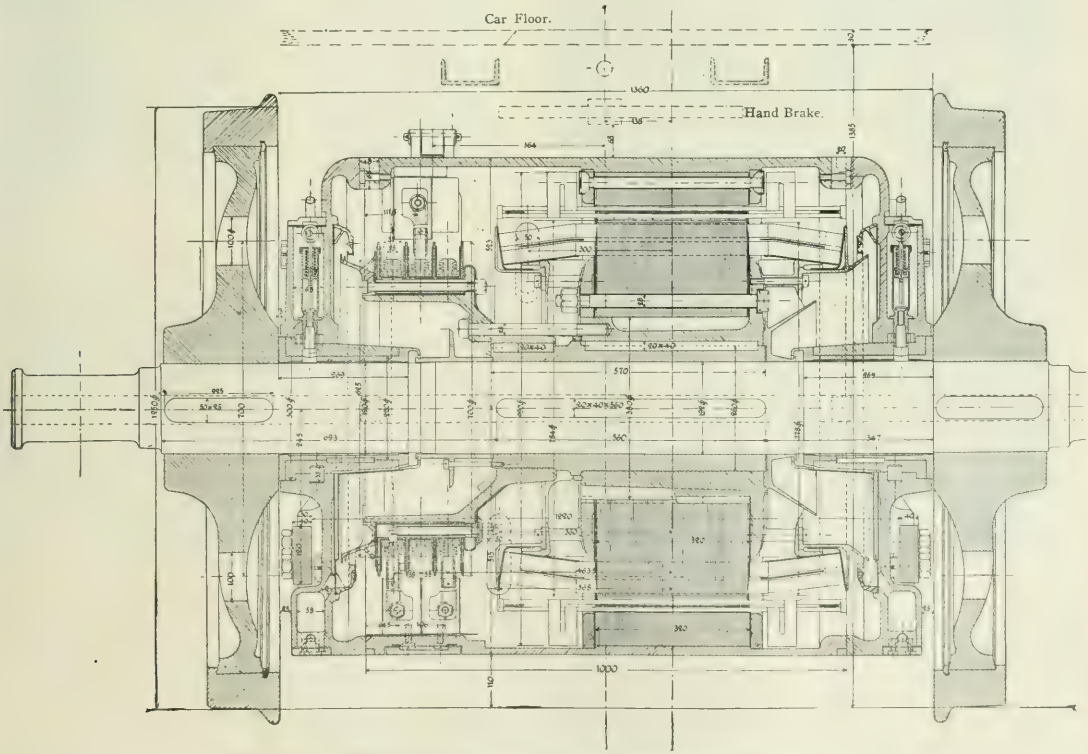


Fig. 13.—Longitudinal Section of High-Speed Railway Motor.

many connections between the two halves. The exterior casing is made of cast steel, and in order to be capable of dissipating the heat efficiently, it is smooth on the inside and closely fits the core of the stator. It is divided into two parts, as are also the bearing covers, so that in case it is necessary to make repairs on the bearings or stator, they can be reached easily.

In Fig. 12 one of these covers is removed. To the lugs of the lower bearing covers flat iron pieces are bolted, which transmit the turning movement of the motor to the truck by means of springs. The bearings consist of heavy steel outer boxes, in which bronze plates, lined with white metal rest. The bearings are lubricated by means of oil and wick, and this method has proved itself very satisfactory. The oil is thrown down by means of oil rings into special compartments in the lower bearing covers. The motor is wound for six poles, there being 90 slots in the primary and 72 in the secondary.

In determining the winding of the motor the following had to be taken into consideration. The heating of the primary core is dependent upon the number of pole changes and the saturation, and as the number of pole changes is given, upon the cross-section of the core. This must be made quite large so as to reduce the heating; that is, the width being given, the radial dimension must be made large. If, now, the primary, with its large radial dimension is laid on the outside, then the diameter of the rotor is small and consequently also the turning moment. It is far better for the more profitable utilization of the space, to put the primary on the inside and make it constitute the rotor. The secondary, which only during the starting and at full speed has a very small number of pole changes, may have a considerably smaller radial dimension than the primary.

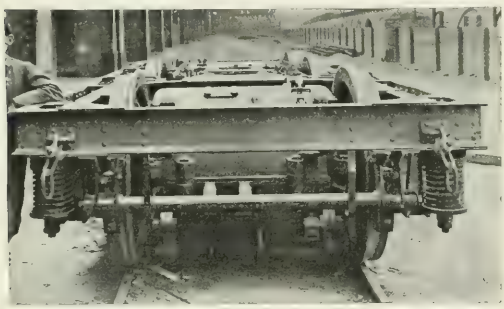


FIG. 15.—MOTOR MOUNTED ON TRUCK.

This will give a fairly large diameter of the rotor (in the motors already constructed about 9 cm., or 3½ inches), and there remains for the primary core considerable depth in the radial direction with the assurance of a low saturation. The rotor in this manner will have a diameter of 780 mm. (30.7 inches), while the over-all diameter of the motor is 1050 mm. (41.3 inches).

The motor is so wound that the primary pressure of 1150-1850 volts is carried to the rotor of the motor. For this purpose three collector rings are affixed at one end, which are made of good bronze and are insulated from each other by mica sheets which project considerably, as seen in Fig. 14. Eight carbon brushes make contact with each of the rings. The brushes are fed forward by means of springs, and in order to keep the brush holders a considerable distance apart from each other, they are distributed all around the periphery. They can be reached from the outside through small holes.

The core of the rotor consists of a number of iron plates, each of which is stamped out of a solid piece of sheet iron and all the plates are firmly held together.

The winding of the rotor, Fig. 14, is of the continuous-current bar winding type, as in this winding the ends of the various coils may be best protected from the action of centrifugal force by tightly-wound wire bands. The slots are insulated by means of mica, and wooden wedges protect the coils from flying out.

The winding of the stator is of the ordinary alternating-current type, and the core consists of a number of separate iron sheets joined together. The three primary and secondary leads are insulated from the frame wherever they pass through it by rubber bushings. Fig. 15 shows a motor mounted on the truck.

Automobile Storage Batteries.

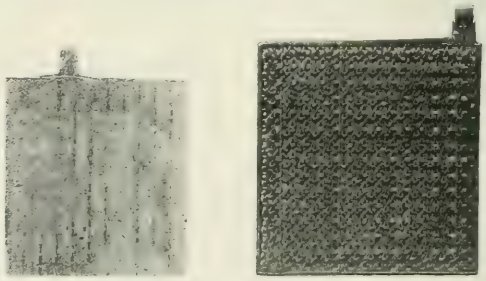
WE present herewith descriptions in detail of a number of storage batteries now available for automobile work, the descriptions having been prepared from information furnished by the manufacturers of the various batteries considered. The statements of performance thus come from the makers themselves, and while we do not doubt that all claims are made in good faith, due allowance must naturally be made for ultra-conservatism on the one side and enthusiasm on the other. The information herewith given, however, is substantially within the range of fact, and presents in concise form the main differences between the batteries considered. With a few exceptions all of the American automobile batteries now on the market are described, only a few manufacturers having denied the request for information concerning their products. The Edison storage battery is not included for the reason that a description of it has recently appeared in these columns, and no further information is available relating to its construction and performance.

As will be noted, data of a number of the batteries have been reduced to the basis of a three-hour discharge. Not too much stress should, however, be laid upon a comparison of different batteries on this basis in the absence of information as to corresponding durability. In other words, such a comparison is not conclusive unless each battery is designed with a view to give efficient results at that particular rate of discharge.

THE SPERRY BATTERY.

The Sperry battery is an improved form of the Planté type of lead-lead battery, but so designed and constructed as to be free from the difficulties that have attended the use of the applied sponge plate.

The grid is made of thin, pure sheet lead, which is corrugated horizontally. In the bottom of the hollows formed by the corrugations numbers of small trapezoidal holes are punched; the punch also cuts



FIGS. 1 AND 2.—SPERRY BATTERY.

diagonally across the trapezoid, and instead of making a clean hole, fins are left which project on either side of the plate. The whole plate when punched resembles a corrugated grater, except that the fins are longer, and triangular in shape. These projections are then spread wider apart so that a pressure on the plate will cause them to bend down in a direction away from the holes from which the fins project.

The material which is to become active is spread in the form of a powder on both sides of the grid, filling up the corrugations and being in sufficient quantity to make a flat plate of usual thickness after press-welding. The whole is then subjected to pressure—about 1000 lbs. per square inch of surface—which forms it into a solid mass. The material is bound to the grid by being pressed together into a continuous mass, which is on both sides of the grid and is welded through the multitude of small holes, thereby riveting itself in the grid. Additional hold is furnished by the fins, which bend down and are clinched over the active material and thus retain the material at the surface.

The retention of the fins and riveting under pressure of the powder into a solid mass cannot be successfully accomplished with every form of material to become active, but it is stated that the material used in the Sperry battery welds up strongly in the press, and after the chemical formation, becomes hard like soapstone. This active material consists of 80 to 85 per cent of finely divided pure lead obtained by dissolving a precipitation as explained in the description of the chloride battery, to which is added 15 to 20 per cent of lead oxide. These are thoroughly mixed, and to the mass thus formed is

added about 1-25 of a compound of alkaline salts and other ingredients.

The alkaline salts and the other ingredients are themselves inert, and their function is twofold: First, to render the material porous by dissolving out when the plate is "formed," leaving numberless pores throughout the mass, and, second, they have the peculiar property of causing the mass to harden on forming instead of soften, as is the case with pasted or other plates formed by the Planté process.

The composition of the active material used, its method of application, and the formation in the Sperry battery, are such, however, that trouble from disintegration and dropping away of active material is obviated, and the makers claim, and their tests seem to indicate, that the plates are extremely hard, solid and durable. The corrugation of the grid horizontally allows proper expansion and relieves the plate of any tendency to buckle. As an additional precaution, however, Mr. Sperry has devised the pyroxylin coating which is applied to the outside of the plate and covers it, passing down one side, under the bottom of the plate and up the other side. It is evident that if any active material should be loosened by any extraordinary circumstances, it would not be able to drop off the plate, being held in position by the outside coating. If a particle of material should by any chance drop off, it will still be retained in the pyroxylin envelope and would not be able to short-circuit the battery.

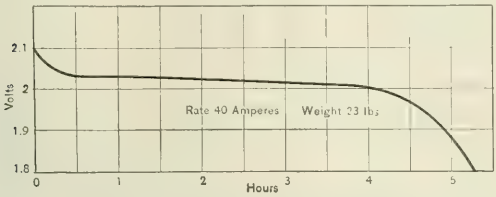


FIG. 3.—DISCHARGE CURVE, SPERRY BATTERY.

This covering is made of open mesh cotton cloth, such as "cheesecloth," which is chemically treated, forming a cellulose nitrate which is termed "pyroxylin." This compound is of the same general character as gun cotton, which is a high explosive. The addition of a small quantity of nitro-benzol renders it inert.

To the sheet of pyroxylin thus formed is applied a coating of pure cellulose. This is formed by treating fiber—in which the non-cellulose constituents belong to the class of aldehydes—with sulphurous acid. The fiber after being washed is again treated with sulphurous acid, leaving pure cellulose. This is then pulped and applied under pressure to the pyroxylin sheet. The envelope when finished is ribbed vertically so that the elctrolyte can circulate freely along the surface of the plate after passing through the envelope.

The jars in which the elements are placed are of the hard rubber variety, but different from the usual hard rubber jar in that they have a series of ribs capped with soft rubber extending across the bottom of the cell. On these soft resilient ribs rest the plates which are in this way relieved from excessive shock or jar. The separators are the usual thin, perforated, ribbed, hard rubber.

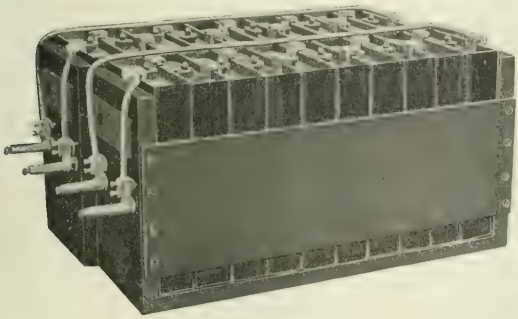


FIG. 4.—SPERRY BATTERY.

Fig. 3 shows a curve of discharge of the Sperry battery taken from 44 cells in series. These cells weigh 1005 lbs. gross or 23 lbs. each. The discharge rate was nearly 40 amperes and the average voltage 1.975. The curve shows the unusual results of 1.75 amperes, 9.187 ampere-hours, and 18.15 watt-hours per pound gross weight at 5¼-hour discharge, giving at this excessive rate of discharge 40 lbs. per horse-power-hour, corresponding to an energy sufficient to raise its own weight against gravity at sea level about 9 miles.

This is equivalent to 2.65 amperes, 7.95 ampere-hours, 5.03 watts and 15.09 watt-hours per pound at the 3-hour rate. There are several sizes of these cells manufactured, the two principal ones being 2 inches by 7¼ inches by 10½ inches, and weighing 18 lbs. gross, and 3 inches by 7¼ inches by 10½ inches, and weighing 22.8 lbs.

A number of life tests have been made on this battery, both in laboratories and on vehicles and in practical work. One vehicle has now made about 7700 miles with the batteries with a loss of 28 per cent of the original capacity. Tests recently conducted under the general supervision of Professor John W. Langley, of the Case School of Applied Science, show that the battery carried through a uniform rate of discharge of 1 ampere per pound until the carriage had run the equivalent of 3060 miles. This test shows the capacity of the battery for the last 10 discharges to be 10 per cent (83.35 : 91.8) in excess of the first 10 discharges. The report indicates that tests up to this point had failed to reveal any indication that the battery had started to fall off in capacity. The 44th discharge of this battery, taking it at 1 ampere per pound of complete working cell, gives a mean potential difference throughout the curve, of over 2 volts, namely 2.014.

THE INTERNATIONAL STORAGE BATTERY.

The Clare cell, made by the International Storage Battery Company, is claimed to embody novel features of mechanical construction, that contribute to durability, efficiency, capacity for rapid working, and a relatively large output of energy per pound of maerial. Active material for these cells in the form of lead oxides is prepared before it is mounted on the supporting plates. These plates are made of porous earthenware, free from impurities that would render it a conductor. One side of each plate is divided into 100 small cells by narrow ribs that intersect at right angles. Into these cells the plastic active material is pressed.

FIG. 5.—BATTERY OF CLARE CELLS.

The other side of each plate is provided with parallel ribs in one direction only, so that when these ribs on two plates are placed in contact the edges of the ribs touch, and there are parallel passages between them. Each plate is also provided with a heavy rib on one or two of its edges, and these heavy ribs extend further from

the plate than do the smaller ribs that enclose the cells for active material. After the active material is forced into its cells, two plates containing it are brought together so that the cells of active material face each other.

The heavy ribs at the edges of the plates hold them a short distance apart over that part of the surfaces where the active material is located. An acid-proof cement is applied to join the heavy ribs at the edges, and a receptacle containing the active material is thus formed by the two plates. Into the long, narrow opening of this

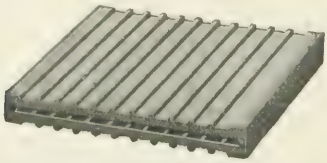


FIG. 6.—CLARE PLATE.

receptacle a sheet of pure, rolled lead is forced so as to come into intimate contact with all of the cells of active material. At one side a strip projects from this lead sheet and serves to connect it with a similar sheet between two other plates. The pair of earthenware plates with active material pressed into their cells, joined at their edges to form a receptacle, and the sheet of lead, form a single positive or negative element of the battery. The corresponding negative or positive element is made in exactly the same way.

The sheet of lead, about 1-32 inch in thickness, serves merely as a conductor of the current, and the earthenware receptacle supports both the active material and the conducting sheet. Two of the elements described go to make up the smallest size of battery. For batteries of larger size the receptacle for each element is made up of four or more of the same earthenware plates. All joints between the earthenware plates are made with the acid-proof cement, so that each receptacle, however large, is a rigid structure, though made up of a considerable number of parts.

Particular attention is called to the earthenware receptacle, because on its structure and on the method of supporting the active material, the novelty of the Clare battery depends. In this battery the conducting sheet of lead does not support the active material, but is itself supported by the receptacle. As the lead conductor is not required to act as a support, it can be, and is, relatively very light in weight. The earthenware receptacle is also much lighter than a supporting plate of lead would be for the same stiffness. The earthen-

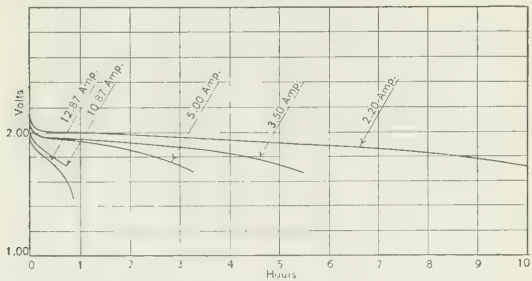


FIG. 7.—DISCHARGE CURVES, CLARE BATTERY.

ware receptacles with their active material and lead conductors are immersed in an acid electrolyte of the usual quality, and the solution passes freely through the porous sides of the receptacle to the active material. As the sides of the receptacles are very thin, being hardly more than 1-16 inch in thickness, and as the electrolyte flows freely through the grooves formed by the ribs on the outer sides of adjacent elements, the internal resistance of these batteries is very low. Active material cannot fall out of its cells in the earthenware plates, because the opening in the receptacle is only large enough to admit the conducting sheet of lead between the two surfaces where the conducting material is located. Experience has shown that the receptacles are sufficiently elastic to allow for all expansion of the active material without injury.

Several tests of these batteries have been made by independent engineers, and the result of one of these is illustrated in the curve here presented. This test was made on a battery rated at 20 ampere-hours. At the end of a 10-hour continuous discharge at the rate of 2.20 amperes, having yielded 22 ampere-hours, the terminal e. m. f. of the battery had fallen to 1.72 volts. During a continuous discharge of 3.5 hours at 5 amperes, yielding 17.5 ampere-hours, the battery dropped to 1.66 volts.

Another battery in a hard-rubber case had a total weight of 16 lbs. This battery during a continuous discharge of 12 amperes for eight hours fell from a terminal pressure of 2.1 to 1.9 volts. The ampere-hours delivered during this test were 96, and the watt-hours 192, so that the watt-hours per pound of complete battery were 12. Heavy overloads are said to have no bad effect on this battery, so far as the life of the elements is concerned.

A group of these cells that is said to have been in hard and constant use during two years, show no breaking or buckling of the earthenware receptacles or falling out of the active material.

THE PERRET BATTERY.

The Perfect storage battery is built on the unit system, the unit being a rectangular rod of pure metallic lead electrically formed in

FIG. 8.—PERRET UNIT.

a bath of pure dilute sulphuric acid. No other oxidizing agent is employed, and there is, therefore, no possibility of trouble from imperfect elimination of the compounds of nitrogen, chlorides, etc.

Each unit has a certain, definite capacity, and any number may be burned together to form a cell of the required size. Before formation

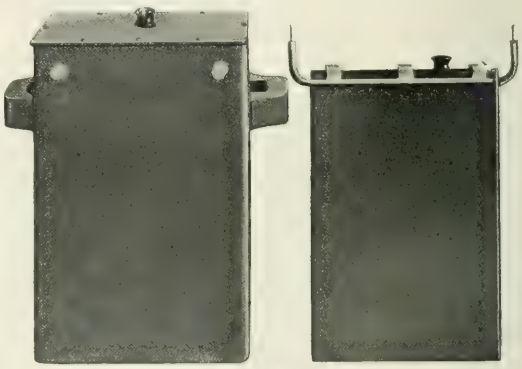


FIG. 9.—PERRET CELLS.

the units are all exactly alike, there being no difference between those intended for positive or negative elements. The rods intended for the positive elements of one cell are burned together with those of the negative elements of the next cell, and all the rods are suspended by their own lugs from the tops of the cells and do not touch anything at their lower extremities. Each unit is free to expand, contract or

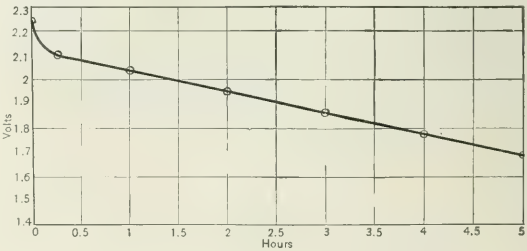


FIG. 10.—DISCHARGE CURVE, PERRET CELL.

twist without warping the element as a whole, which differs materially from the ordinary plate.

The discharge curve (Fig. 10) refers to a Perret cell weighing 7½ lbs. This shows a capacity of 1.33 amperes, or 2,527 watts, per pound

at the 5-hour rate, which is equivalent to 6.65 ampere-hours, or 12.635 watt-hours, per pound of complete cell. The cell may be discharbed in three hours or less, and charged in the same length of time without injury.

These cells are made in two sizes at present, though the makers intend putting other sizes on the market within the next few months. Type A is 10 by 6½ by 1⅞ inches, weight 7½ lbs., capacity as above. Type B is 10 by 13 by 1 3-16 inches, weight 15 lbs., capacity 100 ampere-hours at 5-hour discharge rate.

THE GOULD BATTERY.

The plates of the Gould battery are made from pure rolled lead. These plates have their surface increased by a spinning process. This spinning is accomplished by clamping the plate in a special machine whereby it is given a reciprocating motion between rapidly revolving arbors carrying a series of disks which are forced into the plate, displacing the lead into a series of alternating ribs and grooves. The active surface of the plate is thus increased to 17 times its area as a smooth plate. This pressing and displacing increases the density and homogeneity of the plate, and makes it more durable. The spinning process leaves the ribs firmly connected to the supports so that each rib is independent and has an independent contact with the supports, and it is not necessary to depend on a center webb for conductivity. The plates are thus in a condition to allow of the expansion and contraction, due to charge and discharge, taking place without loss of active material or damage to the grid. The plates are placed in a bath and current passed through them, whereby active material is formed from the material of the plates themselves. After forming, the plates are cleaned, washed, and all traces of the forming solution removed, the plates are then assembled into elements consisting of the various numbers of plates, according to the capacities required.

FIG. 11.—GOULD CELL.

The principle followed by the Gould Storage Battery Company is to increase the surface exposure as well as to increase the contact area of the active material with the grid, it having been demonstrated by their tests that by reducing the rate of charge and discharge per square inch of active surface, the life of the battery is increased, as well as its ability to stand high rates of charge and discharge.

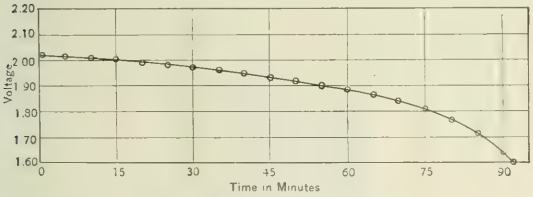


FIG. 12.—DISCHARGE CURVE, GOULD CELL.

The plates are therefore made as light as mechanical considerations will permit, and the greatest possible amount of active surface is obtained by the spinning process before mentioned. The actual active surface is 450 square inches per pound of plate, which gives 250 square inches per ampere at the 8-hour discharge rate. As the active oxides form in a thin adherent layer over the surface, the voltage at rapid discharge rates is somewhat higher than usual in lead cells. The thinness and porosity of the active material permits the escape of evolved gases without dislodging the oxides.

The separators consist of the usual ribbed and perforated rubber sheet, and the jars are of the same material. These jars have, raised on the bottom, two heavy ribs upon which the plates rest. This leaves a proper space below the plates for circulation of electrolyte, and the accumulation of sediment. A hard rubber cover fitting into the top of the jar and resting on the top of the cross bars prevents splashing of the electrolyte. The connectors are of the usual flat top variety.

The foregoing table gives weights, dimensions and capacities of the Gould automobile batteries, Type EV, dimensions of plate, 5⅞ inches by 9 inches.

This shows that at the 3-hour rate, 1.10 amperes, or 2.09 watts, are continuously available, which is 3.30 ampere-hours, or 6.27 watt-hours, per pound, gross weight of battery.

THE CHLORIDE ACCUMULATOR.

The general characteristics of this battery are well-known. The positive plate is termed "Manchester Plate" by its makers, and consists of a grid cast of lead with round holes about 13-16 inch in diameter and 15-16 inch between centers.

These holes taper to a smaller diameter from the outside surface to the middle of the plate, making in effect holes which are counter sunk, from both faces of the plate. The active material consists of pure lead which is taken in the form of ribbon, the width of which is equal to the thickness of the plate, and passed between two rollers. The periphery of the lower roller is smooth, while the upper one is toothed, the teeth cut into the lead ribbon making a ridged surface. The ribbon is then cut into suitable lengths and rolled into spirals, the outside diameter of which is the same as the diameter of the hole in the grid measured at its smallest diameter. These spirals are pushed into the holes and tightened by expanding, when the plate is "formed" by charging.

FIG. 13.—CHLORIDE ACCUMULATOR.

A lead ribbon which has been ridged on one surface forms, when rolled into a spiral, a pellet of active material which is very porous and allows free circulation of the electrolyte through the plate.

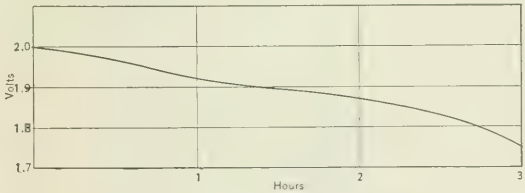


FIG. 14.—DISCHARGE CURVE, CHLORIDE ACCUMULATOR.

The negative plates are the regular "chloride" type, made by casting the grid around the pellets of active material, these pellets being placed in the moulds. This grid is of lead alloyed with a small amount of antimony and cast under heavy pressure, to insure good electrical contact between the pellets and the grid, and also to make the latter take firm hold of the pellets and obviate any danger of their dropping out.

The pellets are made of finely powdered lead, which is dissolved in nitric acid. The addition of hydrochloric acid to the solution pre-

Element number	905A	907A	909A	911A	913A	915A	905C	907C	909C	911C	913C	915C
Number of plates	5	7	9	11	13	15	5	7	9	11	13	15
Normal charging rate	18	27	36	45	54	63	22½	33¾	45	56¼	65	78¾
Discharge in amperes for 4 hours	17	25	33	41	49	57½	22½	33¾	45	56¼	65	78¾
Capacity in ampere hours { at 3 hours discharge	60	90	120	150	180	210	81	121½	162	202½	243	283½
Capacity in ampere hours { at 4 hours discharge	68	100	132	164	196	230	90	135	180	225	270	315
Weight of element in lbs	15¾	22¾	29¾	36¼	43	48¾	13.8	20.5	27	33.8	40.5	47.5
Outside dimensions of rubber jar in inches } Width	2½	3¼	4¼	5¼	6¼	7¼	2½	3¼	4¼	5¼	6¼	7¼
Outside dimensions of rubber jar in inches } Length	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼
Outside dimensions of rubber jar in inches } Height	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½
Height of cell over all, in inches	12	12	12	12	12	12	12	12	12	12	12	12
Weight of acid in pounds	3¼	4½	5½	6½	7¾	8¾	4	5.3	7.1	8.8	10.5	12.2
Weight of cell complete in pounds	20¼	28½	37	44¾	51½	59½	19	27	35.5	44.1	53.3	62.2

cipitates the lead in form of lead chloride. The precipitate after being washed is melted with zinc chloride and the fused mixture poured into moulds the form of the pellets. These are approximately ¾ of an inch square, and the same thickness as the grid, namely, ¼ inch.

The finished plates are placed between zinc plates and immersed in a zinc chloride solution. On short circuiting the plates, the actions set up are such as to remove the chloride, leaving the pellet in the form of pure lead in a very porous state. The types manufactured are denominated M, FV, MV, OV, PV, QV, RV, TV, UV and SV. The various types of plates and cells, their sizes, capacities, etc., are as given in the following table:

ELEMENTS OF TYPE MV.

Number of plates	5	7	9	11	13	15	7 inverted.
Discharge in amperes for 3 hours	18	27½	36½	45½	55	64	30½
Size of plates. Length	5⅞	5⅞	5⅞	5⅞	5⅞	5⅞	9¼
Size of plates. Height	8½	8½	8½	8½	8½	8½	5 13-16
Outside measurements of rubber jar in inches. Width	2 7-16	3¼	4 7-32	5 3-16	6 7-32	7 3-16	3¼
Outside measurements of rubber jar in inches. Height	10⅜	11½	11½	11½	11 9-16	11 9-16	8 3-16
Outside measurements of rubber jar in inches. Length	6 3-16	6 3-16	6 3-16	6 3-16	6¼	6¼	9⅞

To height of jar add ¾ inch for standard type of connection.

Weight in Pounds. Elements	16	22¾	29½	36½	43¼	50	24¾
Weight in Pounds. Electrolyte	2¾	4	5	6½	7¾	8¾	4¾
Weight in Pounds. Complete cell	19¾	28	36	44½	53¼	61½	31

It will be noted that the jars of 7 TV, 7 UV and 7 RV are higher than those of the other types. This renders sealing unnecessary, as the electrolyte does not fill the jar, there being about 4 inches between the surface of the electrolyte and the top of the jar, which is ample to prevent the liquid from slopping over. These can only be used in automobiles, which have deep bodies giving sufficient head room for the high jars.

MISCELLANEOUS TYPES.

Number of Plates	7	7	7	7	7	9	5	5	7
Type of plates	QV	PV	TV	RV	SV	OV	M	FV	UV
Discharge in amperes for 3 hours	13	22½	36	22½	17	43	31½	24	27½
Size of plates. Length	3 1-16	4⅞	5½	4½	3⅞	6¾	10½	5⅞	11¼
Size of plates. Height	8¾	8½	12	9¼	8 11-16	8½	7⅞	10⅞	4½
Outside measurements of rubber jar in inches. Width	3¼	3¼	3½	3½	3¼	4¼	2 3-16	2 13-16	3½
Outside measurements of rubber jar in inches. Length	3 7-16	5 5-16	5¾	4 13-16	4 3-16	7¼	11 7-32	6 3-16	4 13-16
Outside measurements of rubber jar in inches. Height	11½	11½	16¾	13 3-16	11½	11½	11 5-32	14¾	15 3-16

To height of jar add ¾ inch for standard type of connection.

Weight in pounds Elements	12½	19¼	30¾	19¼	15	33	26	21¼	23
Weight in pounds Electrolyte	1¾	3¼	6	4¼	2¼	6¾	4¾	5	4½
Weight in pounds Complete cell	15¾	23½	39¼	25¼	18¼	41½	32½	27¾	29¼

The other types require to be sealed, which is done with a cover made of hard sheet rubber fitting tightly in the cell. It rests on supports below the top of the cell, and may be made water-tight at the edges by a black composition put in in the form of fillet, one side of which rests on the cover and the other rests against the inner walls of the cell. A small hole is made in the middle of the cover for ventilation and escape of gas.

FIG. 15.—EXIDE CELL.

The connectors are generally U-shaped, the two ends being fastened to two sets of plates, and the bend passing over the edge of the jars that abut against each other. The elements in high jars are connected by "flap top" connectors.

Several types of separators are used, one being made of corrugated hard rubber, pierced with a number of small holes through which the electrolyte can circulate. In order to secure lightness, the jars are made thin. They are sufficiently strong for rough usage when put together in a tray, so that the contiguous cells or sides of trays afford support. They are, however, not strong enough to be used without trays or separated from adjacent jars. The table shows

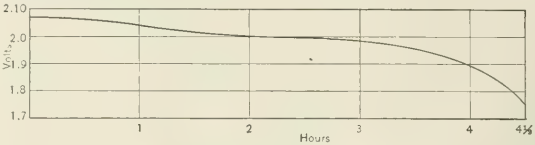


FIG. 16.—DISCHARGE CURVE, EXIDE CELL.

that these cells give an average of .98 ampere or 1.86 watts per pound gross weight at the 3-hour discharge rate.

A new automobile battery which the Electric Storage Battery Company has brought out, is called the "Exide Accumulator" (Fig. 15). No information as to principles and construction is available. It is, however, a form of pasted plate and much lighter than the "Chloride" accumulator, as will be noted from the accompanying table:

TYPE PV "EXIDE" BATTERY.

Number of plates		5	7	9	11
Discharge in amperes for 4 hours		12	18	24	30
Size of plates	Length	4 13-16	4 13-16	4 13-16	4 13-16
Size of plates	Height	8⅝	8⅝	8⅝	8⅝
Outside measurement of rubber jar, in inches	Width	1 13-16	2 9-16	3¼	4¼
Outside measurement of rubber jar, in inches	Length	5 5-16	5 5-16	5 5-16	5 5-16
Outside measurement of rubber jar, in inches	Height	11½	11½	11½	11½
Weight in pounds	Elements	9¼	13¼	17¼	21¼
Weight in pounds	Electrolyte	1½	2½	3	4½
Weight in pounds	Complete cell	11½	17½	21½	27½

This shows that the capacity at the 3-hour rate of discharge is 1.33 amperes, 2.53 watts, 3.99 ampere-hours, and 7.59 watt-hours per pound of cell.

THE WILLARD BATTERY.

This battery is made up of plates of the Planté type, which are sheets of pure lead, ribbed or grooved. The Willard plate is grooved across the width of the plate, the ribs not being perpendicular to its surface, but making an angle with it; that is, the cut is in a downward direction from the surface to the center of the plate, which viewed from the edge presents a "herring bone" cross section, the ribs sloping upward. These ribs are very thin and flexible, and their surfaces increase the active surface of the smooth plate to about 16 times its original area.

On formation of the lead oxides on a positive plate, the active lead is expanded, and in case of rapid charge this expansion may distort

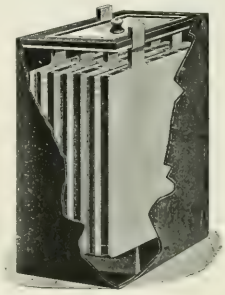


FIG. 17.—WILLARD CELL.

the plate and cause buckling, or the pressing out of the active oxides. The Willard cell, so the makers claim, is not subject to any deterioration or buckling, as the active oxides are formed between the ribs of the plate and their expansion only opens out the ribs, separating them a slight amount from each other. The manner of "forming" these plates is not stated, but an examination indicates that the process is chemically alkaline.

The construction gives a plate without any joint whatever between the active and the conducting lead of each plate, as each rib is an integral portion of the plate. This results in a low internal resistance. The makers state that by charging 20 minutes at double the normal charge rate, then at one and one-half times for 10 minutes

and one-fourth capacity for 20 minutes, the battery can be charged within 50 minutes without any injury to or deterioration of same. The capacity referred to is on a basis of 1-hour discharge.

The form of plate used permits high charging rates when the cell is empty. It is also stated that this battery can be made to discharge completely in 30 minutes without damage, though a higher rate is not

45-MINUTE CHARGING TABLE, WILLARD BATTERY.

Cell No.	20 min.	5 min.	5 min.	10 min.	5 min.
1001	72 amps.	52 amps.	30 amps.	16 amps.	5 amps.
1005	96 "	68 "	48 "	20 "	7 "
1105	118 "	84 "	59 "	26 "	9 "
1007	140 "	100 "	70 "	30 "	10 "
1107	178 "	128 "	90 "	38 "	12 "
1109	238 "	170 "	119 "	51 "	17 "
1111	300 "	214 "	150 "	64 "	21 "
1113	356 "	254 "	178 "	76 "	26 "
1115	420 "	300 "	210 "	90 "	30 "

advisable. The separators are made of hard rubber, fashioned in the form of a sheath. They are ribbed to secure strength and perforated to allow free circulation of electrolyte.

The makers do not claim extreme lightness for their batteries, as

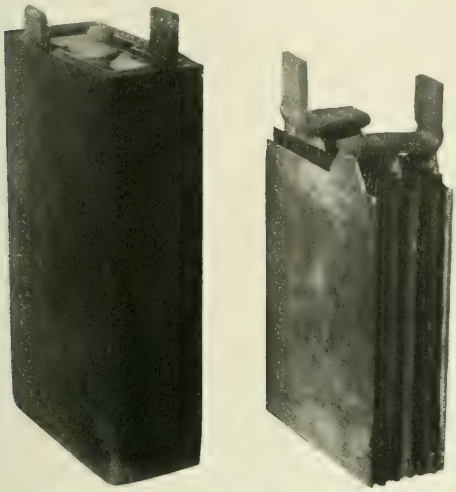


FIG. 18.—WILLARD CELL AND PLATES.

their idea is that plenty of lead is required for durability, and that light batteries are subject to more rapid deterioration than heavy ones. Their automobile battery they claim is a compromise between the weight necessary for durability and lightness required to prevent vehicles from being too heavy and clumsy. In this compromise the

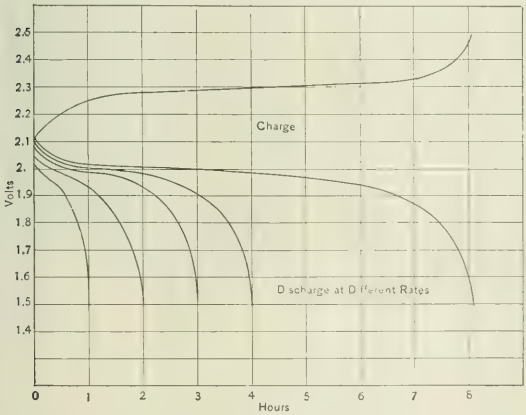


FIG. 19.—DISCHARGE CURVES, WILLARD CELLS.

makers believe that they have reduced the weight of the plates to the lowest amount compatible with long life under the arduous service to which automobile batteries are subjected.

A series of curves is shown in Fig. 19, which gives, graphically, the relation between voltage and time of discharge of the Willard cell at varying rates of discharge. The uppermost curve shows this relation on charge at the 8-hour rate.

The makers of the Willard battery manufacture two types for automobile service. One is designated the "Standard," and the other the "Willard Special." The accompanying tables give the data of the two types:

WILLARD STANDARD.

Cell Number.	Wt. in Lbs.	Outside Dimensions in Inches.			Ampere-hour capacity when discharged in 3, 4, 5 or 6 hours.			
		Wide.	Long.	High.	3 Hrs	4 Hrs	5 Hrs.	6 Hrs.
1001	13	5 9-16	2⅞	8¼	34	38	40	42
1005	16	5 9-16	2⅞	9⅜	45	50	53	55
1105	19	6⅝	2⅞	10⅜	56	63	67	70
1007	22	5 9-16	3¾	9⅜	66	73	78	81
1107	28	6⅝	3¾	10⅜	84	93	99	103
1109	35	6⅝	4⅞	10⅜	112	124	132	137
1111	43	6⅝	6	10⅜	140	155	165	171
1113	50	6⅝	7⅛	10⅜	168	186	198	206
1115	58	6⅝	8¼	10⅜	196	217	231	240

WILLARD SPECIAL.

1405	18	5 9-16	3¼	10⅜	48	53	56	59
1407	25	5 9-16	4 11-16	10⅜	72	80	85	89
1409	31	5 9-16	6⅛	10⅜	96	106	112	117
1411	37	5 9-16	7 9-16	10⅜	120	132	140	147
1413	44	5 9-16	9	10⅜	144	158	167	175
1415	50	5 9-16	10 7-16	10⅜	168	185	196	205
1505	21	6⅝	3¼	11⅜	62	68	72	75
1507	31	6⅝	4 11-16	11⅜	93	103	109	114
1509	39	6⅝	6⅛	11⅜	124	137	145	152
1511	47	6⅝	7 9-16	11⅜	155	170	180	189
1513	55	6⅝	9	11⅜	186	206	218	229
1515	63	6⅝	10 7-16	11⅜	217	240	254	266

From the foregoing, it will be seen that the continuous output of the "Standard" batteries averages .96 ampere, or 1.82 watts, per pound gross weight, on a basis of 3-hour discharge rate, which is equivalent to a total output of 2.88 ampere-hours, or 5.47 watt-hours. The "Special" gives 1.01 amperes, or 1.92 watts, continuously for three hours, being a total of 3.03 ampere-hours, or 5.75 watt-hours, per pound gross weight.

PORTER BATTERY.

The construction of the Porter cell differs materially from other types of pasted or chemically formed lead batteries. The plate or grid itself for automobile work is 5 by 7 inches and ⅛ inch thick. It is composed of an alloy or compound which the manufacturers state gives greater conductivity, greater resiliency and consequently greater working capacity than the ordinary pure lead plate, and also resists the action of the sulphuric acid in the electrolyte that upon

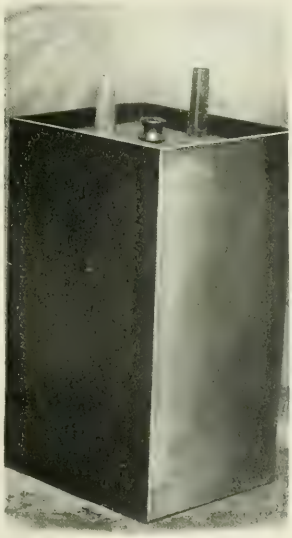


FIG. 20.—PORTER CELL.

lead produces sulphate of lead or the white precipitant which causes so much of the trouble in the pure lead types. The active material is securely held in the grid so that its greatest width is in the center of the plate and the smallest surface is exposed. This not only acts

as a wedge, but also allows the material to do the greatest amount of work with a minimum of wear, and greatly increases the proportion of capacity with the surface of active material exposed, at the ratio of about 3½ to 1. The active material itself is treated before being

Cell No.	Weight.	Outside Dimensions.			Ampere-Hour Capacity.		
		Wide	Long.	High.	3 Hours.	4 Hours.	5 Hours.
5	8½	5¼	1⅝	10	32	38	42
7	11	5¼	2⅛	10	48	57	61
9	13½	5¼	2⅝	10	64	76	84
11	18	5¼	3⅛	10	80	95	106
13	21	5¼	3⅝	10	96	114	124
15	25	5¼	4⅛	10	112	133	146
17	28	5¼	4⅜	10	128	152	167
19	31	5¼	5⅛	10	144	171	188
33	50	5¼	⅝	10	256	304	334

"formed," and the relative distances, while in the forming process, are increased and decreased proportionately, so that the interior is also formed, and not alone the outer surface, as is ordinarily the case.

From the preceding table issued by the manufacturers, it will be noted that on a high discharge, such as is required in automobile work, great capacity per pound weight is shown.

All the parts of cells are standard and interchangeable, which is very desirable. In the method of working up the batteries, the cells

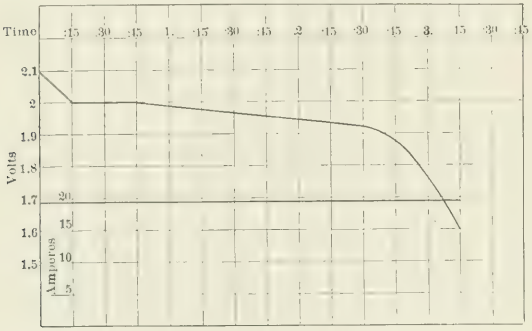
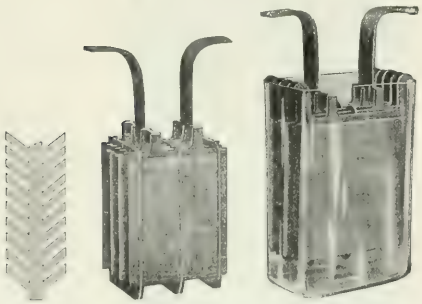


FIG. 21.—DISCHARGE CURVE, PORTER CELL.

are all formed of equal capacity and all work within .05 volts of each other on an equal discharge, so that the danger from reversed cells on a low discharge is extremely small. The curve of Fig. 21 refers to a 12-lb. cell discharging at a little over a 3-hour rate.

The efficiency on a constant-current, constant-potential circuit, on a 4¾-hour charge, 3½-hour discharge, is very high, standing a little above 88 per cent, the charge on a 13-lb. cell being 76 amperes, and the discharge 67. On a constant potential graduated current the percentage of efficiency in ampere-hours is very much higher. The 25-lb.



FIGS. 22, 23 AND 24.—AMERICAN BATTERY.

cell being started at 50 amperes and finished at 8 amperes, takes a total of 260 ampere-hours, and discharging at a 6-ampere rate, 247 ampere-hours, or a little over 95 per cent. The average voltage on this discharge is 1.9 volts per cell, so that the watt capacity of each cell would be 494, and the weight per horse-power-hour would be a little less than 40 lbs. On a high discharge rate, as required in automobile work, the capacity is necessarily reduced and the weight is increased to between 50 and 60 lbs. per horse-power-hour.

This battery now holds the world's record for long distance runs in automobiles, having done in Chicago on 600 lbs. weight, 187½ miles on a single charge in an electric Stanhope. As this was a very light vehicle, the manufacturers do not consider it as a practical demonstration for other vehicles. On 500 lbs. of battery they have run a Woods road wagon at a speed of 10 miles per hour 80 miles on a single charge. In a Buffalo Electric Carriage Company's Stanhope, over country and hilly roads, the wagon has run as high as 69 miles on a single charge, equipped with a 40-cell set, No. 11, Type A. Fig. 20 shows a No. 21, Type A cell, weighing 35 lbs., and having a capacity of 250 ampere-hours. It was with this type of cell that a run of 151 miles was made at Cleveland, Ohio.

THE AMERICAN BATTERY.

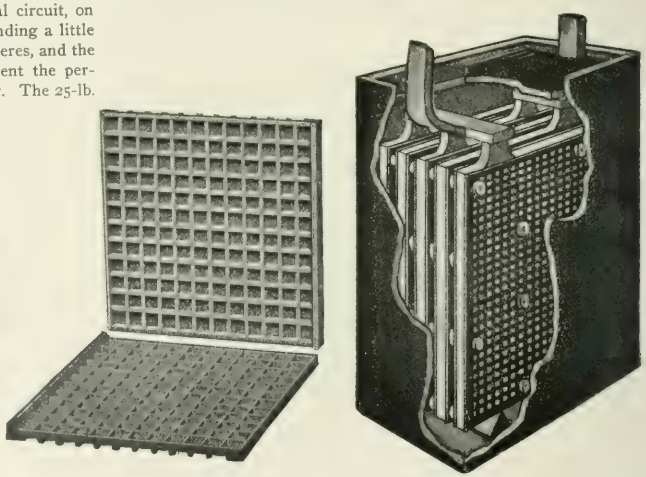
This battery is made up of elements which are formed by grooving pure sheet lead, leaving a number of thin projecting ribs. The active material is electro-chemically formed, as is usual in such batteries. The ribs are turned upwards.

The plates are supported by insulators, which lift them off the bottom of the jar and also serve to separate the plates. The elements are in this way suspended, and there is left a clear space in the bottom for the circulation of electrolyte and the deposition of sediment without danger of short circuiting.

Interposed between the insulators and positive plates are thin perforated sheets of hard rubber which are put in as an additional protection against contact of plates and consequent short circuits.

The separation between the positive and negative plates is somewhat greater than is usual in lead batteries, being a full quarter of an inch. This is to allow free circulation of electrolyte. This increases the internal resistance but very slightly, and the size of the cell for a given capacity. Following is a table of dimensions, weights and capacities of the American batteries:

Type.	3-Hour Rate.	5-Hour Rate.	DIMENSIONS.			Weight. Pounds.
			Length. Inches.	Width. Inches.	Height. Inches.	
M. ½	8	5½	6⅝	1⅞	8⅛	10
M. 1	10	7	6⅝	1⅞	9⅝	13
A. 1	13	9	6⅝	1⅞	11⅝	15
M. 2	18	12	6⅝	3⅛	9⅜	21
A. 2	24	16	6⅝	3⅛	11⅝	26
M. 3	27	18	6⅝	4½	9⅜	30
A. 3	36	24	6⅝	4½	11⅝	36
M. 4	36	24	6⅝	5⅞	9⅜	39
M. 5	45	30	6⅝	7¼	9⅜	48
A. 4	48	32	6⅝	5⅞	11⅝	48
A. 5	60	40	6⅝	7¼	11⅝	61
A. 6	72	48	6⅝	8⅝	11⅝	72



FIGS. 25 AND 26.—REUTERDAHL BATTERY.

These show .96 ampere, 1.824 watts, 2.88 ampere-hours and 5.47 watt-hours per pound weight of cell at 3-hour discharge rate.

THE REUTERDAHL BATTERY.

The elements of this battery consist of grids or plates of lead antimoniated so as not to be acted on by the electrolyte, imbedded in and surrounded by a mass of active material. The plate or grid serves only as a conductor. It is rendered dense and of low resistance by casting under pressure.

The details as to constituents of active material are not given. The negative material is spongy lead and the positive lead peroxide. The plates are formed partly by Planté and partly by Faure processes.

The active material after being pressed into a compact mass surrounding the grid, is enveloped by a sheath that retains the material in its proper position, and does not allow it to fall away. This sheath consists of a framework of hard rubber or chemically prepared wood having a sheet of perforated hard rubber on each side. These perforations are 1-16 inch in diameter and spaced ⅛ inch between centers.

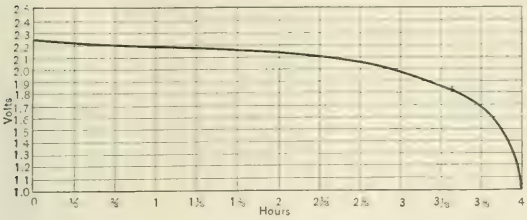


FIG. 27.—DISCHARGE CURVE, REUTERDAHL CELL.

The sheets of hard rubber are held against the frame by hard rubber bolts passing through holes in the sheets and framework. These bolts are of such length and so arranged that they serve to hold the sheets against the frame, and to separate the composite plates from each other. Besides the bolts passing through the frame there are bolts passing through the plate itself.

The purpose of these bolts is to hold the sheets of rubber at a fixed distance apart and thus insure the retention of the active material against the grid.

The interior bolts are so staggered that a bolt from one element does not abut against a bolt in the adjoining element but comes against the sheets of rubber surrounding that element, so that with five bolts through each there are 10 points of separation. The central bolts thus serve the double purpose of retaining the sheets in proper and definite relation to each other, as well as separating adjoining elements. The sheet rubber allows for expansion of the active material, as it combines flexibility and rigidity.

The chief difference between this and other lead storage batteries consists in the retaining case and grid, which do not enter into the electrolytic action at all. The life of the element therefore does not depend on the support, but on the active material only. The containing jar is of hard rubber, with ribs on the bottom on which the elements rest. All conductors are of antimonious lead cast under pressure. The capacity of the Reuterdahl 22-lb. cell at a 3-hour discharge rate is given as follows: Amperes per pound, 1.5; watts per pound, 2.85; ampere-hours per pound, 4.5; watt-hours per pound, 8.55.

THE OSBURN BATTERY.

This battery belongs to the pasted plate class, and at present is made exclusively for automobile work. The inventor, however, has attacked the problem of low cost of battery per mile of vehicle travel in an original and unusual way.

The manufacturers contend that durability is only one of the factors which make up the cost of maintenance and operation of an electric vehicle, and that it resolves itself into the question of total cost of operation per mile. In automobile work the questions of weight and cost of carrying this weight must be considered. Lead being the principal ingredient in a storage battery, and each pound storing a given amount of energy, the life is shorter with a light weight battery, but the battery also costs less. Therefore, it does not appear economical to pay for and transport for an entire year a sufficient amount of lead for the succeeding year.

Mr. Osburn, therefore, has set to work to produce a battery in which the elements will last from 6 to 12 months, and be light enough to reduce the total weight carried to a minimum, and the cost low enough to enable a complete replacement once or twice a year, and still keep the cost of battery per mile within a reasonable limit.

This would certainly result in a satisfactory battery for the purchaser, as the initial investment is low, the maintenance not more than is usual with automobile batteries, and he would have a new battery at the beginning of the second year instead of one partly run down. With these ideas in view the Osburn battery was developed.

In the construction of the grid lies the principal difference between it and the other varieties of pasted cells. These grids are made from pure lead of special manufacture, and are stamped in presses into a network of metal adapted to hold the active element, and at the same time to furnish a connection to all parts of it.

The plate is formed from a thin sheet of rolled lead. Rows of small square holes are punched into the sheet, diagonal cuts are then made from the corners of the holes, and the flap thus formed is turned at right angles to the surface of the plate, forming a series of pockets for containing the active material.

The thickness of the completed plate is equal to the sum of the thickness of the lead and the pockets formed by the portions turned at right angles. The opposite faces of the upturned portions form the side walls of adjacent pockets, while the greater portion of the edges are brought into contact with the active material, the only portions of the plate thus not in contact being the side edges of the sections. This insures a maximum amount of surface to the active material, therefore resulting in a maximum rate of discharge for a given weight.

The active material consists of precipitated lead mixed with lead oxide and a small amount of some other chemical which the inventor does not at this time care to make public. The material is pasted into the grid and then subjected to pressure. The forming process is the same as that usual in pasted plates. It should be noticed that the applied material forms a continuous active surface, every part of the grid being covered. The grid is therefore protected from the action of the electrolyte, and disintegration avoided.

The negative plates are made much thinner and lighter than the positive, as it has been found that the negatives may have their weight and cross section decreased without altering the durability of

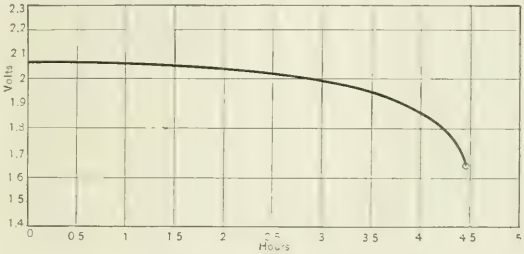


FIG. 28.—DISCHARGE CURVE, OSBURN BATTERY.

the battery, if the active surface be kept equal to that of the positives, exclusive, of course, of the outside surfaces of the first and last negative plates in each group, which are inactive.

The separators are also of unusual construction. They are made of thin, hard, sheet rubber 1-64 inch thick. Pairs of slits are made at proper intervals in the sheet and woven through these slits are round, hard rubber rods. These latter form vertical ribs that strengthen the thin sheets and give a proper distance of separation between the elements. The completed separator is ⅛ inch thick, which is also the distance between plates.

The separators extend downwards below the ends of the plates, and are held together by round, hard rubber rods, which pass through the lower ends of the separators at right angles to their surfaces, each rod passing through all the separators. The jars are the usual hard rubber variety, generally sealed, and vented by a small hole in the center of the cover.

The standard cell consists of nine negative and eight positive plates, each plate being 7½ inches by 2¾ inches. The size of the containing jar is 3¼ inches by 5¼ inches by 10¾ inches. The electrolyte is 1¼ inches deep over the top edges of the plates. The complete cell weighs 15 lbs. gross.

The following is the output per pound gross weight at the 3-hour discharge rate: Amperes, 1-75; watts, 3.5; ampere-hours, 5.25; watt-hours, 10.5. Fig. 28 shows a discharge curve of this battery at the 4-hour rate. It will be seen that the voltage holds up above 2 volts for 2¾ hours, thus keeping up the average voltage and wattage.

The inventor claims that a number of sets of these batteries have made over 2000 miles before any repairs were needed.

Tangential Traction Electric Railway System.

A CURIOUS system of electric traction has been proposed by MM. Dulait, Rosenfeld and Zelenay, of Charleroi, Belgium, in which there is a complete absence of a rotative motor on the car and of any electrical connection between the car and the line. The movement of the car is assumed to be obtained through the influence of a magnetic field traveling with the car.

As is well-known, in induction motors there is no electrical connection between the rotor and the stator; the current in the stator

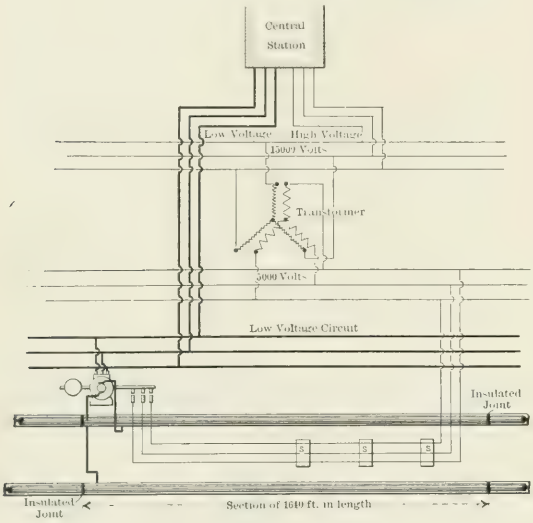


FIG. 1.—DIAGRAM OF CONNECTIONS.

produces a rotary field, and this acting on the rotor causes it to travel with the field. If, now, we imagine the surface of the stator developed into a straight surface, and the rotor similarly developed and suspended above, the rotary movement will, the inventors state, be transformed into a movement of translation, and it is not necessary that the rotor should extend over the stator the full length of the latter. Now, taking the case of a car running on two rails, suppose the developed stator to be placed between the rails and that the developed rotor is suspended under a car and over the stator. The car will then be put in motion when polyphase currents flow in the stator. Under these conditions the magnetic field is no longer a rotary one but a field of translation.

As to the objections which may be presented to this system on the score of large air-gap, which in ordinary motors is sometimes less than 1-32 of an inch, it is granted that a small air-gap would be impracticable in the present system, but the inventors state that they have been enabled very largely to increase the air-gap and at the same time largely reduce the quantity of copper required. No information is given, however, as to how this end has been attained.

Another objection that may be urged against the system is that a large portion of the developed stator will require to be energized. The inventors state that they have met this difficulty by dividing the stator into sections each having its own feeders. The ideal length of the sections would be such that there would be never any current except in the section covered by the car. It is stated, however, that it has been found that sections 1600 ft. in length will give a very satisfactory efficiency. Cutting in and out of circuits is performed automatically by electrical means from the car itself.

It is also claimed that it has experimentally been found that the stator can be discontinuous and that in general it will suffice to lay down stators over only a fifth of the length of a road. Another point adduced is that the construction of the system can be made such that consumption of energy will be almost constant at all points of the line, whether the car is running on a lavel or on a grade. The only explanation offered for this is that the speed of a three-phase motor is varied by varying the number of poles.

This system is claimed to have a great advantage from the fact that it will permit of the direct employment of currents of the highest tension, since the exciting circuit, being in no place exposed, can give rise to no danger.

In a pamphlet by the inventors from which the above is translated, a table is given showing the relative cost of traction by the trolley system and the tangential system. In the case of a schedule speed of 62 miles per hour and a maximum speed of 75 miles, the efficiency of the last-mentioned system is put at 64 per cent, and that of the direct-current trolley system at 54 per cent. One of the accompanying illustrations show a track and car equipped with the system, and another gives a diagram of the connections.

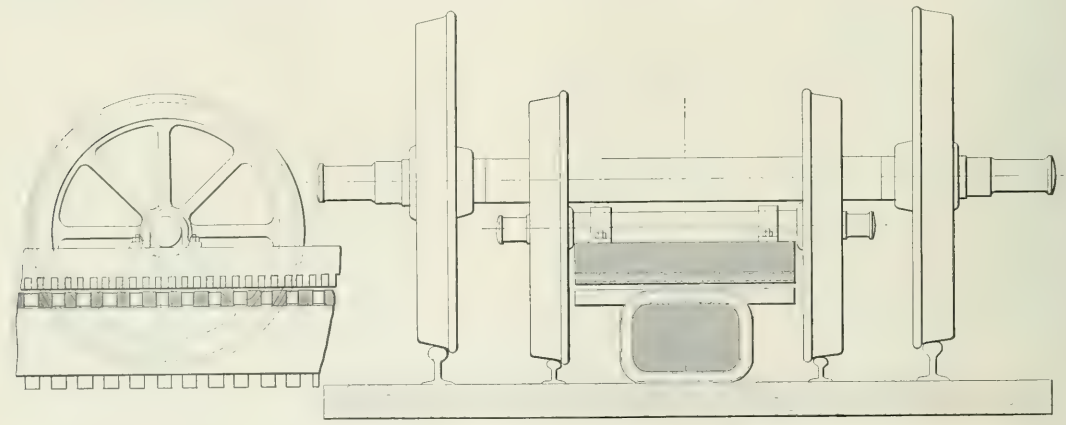


FIG. 2.—TANGENTIAL TRACTION ELECTRIC RAILWAY SYSTEM.

Submarine Boat Launched.

The new submarine torpedo boat "Porpoise" was launched at 3.30 o'clock p. m. on Sept. 23 from the Crescent Shipyard, Elizabethport, N. J. Miss Fanny Maxwell Moore, daughter of Charles A. Moore, of Brooklyn, performed the christening ceremony, and a number of prominent naval officers were present for the occasion. The "Porpoise" is one of five Holland submarine boats built for the United States Government. Her length is 64 ft. 4 inches, and her beam 11 ft. 9 inches. Her displacement when submerged is 120 tons. When steaming along the surface she is to be propelled by a 160-hp gasoline engine, and when entirely submerged by a 70-hp electric motor. Her estimated speed will be 8 knots an hour on the surface and 7 knots an hour under water. Five Whitehead torpedoes constitute the armament of the "Porpoise."

Changing a Magneto Drop to a Central Battery System.

By Charles L. Goodrum.

THE officers of Atlantic Coast Telephone Company in April decided to improve its plant at Atlantic City by the adoption of the central energy system. Owing to the short time available for the work in order to have it finished in time for the summer

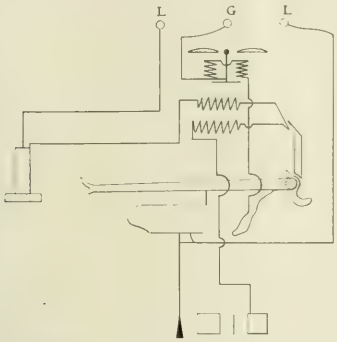


FIG. 1.—DIAGRAM OF CONNECTIONS AT SUBSCRIBER'S STATION.

season, and also for the reason that a new switchboard and instruments would practically mean the purchase of a new plant, it was decided to transform the present system without displacing the

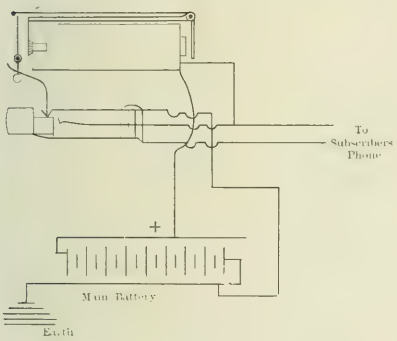


FIG. 2.—DIAGRAM OF BATTERY CONNECTIONS.

switchboard and old instruments, and for this purpose the services of the writer were secured.

The installation consisted of a magneto drop of 1300 subscribers' capacity. The present general battery system is of the transfer type,

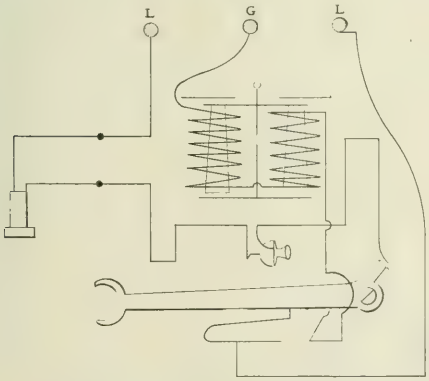


FIG. 4.—DIAGRAM OF REWIRING.

with five pairs of trunks from each section to every other section. Following is the method pursued in changing over while at the same time keeping up the service:

Fig. 1 shows the means whereby at the subscribers' station, and with the receiver on the hook, one side could be left open and the other grounded through the ringer. This enabled ringing over one line and ground. By grounding the common side of the drops on the switchboard, the subscriber could call central by turning the ringer crank in the usual way. The next step was to set up 11 cells of storage battery, the negative being grounded. The circuit is shown in Fig. 2.

When a subscriber rang up, the drop was not affected but (he did not know this) the drop fell when he took down his receiver. Two sections were changed each night, and after all sections were

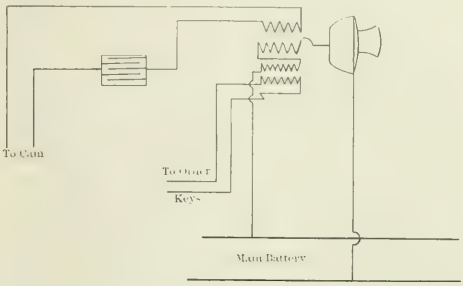


FIG. 6.—CONNECTIONS WITHOUT TRANSMITTER BATTERY.

changed, several men were sent out to take off cranks and test the telephones, when it was found that the service was intact. At the same time the cord signals were arranged as shown in Fig. 3. The

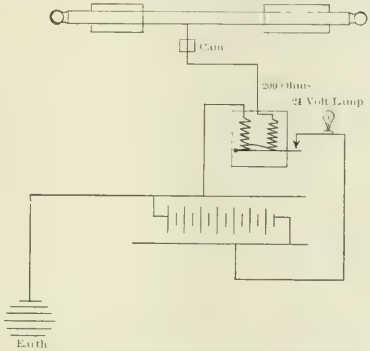


FIG. 3.—ARRANGEMENT OF CORD SIGNALS.

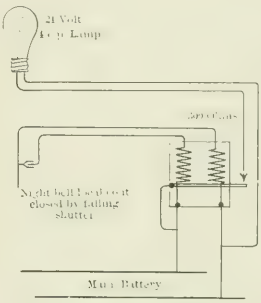


FIG. 5.—PILOT LAMP CONNECTIONS.

tip of one plug was connected to the tip of the other plug of that pair, and one sleeve to the other sleeve. In the center a 200-ohm relay was tapped. It will be seen that the plug connects to the positive side of the battery in the jack on the tip, and to the negative through the relay. The supervisory signal burns while the receiver is off the hook and responds to the movement of the hook at the station connected with that plug. Having this done, the old telephones were wired, as shown in Fig. 4, and much to our satisfaction it was found that the transmission was excellent.

The next step was to put a pilot lamp on each section, as shown in Fig. 5, by using a relay wound to 150 ohms in each spool and connected as shown, the local thus causing no trouble through contact with other wires coming from the battery. The next move was to

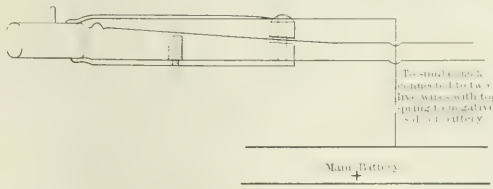


FIG. 7.—TRUNK JACK SPRING.

get rid of the operators' local transmitter battery on the switchboards, which was done as indicated in Fig. 6. The resistance of the primary and secondary of the induction coils was 100 ohms each.

The plant was now working on the central energy system, and the principal trouble was found in trunking from one section to another, there being no check to show if the connection was to the proper trunk. This was remedied as follows:

In Fig. 7 the trunk jack spring is connected to the negative side of the battery, while the spring and the frame of the jack are not in contact with the plug of that trunk. This applies to the negative of the battery to both sides of the trunk. Having all trunk jacks, as in Fig. 7, six pairs of trunk cords were put in each section. Twelve pairs of regular cords and plugs did all the work, and with six trunk cords this made 18 pairs to each section. One of the trunking cord circuits is shown in Fig. 8.

When the operator gets a call she answers in the ordinary way, the supervisory lamp on the pair of cords used lights up, showing that the caller is at the telephone, and when she ascertains what

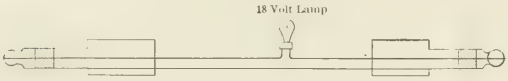


FIG. 8.—TRUNKING CORD CIRCUIT.

number is desired she then calls for the connection to be made on her trunk from the section number wanted. The supervisory lamp is then extinguished until the trunk is put in the jack called, which shows that the trunk is ready when she rings up her party. Should the operator misunderstand or otherwise not properly connect the trunk, her supervisory lamp in the trunk cords will burn, while if correct it will not light up until the first operator disconnects. The reason why it lights up is that the lamp is between the tips, and one plug being in the regular line jack, it is positive at one tip, the other plug being in the trunk jack, it becomes negative, whereby the lamp is lighted until the plug is put in the other end of the trunk, which disconnects the negative and puts the lamp out of circuit. When a subscriber has finished, his supervisory lamp goes out, and when the operator disconnects, this act lights the trunk lamp, and when she takes down the cord this results finally in clearing both ends.

The exchange as transformed has 1200 telephones, and is giving very good service, the old apparatus answering as well as central energy apparatus and the best of transfer boards. This method can be applied to any magneto drop by arranging the circuits to suit the jack and drop.

The Inductor Alternator—I.

By Edward Heitmann.

ALTHOUGH the inductor alternator has been in use for many years, and has given universal satisfaction, the idea seems still to prevail in some minds that the design is such, that it will not lend itself to the requirements imposed by the various engineering conditions of the present time. This paper has been written with the object of dispelling this unnecessary fear, and to convince those interested that this type of alternator, when properly designed and constructed, will readily meet the most severe conditions encountered in the operation of generators of all sizes and types.

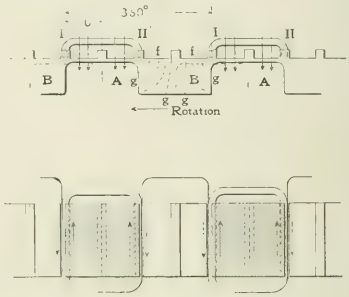
It will briefly discuss the electrical and magnetic features of this type of alternator, describe the mechanical construction, and, perhaps of most importance to central station men, will give the characteristics and data of a few machines, fully illustrating the actual operation under working conditions.

There are several mechanical and electrical details to be described which will be better understood and appreciated if the magnetic and electrical relation of the parts are first discussed.

As in all other dynamo electric machines, the generation of the e. m. f. depends upon the inductive action of a magnetic field upon conductors placed in armature slots, but the distinguishing features are the disposition of this magnetic field in a plane parallel to and passing through the axis of the rotating member, and that both the armature and field coils are placed on the stationary part of the machine. The revolving element, usually called the "inductor," consists of a cast steel mass of proper construction, the periphery containing polar projections which in sweeping past the armature windings induce therein an e. m. f. The exciting coil is usually a single stationary coil properly disposed with reference to the magnetic circuit. It follows that all the poles on one side of the machine are of the same polarity. Fig. 1*a* represents a developed portion of the armature surface with the corresponding poles. Let the direction of rotation and of the flux be as indicated by the arrows. The winding of one phase only is shown. With the poles in position *A*, no e. m. f. will be induced in the winding. However, as they move toward the left, leg *I* of each coil is subjected to the action of the flux and generates an e. m. f. directed perpendicular to the plane of the paper and downward, which rises to a maximum when the poles are in position *B*, and again falls to zero when the poles lie between legs *I* and *II'*, thus completing one-half of the cycle. The direction of the current is shown by the full line arrows in Fig. 1*b*. Leg *II* of each coil will now generate an e. m. f. which, as before, will be directed perpendicular to the plane of the paper and downward, and which will pass through a similar cycle. The broken line arrows in Fig. 1*b* now indicate the direction of the current. Obviously this direction is reversed, and the second half of the cycle thus completed.

If a second winding is placed in the slots midway between the winding shown, it will have induced in it an e. m. f. differing in phase by 90 degs. from that in the first, and the whole will constitute a two-phase winding, similarly, with slots 60 degs. apart a three-phase winding is obtained.

The armature winding of an inductor alternator is usually of the style known as concentrated windings, that is, all the conductors per pole per phase are placed in a single slot. Since the instantaneous value of the e. m. f. induced in such a coil is proportional to the strength of the magnetic field which it is cutting at that instant, it is apparent that with the pole shaped as shown in Fig. 1*a*, and having an approximately uniform density over the entire pole face, the curve



FIGS. 1*a* AND 1*b*.—INDUCTION ALTERNATOR.

which represents the instantaneous values of the e. m. f. throughout the cycle will not be a sine curve, but a flat-topped curve, which comes to zero quite abruptly.

An approximation to a sine curve may be obtained by distributing the winding in two or more slots per pole per phase, or by properly shaping the pole piece, so that the air gap density will vary in some definite way. Both of these methods will again be considered.

Since with a fixed impressed m. m. f., the magnetic fluxes through two parallel paths are inversely proportional to their respective reluctances, it will at once appear that a field must exist between the polar projections as indicated by the lines *fg* in Fig. 1*a*. This is the leakage field of the inductor alternator, and extends as shown from the armature surface between the poles to the iron parts beneath.

The field rotates with the main field and therefore reacts on that portion of the winding not under the pole face, inducing an e. m. f. opposed to that set up by the main field. Hence it is of importance to keep this field as small as possible. A method for accomplishing this will also be considered later.

As has been shown before, all the poles on one side of an inductor alternator have the same polarity, hence the armature teeth and iron are always magnetized in approximately the same direction. When the tooth is directly under a pole, it is working at its maximum density. This decreases as the tooth immerges from under the pole, and becomes nearly zero when midway between the poles, increasing again to a maximum when it is directly under the following pole, but always magnetized in the same direction. Likewise, in the armature body, excepting that here there is a slight change in direction, owing to a small angular swing of the flux. Hence *the direction of magnetization is never completely reversed*, as it is in other types of alternators, but *merely increases from a zero to a maximum value and again decreases to zero with a nearly constant direction.*

A thorough appreciation of this fact is necessary, for upon it depends to a large extent the economical design and good operation of

inductor alternators. Since the iron is worked only through a partial cycle, the iron losses must be extremely small if worked at ordinary low densities, or it can be worked at very high densities without bringing the losses up to those found in other types. Also, since the magnetic flux follows a radial path through the iron to the magnet bars, the radial depth of the armature laminations is determined entirely by mechanical reasons. If the armature and winding are designed with this point in view, the radial depth of iron can be made much less than in revolving field alternators. Having but a single coil for excitation, the copper required is reduced to a minimum and therefore the field C^2R losses are small. Owing to the low iron and field losses, and the extremely good ventilation obtained with the style of inductor adopted, the armature losses can be taken high without loss in efficiency or excessive heating. It would at first appear that if only one-half of the winding is effective at a time either the amount of copper or the amount of iron must be twice as great as in an alternator in which the whole winding is active. However, the above shows this is not the case, and as a matter of fact, the active material in a properly designed inductor alternator is but very little in excess of that in other types. Another fact of interest is that working the teeth at such high densities as are possible in inductor alternators results in a remarkable improvement in the regulation This will again be considered later.

Enough has been said to show that the entire design tends toward a machine of good full load efficiencies, and owing to the low iron losses, one of very good efficiencies at partial loads. It will be shown later that the regulaion can be made equally satisfactory.

An Improved Apparatus for Arc-Light Photometry.*

The paper describes a photometric equipment which, while embodying certain features of Blondel's apparatus, combines simplicity of operation with adaptability to either open or enclosed arcs. A mathematical presentation is given of the theory of the apparatus, from which the conclusion is drawn, that to produce on the photometer screen an illumination proportional to the mean spherical intensity of the source, it is necessary (1) to direct towards the photometer the beams of light which the eye of an observer would receive if he were to view the source at angular intervals of 15 degs. in a vertical plane, and (2) to reduce the intensity of the light in these directions in the ratio of the [illegible] the vertical.

In carrying out the method, a ring (Fig. 1) of 24 large trapezoidal mirrors, M, M, surrounds the arc. This system of mirrors constitutes a truncated, 24 sided pyramid. The inclination of the mirror

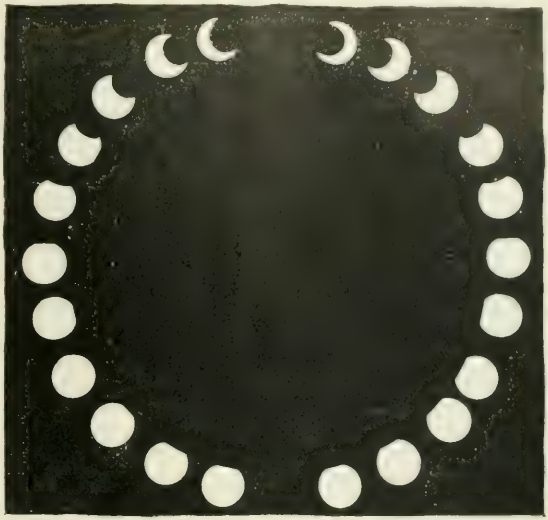


FIG. 2.—IMAGES IN DETERMINING SPHERICAL CANDLE-POWER

to the axis A of the system is such that the eye, placed at the photometer P, sees 24 images of the lamp L, of which L' is the horizontal one, precisely as if the mirrors being absent, one were to travel in a circle about the arc in the plane oo' stopping at 15 degs. intervals.

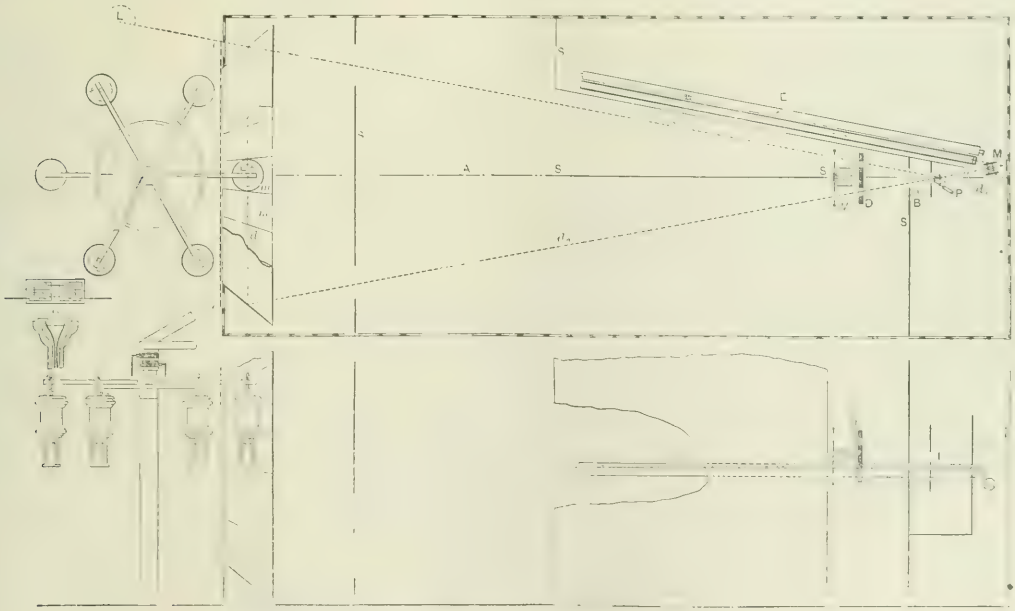


FIG. 1.—ARRANGEMENT OF APPARATUS

Figs. 2 and 3 show the aspect of this series of images from a point near the photometer. The slight amount of displacement shown in these illustrations is due to the fact that the camera could not be placed at the optical center of the system. Fig. 2 shows the entire set of images as used in the determination of the mean spherical intensity, and the Fig. 3 the lower images only for the determination

*Abstract of a paper read Sept. 27, 1901, before the American Institute of Electrical Engineers.

of the mean hemispherical intensity, as in the case of lamps with shades. As actually used, the top and bottom mirrors were left out, not because there may not be light in these directions, but because these intensities, when multiplied by sin O, do not contribute to the mean spherical intensity. Direct light from the arc is intercepted by a black screen *S*.

This system of mirrors serves then to direct the light to the photometer screen in the chosen directions. The second condition is

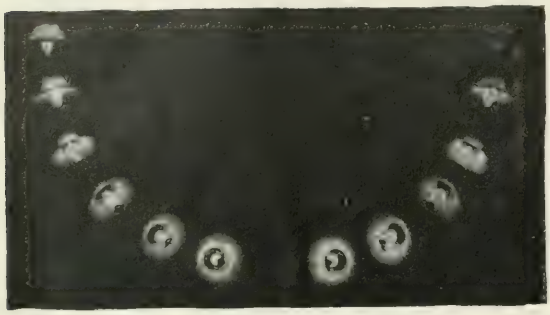


FIG. 3.—IMAGES IN DETERMINING HEMISPHERICAL CANDLE-POWER.

that the intensity of each beam of light shall be reduced in the ratio of the sine of the vertical angle. This has been done by a polygonal glass disk *D*, composed of as many sectors as there are mirrors. These sectors are smoked until they give the desired absorption. In order that the film of smoke may be permanent, the ring of smoked sectors is covered by two plates of plane glass. These plates cover but do not touch the smoked surfaces. The three thicknesses of glass are firmly bound together, and the screen, as a whole, may be handled without fear of changing its absorption. The precaution must be taken to thoroughly clean its external surfaces before making measurements. An essential condition to the success of this method is that the photometer screen should receive through any given sector from the image in the corresponding mirror and from no other. That this condition is fulfilled, can easily be determined. Thus, if all the mirrors be covered except the horizontal one, and all the sectors be covered except the sector just above the horizontal, that is, at 15 degs. A, then if the patch of light produced by this arrangement of the apparatus falls not upon the photometer screen, but upon the black surface in the vicinity of the photometer, the required condition is met. The sectored disk is best put in place by replacing the photometer screen by a cardboard pierced by a small opening. The observer can then sight through this hole and ascertain the adjustment of the disk with reference to the system of mirrors.

The mirrors are of good quality, French plate glass. Their reflection coefficients were carefully determined for the incidence at which they are used. Some inequalities were found, as would be expected, although the maximum difference from the mean value of .815 is only + 2.9 per cent. However, in order that the apparatus might be used for the measurement of steady sources, variations of the coefficient were corrected by smoking of the corresponding glass sectors. That is to say, if the coefficient of a particular mirror were high, the corresponding glass sector was smoked a little heavier than would otherwise be done.

Some care and skill are necessary to produce a uniform coating of smoke of just the required density. It was found convenient to use a sheet iron chamber, fitted with a suitable flue, and pierced near the top with a small opening for the introduction of the glass. This chamber must be placed near one end of the photometer bar in order that the absorption of the glass may be tested as frequently as may be necessary. The setting of the photometer being predetermined, each sector is smoked until it shows the required absorption. There is a tendency for the coating to form most heavily near the edges of the glass. This may be overcome by providing a guard ring of glass of the same thickness as the piece to be smoked, the whole being mounted in a convenient holder. The best results will be obtained by holding the piece of glass vertically in the smoke chamber, occasionally reversing the piece. Turpentine is a good combustible, but it must be introduced into the receptacle at the base of the chamber in small quantities, otherwise the combustion will be so violent as to produce a flocculent deposit on the glass.

In testing the glasses it is best to use a small source of light, such as a narrow slit in front of a straight filament glow-lamp. Any inequalities in the coating of smoke can be detected by moving the glass about in front of this opening, care being taken that the same plane is maintained. It will be seen in Fig. 1 that the incidence of the light upon the glass is not quite normal. Care was taken to maintain this same incidence in the absorption tests.

At M_s is shown a mirror for directing the light from the temporary standard to the photometer. This mirror might have been omitted had not the limits of the photometer room already been taxed to the utmost. Still better, if the mirrors were from one large piece of glass, the direction of the photometer bar might be such that the same incidence would be had on M_s as upon the others. In this case the correction for the mirror absorption would be eliminated.

The illumination upon the arc side of the photometer screen is, of course, very intense. It is necessary to reduce this illumination. For this purpose there was used a rotating wheel *w*, provided with a large number of narrow radial slots. It is quite essential that the number of open slots should be large, as otherwise the illumination on the photometer screen will be seen to beat or pulsate when measurements are being made on the alternating arc. In order to avoid this the constant of this wheel was determined by direct experiment on the arc itself, and not by calculation. The mean of several determinations gave the transmission constant of the sectored wheel, K_w, the value of .090. The number of slots in this wheel is 48, which gives a frequency amply great at the normal speed of the motor used for driving the wheel.

A possible source of error is the diffusion of the smoked glass disk. That is to say, since the disk receives a certain flux of light dependent upon the solid angle which it subtends from each image as a center and upon the intensity of such image, it becomes, to some extent, a secondary source. The direct measurement of this is a matter of some difficulty. To determine if the correction for this diffusion were of importance, the longitudinal screen *ss'* was removed, the mirrors to the left of the vertical were covered, and likewise the right half of the sectored glass disk. With an arc of ordinary intensity in the center of the mirror system, it is evident that the left half of the sectored disk receives a flux of light about equal to that which it would normally receive with the longitudinal screen in position and the mirrors entirely uncovered. At the same time, no direct light from the images falls upon the photometer screen. Any illumination perceived under such circumstances would be due to the diffusive action of the glass. As a matter of fact, it was found that with the temporary standard stopped down by a narrow slit, a setting could be obtained in this way when the sectored wheel was not in position, but when this wheel was running in its proper place the correction was entirely negligible. Hence no further attempt was made to take account of it.

The distance from source to photometer screen is large, being nearly nine metres. As the incidence of the light from the temporary standard is the same as that from the arc, no correction is here necessary.

The paper gives the deduction of the working equation of the apparatus, which, for the particular apparatus described, is as follows:

$$I_{ms} = 1.17 \left(\frac{865}{d_s}\right)^2 I_s \quad I_{mhs} = 2.01 \left(\frac{865}{d_s}\right)^2 I_s$$

where I_{ms} is the mean spherical intensity, I_{mhs} the mean hemispherical intensity, I_s the standard of intensity, and d_s the distance

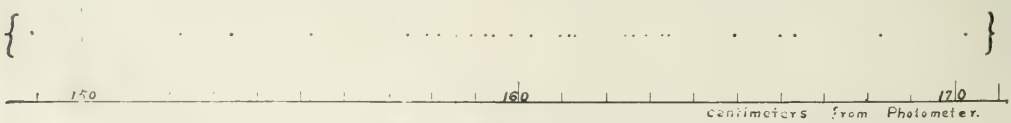


FIG. 4.—PHOTOMETER SCALE.

from the temporary standard to the photometer screen, this value being recorded on a drum. A single covering on a drum suffices for the record of many tests, and the records may be worked out at the leisure of the operator. Fig. 4 gives a specimen record and shows the usual range of fluctuation. The number of settings here is 30. This large number is necessary because of the fluctuations in the intensity of the arc, even with the steadying effect peculiar to the multiple mirror method. With hand fed arcs, a smaller number will suffice to give a value representative of the average performance of the arc. For the distribution curves, it suffices to uncover the mirrors in pairs and make settings in the usual way. The appropriate mirror constants must, of course, be used in working up the results.

As a check on the accuracy of the integrating method as compared with the usual method: The results are given of a test on an arc of the enclosed type. The value obtained from the Rousseau diagram is 308. That by the method described in this paper, 319. This agreement is within 3.4 per cent. When one considers the difficulty in maintaining an automatic feed arc under constant conditions during the time required to take the distribution curve, this must be considered as a very satisfactory agreement.

Electric Automobilism in the Sandwich Islands.

THE Hawaiian Automobile Company was organized in the year 1899 and began operations in the year 1901, doing a general livery business in Honolulu, and during the early part of its operations was well patronized by the public and very successful. Its complement consisted of twenty special surreys of the type shown, one trap, one family surrey and five runabouts, all using electricity as a means of propulsion. The steam plant consisted of two 100-hp Babcock & Wilcox boilers, with Green fuel economizer, steam heater and separator, and two 11½ by 10 McIntosh & Seymour high-speed engines direct connected to two 60-kw, 125-volt shunt-wound General Electric Company's generators. The plant was also fitted with a Spencer damper regulator and a 9-inch Westinghouse air pump used for compressor purposes. The switchboard, as shown in the engine room, is fitted with both indicating and self-recording volt and ampere meters. The switchboard for the battery room is of special design, and was built at Schenectady by the General Electric Company, and is so arranged that all the batteries and vehicles on charge in the building can be regulated from this board. This board is connected with the main board by cables through subway, the cables having a capacity of 1,500,000 circ. mils. In the battery room, for the handling of the batteries, a traveling frame is provided from which is suspended a 2000-lb. capacity Pneumatic Tool Company's hoist, and for placing the batteries in the vehicles and taking them out, a push and pull

FIG. 2.—HAWAIIAN ELECTRIC SURREY

ram made by the American Bridge Company, especially designed for this work, was erected. The batteries are charged upon benches, as shown, and the current is controlled by Cutler-Hammer rheostats. In the main room charging plugs are provided around the walls for charging vehicles without removing batteries. To replenish the batteries with electrolyte, a large acid tank is erected at an elevation of 12 ft. above the floor, and from this hard rubber piping is led around the entire battery room with suitable stop cocks and rubber pipe connections for putting fluid into any set of batteries in the room. Large sinks are provided in the battery room for the cleaning and washing of elements, the floor of this room being laid with a pitch to center for drainage purposes.

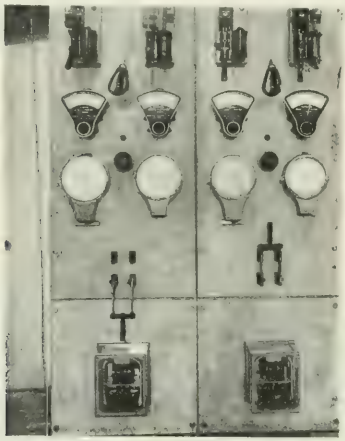
FIG. 1.—EXTERIOR OF AUTOMOBILE STABLES, HONOLULU, SANDWICH ISLANDS.

The building itself is of concrete, steel reinforced and built under the Ransom patents, cement floored throughout, and has high-light-

FIG. 3.—CHARGING ROOM, HONOLULU.

FIG. 7.—AN AVERAGE HONOLULU STREET AND ROADBED.

ing. The walls have a height of 22 ft in the clear, and the entire building is roomy and cool. Large wash pits have been provided on the outside of the building in the yard for washing carriages and also a suitable repair pit on the inside for making repairs on motors when needed. Everything about the plant is strictly first-class in construction and as up-to-date as possible, it being the intention of the promoters of the plant to leave nothing out that is necessary to a first-class establishment of this kind. A complete oxyhydrogen lead



FIGS. 4 AND 5.—SWITCHBOARDS, HAWAIIAN AUTOMOBILE STATION.

FIG. 6.—INTERIOR VIEW, AUTOMOBILE STATION, HONOLULU.

burning apparatus has been provided for making repairs and renewals to the batteries.

This plant has at the present time temporarily suspended operations on account of the deterioration of the batteries at first in use, which prevented the company from successfully operating its vehicles, and Mr. Louis T. Grant, the general manager and designer of this excellent plant, is now in the United States studying the battery problem with a view to securing a battery whose deterioration will not interfere with the steady commercial manipulation of this station. The plant has been built and operated under the immediate supervision of the above named gentleman, and it is his hope and expectation that the public service of the system may be continued and developed in the near future. The principal promoters to whose energy is due the organization of the company are Mr. E. D. Tenney and J. B. Atherton, two of Hawaii's leading and most progressive citizens. Honolulu itself is a practically ideal city for the automobile business, having fairly level roads, most of which are macadamized and grades are practically slight. With its even temperature the year around, the people ride a great deal in all seasons, and it is sincerely hoped that this venture, representing an outlay of nearly $150,000, will prove successful.

Electricity and the Royal Visit to Canada.

DURING the past week or two our Canadian friends have been celebrating the visit to the Dominion of the Duke and Duchess of Cornwall and York in a very loyal and enthusiastic manner. As might have been expected, electricity has played a most conspicuous part in the illuminations, while one of the special features has been the building of a royal trolley car for the use of the royal pair. It is the only car of the kind, if exception be made of one which is said to have been built for the Emperor of Korea, and equipped like this one by the Westinghouse Company. For details as to the Canadian car we are indebted to Mr. T. Ahearn, president of the Ottawa Electric Company, who has also been kind enough to send us photographs.

The first electric car thus provided for the exclusive use of European royalty has been furnished by the Ottawa Electric Railway Company, and is called "The Duchess of Cornwall and York," after her royal highness. The brake and motor equipment are entirely of Westinghouse manufacture. Four railway motors of 50 horse-power each drive the car at a speed of 50 miles per hour, and at this high speed the motion is entirely controlled by automatic air brakes. The car is 50 ft. in length, with straight sides and vestibuled at both ends, with full monitor roof of the Pullman pattern. The color of the car is also Pullman standard, with the British coat of arms conspicuously displayed on its front and rear. The interior is finished in antique polished oak, with a handsomely decorated ceiling of three-ply bird's-eye maple veneer. At either end of the car and set in frames are two large British plate mirrors that greatly enhance the beauty of the interior decoration. Rich bronze trimmings —the hatracks, hooks, etc., are of solid bronze—heighten the luxuriousness, and at night the car is resplendent with the illumination of five clustered groups of incandescent lamps in handsome fixtures. A rich royal blue velvet carpet covers the floor, and from the windows hang highly ornamental curtains of the latest pattern. For the comfort of the royal occupants, large, easy chairs, beautifully upholstered in olive-green plush, are provided.

As to the special lighting in Ottawa, our correspondent in Canada writes that those who looked in the direction of Ottawa, from outside quarters, during the four nights which the Duke and Duchess of York remained at the capital of the Dominion, might have been excused if they imagined that a second great conflagration was devastating the city. The electrical decorations have never before been equaled in Canada, and for chasteness and originality of design have never been surpassed in the world. Superb as were the illuminations in general throughout the city, the acme of electric splendor was reached on Parliament Hill, Major's Hill Park and the new Interprovincial bridge which spans the river between Ottawa and Hull, and which is at present the largest cantilever bridge in the world.

The scheme of the government electrical illuminations was largely followed out along the lines so successfully adopted at the Pan-American Exposition. The Gothic style of architecture of Canada's Parliament and departmental blocks afforded a scope for even better electrical effects than the renaissance of the Buffalo buildings. The great buildings were outlined in incandescent brilliancy, in tower, turret and facade, the arched lines of the doors, windows, pinnacles, etc., being picked out in thousands of incandescent lamps, while high above, at the apex of the central tower, gleamed an electric crown which could be seen for many miles away. In addition to

FIG. 1.—THE ROYAL CAR, OTTAWA.

these illuminations, the hedges and trees on Parliament Hill and Major's Hill Park adjoining were hung with myriads of electrically lighted Parisian lanterns. In the flower beds and among the foliage glowed numberless red, green, blue and yellow electric lights, producing the effect of gorgeously tinted flowers and opening buds. On the Inter-provincial bridge gleamed 10,000 electric jets. The outlines of this great structure were strictly followed and illuminated by rows of 10-cp lights. Surmounting the center span were the words "Royal Alexandra," the name given the new bridge, and formed of electric letters, each letter being 12 ft. high and the whole 200 ft. in length. Roughly estimated, not less than 100,000 electric lamps were used in the decorations and illuminations throughout the city.

But there were interior electrical displays, which rivaled the mag-

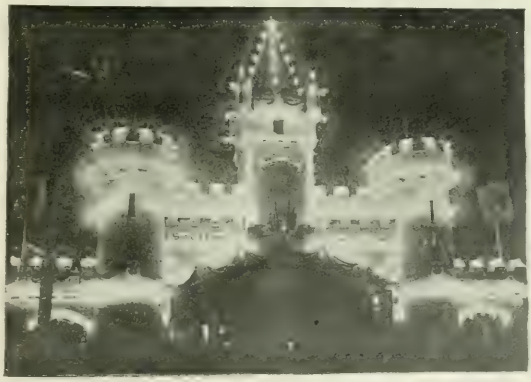


FIG. 2.—SCOTTISH ARCH ON DORCHESTER STREET, MONTREAL.

nificence of the exterior show. The preparations for the illuminations of the Parliament and other public buildings had been in progress for fully two months past, under the supervision of the Ottawa electrical engineers, Messrs. Ahearn & Soper. A great surprise was in store for such as were favored to view it. In the Senate Chamber, where their Royal Highnesses held the drawing room, the electrical preparations of the firm's experts had been quietly carried on behind closed doors, and when Ottawa's fashion and beauty entered the Red Chamber they received their first glimpse of a scheme of decoration, that for delicacy and refinement of treatment and for

dazzling magnificence, has probably never before been equaled in this line. All gasoliers and electroliers had been permanently removed from the chamber, and the old heavy panelled ceiling had been replaced by one composed entirely of luxifer prisms, through which the soft rays of 1000 incandescent lights, placed above and out of sight, penetrated. Just inside the main entrance of the chamber were two flower stands, between which the guests passed on their way to the throne. Amidst the growing flowers in these stands were

FIG. 3.—C. P. R. STATION, MONTREAL.

hundreds of Duchess of York roses made of Bohemian glass. Inside the roses, and concealed by their petals, were tiny incandescent lamps which lighted up the roses with a mellow glow. Two similar flower stands were placed to the right and left front of the throne.

The beautiful gothic arches of marble in the chamber were outlined in hundreds of incandescents of the size of grapes. Beneath the arches and resting against the panels of the chamber were hung festoons of smilax and electric roses. Each festoon was joined at the junction of the base of the arches with a wreath of smilax and electric roses through which, as in those of the festoons, glowed a soft, entrancing light. On each side of the throne stood a column upholstered in red plush and mounted with the new royal crown having nine pearls on each side. These pearls consisted of miniature incandescent lamps, pearl shaped and frosted. The columns were entwined with smilax and miniature lamps.

The piece de resistance, however, was the throne dais itself, upon which stood the Duke and Duchess and the Governor-General and

FIG. 4.—CITIZENS' ARCH, MONTREAL.

Lady Minto. Ordinarily the drapery of the throne is beaded perpendicularly, at intervals of about 2 inches, with gold and crimson cord. On this occasion the beads were composed of miniature electric lamps. Above the throne and forming a canopy of diamonds over the royal party were thousands of miniature electric lamps, radiating from a central point and drooping in graceful curves to the columns on either side to which they were attached. Nothing more beautiful and alluring could be imagined, and a greater artistic triumph in electric lighting it would be difficult to attempt

Nor was Ottawa alone in these efforts, for we are enabled to show some of the effects obtained at Montreal, for the photographs of which we are indebted to the Mr. Charles Brandeis, of the Lachine Rapids Land & Hydraulic Company, which alone supplied over 15,000 special lights for decorative purposes. Among the buildings, etc., thus provided were the company's own offices, 1500 lights, the Canadian Pacific Railroad's Windsor Street depot, with 3500 lights; the St. James' Club, with 1150 lights; the Citizens' Arch on Sherbrooke Street, 900 lights; the Scottish Arch, 450 lights; the C. P. R. Place Viger depot, 2000 lights. The work thus carried out by Mr. R. S. Kelsch, the superintendent of the company, was most successful.

New York Rapid Transit Power Plant.

The New York Rapid Transit Subway Construction Company has selected and purchased the property which will be used as the site of its central station from which power will be supplied to the entire rapid transit system. This site consists of the block bounded by Fifty-eighth and Fifty-ninth streets, Eleventh and Twelfth avenues, together with the water front along the Hudson River opposite this block. The Eastmans Company has held the property at $1,000,000 as their selling price.

The power house to be erected on this block promises to be one of the largest establishments of its kind in the world. It will be built of brick, and will cover an area of 200 by 650 ft. Its equipment will consist of twelve 7500 to 11,000-hp engines, each one of which will drive a 5000-kw generator. To furnish the steam 72 1200-hp boilers will be installed.

Mr. John Van Vleck, the electrical and mechanical engineer, speaking at the Subway Construction Company's office, stated that it was not possible for the present to speak in any great detail of the new power house, because the plans have not yet been fully developed. The work of clearing the site, preparatory to the construction work, will be begun in the near future, but just how soon Mr. Van Vleck would not say. It will take about two years to put up the building and install the machinery; in fact, it is the plan to have the underground railroad and the power house reach completion at about the same time. To have the power house finished before the road, it is pointed out, would simply mean tying up so much capital sooner than is necessary, and on this account it is not probable that the work on the former will be pushed immediately. Mr. Van Vleck would not venture an opinion as to the probable cost of the building with all of its equipment.

Telephoning the Hospice of St. Bernard.

Mr. John W. Gates, of the U. S. Steel Corporation, tells a story about a friend of his who went into the Alps last summer. "My friend began the ascent to the hospice of St. Bernard," said Mr. Gates "When about an hour's climb from the pass he was stopped by a dense fog. He waited gleefully, expecting to be rescued by the dogs, and so be able to come back to us with a thrilling story. The dogs did not come, however, and the fog partly lifted, so he resumed his climb, and finally arrived at the hospice, where he was welcomed warmly by the brothers. His first question was:

"'Why did you not send the dogs out in so dangerous a fog?'

"He nearly dropped from his chair when one of the brothers said:

"'You did not telephone us.'

"'Telephone you?' he ejaculated.

"'Yes,' was the answer. 'You see, shelters have been built all along the climb, and each shelter has been provided with a telephone. If a fog comes up all one has to do is to go to the nearest shelter and telephone. We immediately send a man and dog to that shelter. The dog carries bread, cheese and wine. As we know at just what shelter the climber is no time is lost in looking for him.'"

Mr. Gates says his friend was so disgusted with having his romantic notions knocked in the head that he left Switzerland at once.

Independent Telephone Development.

It is now announced that Mr. C. W. Morse has secured control of the Telephone, Telegraph & Cable Company of America, and this week Mr. Morse stated that Judge J. M. Thomas, the well-known president of the National Independent Association, will be general manager of the organization under the new conditions, thus retain-

ing his old connection with it. In New York City the representative of the company would naturally be the Knickerbocker Company, and Mr. Morse states that they will "fight for a foothold in New York right away." In Boston the alliance includes the Massachusetts Telephone Company. In more or less close intimacy with this movement, two large telephone companies were incorporated this week in New York State. The Frontier Telephone Company, of Buffalo, with a capital of $500,000, has been formed, to operate a telephone system connecting Buffalo, Rochester, Syracuse, Utica, Albany, Poughkeepsie, New York City, Tonawanda, Niagara Falls, Lockport, Dunkirk, Erie, Pa.; Cleveland, Ohio; Jamestown, Elmira, Binghamton and Hornellsville, the directors being J. A. Stearns, of Wilkesbarre, Pa.; Alvin Mokle, of Hazleton, Pa.; J. M. Thomas, of New York City; E. C. Lufkin, J. B. Weber and C. B. Hill, of Buffalo, and F. R. Green, of Fredonia.

The other incorporation is the Seneca Falls Home Telephone Company, with a capital of $100,000, to operate in Seneca Falls, Tyre and Junius, Seneca County. The directors are Howard Hendrickson, of Albany; A. G. Lord, J. A. Drake, S. R. R. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin and J. H. Griswold, of Elyria, Ohio.

CURRENT NEWS AND NOTES.

INTERNATIONAL GRIEF.—President Langdon, of the English Institution of Electrical Engineers, sent on Sept. 19 the following dispatch in behalf of that body to the sister society in this country: "President American Institute of Electrical Engineers: Members Institution Electrical Engineers, London, tender sympathy yourselves and American Nation in sad death President McKinley."

DIRECT TELEGRAPH TO THE KLONDIKE.—The all-Canadian Government telegraph line from Vancouver, B. C., to Dawson was completed on Sept. 24, and the first dispatch transmitted was a message of congratulation from Governor Ross, who was in Vancouver at the time, to his legal representative at Dawson. The line is 2200 miles in length and part of the route was that adopted for the Collins overland line in 1865.

AN ACCOMMODATING OPERATOR.—One of the latest stories concerning the telephone girl comes from a Bell exchange in central Illinois. A subscriber called for No. 126, which instrument was located at the home of an intimate friend. The answer came in an unfamiliar voice, and the subscriber discovered that she had been connected with No. 125. She rang off and called up central again, and the conversation that followed was something like this: "Say, central, you gave me the wrong number. I called for 126 and you gave me 125." "I know it," answered the operator, "but it was the best I could do. No. 126 was busy."

BOSTON EDISON PLANT.—The admirable article on the new plant of the Boston Edison Company, by Mr. E. S. Mansfield, has been reprinted in handsome pamphlet form, with an illustrated cover. This plant stands on the famous old tea wharf of revolutionary fame, and the design on the cover reprint shows a half-tone of the tea party episode surrounded by a line cut of the Edison Atlantic Avenue station. We are indebted to the John Hancock Life Insurance Company, of Boston, for the original picture of the "tea party" used for this purpose, and take this opportunity of expressing our thanks for their courtesy in this matter. The article appeared originally in our pages in the issue of May 18, 1901.

CHICAGO ELECTRICAL ASSOCIATION.—The subjoined is the fall and winter programme of the association: Oct. 4, 1901.—Telephone Protectors, by S. G. McMeen, Central Union Telephone Company. Oct. 18, 1901.—Proposed New Rating of Incandescent Lamps, by John D. Nies, instructor in electrical engineering Lewis Institute. Nov. 1, 1901.—The Storage Battery in Telephone Work, by James Glen Wray, electrical engineer Chicago Telephone Company. Dec. 6, 1901.—Demonstration of High-Frequency Effects, by Arthur Vaughn Abbott. Ladies' Night.—This meeting will be held in the auditorium of the Lewis Institute. Jan. 3, 1902.—Tests on High-Tension Service Lines, by George N. Eastman, testing department Chicago Edison Company.

ELECTRIC FURNACE.—A patent issued Sept. 24 to Leonard S. Dumoulin, of Flushing, N. Y., covers an electric furnace of the resistance type, designed with particular reference both to maintenance and repair. The primary heaters, two or more in number, are horizontal carbon rods, of reduced section within the smelting chamber, their enlarged ends resting in apertures in the furnace walls. The smaller central portion of the rods offers sufficient resistance to the current to develop the degree of heat required, and is protected from disintegration and from oxidation by the ores under treatment by means of a sheath of fire-clay, best applied in a plastic condition. The heavier uncovered ends remain comparatively cool by reason of their low resistance and the free radiation afforded by their exposed position. As a further protection and support these sheathed bars may be inserted within fire-clay tubes which traverse the walls and smelting chamber of the furnace. The construction is novel in detail only.

FRENCH SUBMARINE BOATS.—A cable dispatch to the *New York Tribune* of Sept. 28 says: The successful trials of the new submarine boat "Sirene" at Cherbourg have elicited from the naval authorities renewed expressions of confidence in this class of vessel. The "Sirene" was 24 hours at sea in rough weather, four hours of which she was under water, when she discharged torpedoes with ease and efficiency. Her qualities are rapidity of submersion, which is accomplished in five minutes from a stationary start; stability and habitability. Among the results of the submarine experiments is the decision of the submarines board of experts that submarines should never discharge their torpedoes at a distance of less than 100 metres from the object to be destroyed, because an explosion within that radius would destroy the submarine itself. Submarine craft are, from Oct. 1, to be placed in a department of their own, quite separate from the torpedo boat service, and with special stations at Cherbourg, Rochefort and Toulon, each under the direction of a naval captain. The officer appointed in this capacity at the Norman port is Captain Heilmac, who lately commanded the French guardship at Constantinople. He has been very successful in his technical studies, and is regarded as the highest authority on torpedoes and electricity.

INDUCTOR ALTERNATOR LITIGATION.—A decision was handed down last week in a suit for an infringement of an Eickemeyer unipolar dynamo patent granted May 25, 1886, on an application filed Nov. 8, 1882, the alleged infringing apparatus being an inductor alternator in the station of the Winsted, Mass., Gas Company. The patent in suit relates to a unipolar dynamo, the object of the invention of which was to produce a practically commutatorless direct-current machine. One of the claims of the patent is on a revolving armature enclosed by a magnetic shell, one or more helices being housed in the shell and arranged concentrically with the armature. The complainant, the General Electric Company, claimed that a S. K. C. inductor generator infringed this claim in that it employs a constant polar relation between the stationary and the rotary elements. The defendant—the Stanley Electric Manufacturing Company—denied that it uses a revolving armature, but the complainant contended that the term "armature" in the claim should be construed to mean the inner part which revolves, whether the copper conductors revolve with it or not. The court made a rather summary disposition of the various contentions of the complainant. The patent in suit, it said, covers a mere impracticable improvement upon the prior direct-current unipolar art, while the defendant's construction embodies a practical improvement in a distinct alternating-current inductor art. "For twenty years the courts have been struggling so to develop the patent law as to protect the rights of the contracting parties and to give full meaning to the promise implied in the constitutional grant, "to promote the progress of useful arts by securing to inventors the exclusive right to their discoveries." * * * When, therefore, an inventor, claiming only to be a mere improver upon an art previously confessedly impracticable, is admitted to the race by a patent granted on a theoretical utility, but finds no practical method to surmount the obstacle or break down barriers which have closed the way to his predecessors, while his machine may still keep its place in the chosen path, yet, having no inherent capacity for forward movement, the inventor will not be permitted to drag it across the whole road open to the world of invention and pervert the purposes of his admission to promote, by obstructions to prevent, the progress of the useful arts." The bill was dismissed.

LONDON-BRUSSELS TELEPHONE LINE.—The first cable for a telephone line between Brussels and London has just been laid. The distance is 250 miles, 56 of which will be under water. The cost of the construction of the line will be £36,000.

PEACHES FOR BUFFALO, N. Y., are now reaching that city by trolley car from the Lake Ontario peach district, the peaches arriving in fine condition, fresh and unbruised. On one day 350 baskets thus arrived from Olcott Beach over the trolley route. This prompt access to a large market is much appreciated by the public, the dealers and the growers.

STAND UP FOR FOUR CENTS.—The local transportation committee of the Chicago City Council has recommended that transfers shall be issued at all the junctions of the lines of the same street car company and that passengers who are not given seats shall only pay four cents. The impracticability of the last clause has already been pretty well proved. The conductor of a crowded car trying to keep track of the four-centers who got seats would not be a man to envy.

SINGLE-PHASE RAILWAY.—In a discussion of a paper on the Zossen high-speed railway read at the Glasgow Engineering Congress, Professor H. S. Carhart said that he knew of a single-phase railway that will be shortly installed in Michigan, the details of which, however, he could not divulge owing to a pending patent. He added, however, that the current would be single-phase and collected at 1100 volts, and that the motors would not be stopped when the train pulled up.

YERKES IN LONDON.—Mr. Charles T. Yerkes has bought another London Railroad, or, rather, he has contracted for 999 years with the Great Northern Railway to take over its suburban business and the franchise for the projected underground road to extend from Holborn to Finsbury Park. Parliament will be asked to grant a franchise for a link, less than a mile long, to connect this line with Mr. Yerkes' Brompton and Piccadilly line. Both lines connect with the District (underground) Railway, giving to Mr. Yerkes control, altogether, of 46 miles of road.

CAPE NOME CABLE.—The possibility of maintaining an Alaska cable begins to appears open to doubt. A dispatch from Port Townsend, Wash., of Sept. 27, says: "The passengers returning on the steamer Oregon report that the cable between St. Michael and Cape Nome is a failure. In several places the ice has cut the cable. It has been ascertained that there are nine breaks. The gap was supplied with a new cable, but it has been so badly damaged as to be practically worthless. A surveying party has been in the field surveying a land route for a telegraph line.

ST. LOUIS EXPOSITION.—The letting of contracts aggregating about $11,000,000 for work on the buildings and grounds of the Louisiana Purchase Exposition will begin about Dec. 1. About $7,000,000 of this amount on the buildings and about $4,000,000 on the grounds. The letting will begin with four exhibit buildings, to cost about $4,000,000, and which will be larger than those of any previous exposition in Europe or America by over 25 per cent. The site includes the unfinished half of one of the largest public parks in the world—Forest Park. The part to be used contains 668 acres, and about 300 acres of surrounding property will be added.

WIRELESS TELEGRAPHY AT THE YACHT RACES.—The Associated Press is reporting the yacht races, now taking place off New York Harbor, by wireless telegraph. The steam yacht "Mindora" follows the yachts over the course and reporters aboard report the principal events of the contest to a shore station at Long Beach, L. I., whence the bulletins are forwarded to headquarters by telegraph or telephone. Barring some slight interference by another enterprise of the same character, the system works very successfully. The Associated Press is using the Marconi system pure and simple, an entire equipment and staff of operators having been sent over to this country by the Marconi Wireless Telegraph Company expressly to report the races.

AMERICAN PACIFIC CABLE.—President Roosevelt has, it is stated, ample power to grant the application of the Commercial Cable Company for permission to lay a cable which shall connect California, Hawaii and the Philippines. This will be the opinion, it is claimed, which officials of the Department of Justice will render upon the papers of the Commercial Cable Company now before them. These papers were referred to the Department by the Secretary of State. There are strong precedents for Presidential approval of the Commercial Cable Company's application. Before rendering an opinion upon the application of the Commercial Cable Company the Department is examining the laws to ascertain if there is any special legislation affecting Hawaii and the Philippines which will estop executive approval of the application.

DRYING WOOD BY ELECTRICITY IN AUSTRIA.—Consul Mahin, of Reichenberg, sends the following description of a new method of quickly preparing wood for building and manufacturing purposes, taken from a local technical journal: The green wood is placed in a large wooden trough, whose bottom is covered with a lead plate, which is connected with the positive pole of an electric battery. Covering the wood is a second lead plate, which forms the negative pole. The wood is then subjected to a bath in a solution composed of 10 per cent rosin and 75 per cent soda. Under the influence of the electric current, the sap is drawn out of the wood and rises to the surface, the solution being absorbed by the wood. The operation requires from five to eight hours. The wood is then allowed to dry for about two weeks, when it is ready for use; or the drying can be done artificially in a much shorter time.

KLONDIKE TELEGRAPH LINE FINISHED.—The officers of the Signal Corps of the army at Washington received information on Sept. 26 of the completion of the last link in the telegraph line between the United States and the Klondike regions. The link just finished is between Quesnelle and Atlin in Canada. The Signal Corps had constructed a line from Fort Egbert in the Yukon region southward, and were waiting for the Canadian authorities to finish the line between Quesnelle and Atlin, the completion of which opens communication through from the United States to Fort Egbert, at the head of the Yukon River. About 300 miles westward from Fort Egbert is Fort Gibbon, which is connected by telegraph with St. Michael. Work is to begin soon on a line connecting Fort Gibbon with St. Egbert, thus adding another link which will open up communication all the way round.

ELECTRO-DEPOSITED CATHODE PLATES.—An interesting observation regarding the physical state of electro-deposited copper, and an ingenious application thereof, are noted in a patent recently issued to Messrs. Elmer G. Elliott and Valentine Kishner, of Perth Amboy, N. J. The inventors find that copper deposited upon a cathode plate which has been grooved, or rather merely scratched with a sharp instrument as a knife blade, presents an apparently continuous surface, but that the electro-deposit above the scratch differs greatly from the rest of the plate in respect of tenacity, being, in fact, so loose and porous in texture that the copper sheet can be readily torn apart along lines originally defined only as scratches on the cathode. The patented application of this is to the manufacture of "starter-sheets" of copper for use in the electrolytic refining of that metal. A lead plate is scratched to define the shape of the desired sheet, suspended as cathode in an ordinary copper-plating bath and a layer of copper of suitable thickness, 1-32 of an inch, for example, is deposited. That portion of the deposited copper which lies within the limits of the scratched pattern may be readily stripped from the lead plate, leaving as a margin upon the latter an electro-deposited frame, which serves to stiffen and strengthen the plate for the next operation and is finally broken off when of such thickness as to interfere with the plating. The copper sheets so formed are employed as cathodes (starter-sheets) in the ordinary refining vats, forming bases for the deposited refined metal and being of even quality therewith. The scratch-grooves may be formed in the edges of the plate instead of in its face near the edges. In this case no margin remains after the deposit is stripped, and the plate must therefore be heavier and stiffer and is formed of copper. The first-mentioned procedure would seem to be preferable as providing a frame, heretofore usually constructed of wood, to guard against distortion of the sheet and as permitting the continued use, as cathodes for the starter-sheets, of the thin sheets of lead which have hitherto proven most satisfactory.

Letter to the Editors.

Shaft Oscillation.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Sept. 28 I notice a description of a shaft oscillator by Mr. A. B. Weeks. This, in my estimation, is not quite sound engineering. In ordinary machines the commutators are only a little wider than the brushes. When the shaft performs its end play the brushes necessarily bear at certain portions all the time and only a part of the time at other places. This causes uneven wear on the commutator, and if the end play is not taken up, it will cause the brushes to jump and consequently spark. My experience with high-speed machines shows that they run much better from a sparking standpoint without end play. Staggering the brushes will tend to keep it more even. Direct-connected dynamos never show signs of any necessity for end play.

New York City. Alphonse A. Adler.

Digest of Current Electrical Literature.

Dynamos, Motors and Transformers

Slotted Armatures.—Ziehl.—A communication in which he criticises the results recently obtained by Dick (Digest, Sept. 7), namely, that a dynamo is properly built if the air-gap is made a minimum and that the excitation required for a larger air-gap, can better be used for overcoming the reluctance of the highly saturated teeth, to obtain the best dimensions of teeth and slots. The present author doubts that this result is in general correct. He discusses briefly the advantages and disadvantages of slotted armatures. The advantage being a saving in exciting ampere turns, the disadvantages being hysteresis and eddy current losses in the teeth and more sparks at the commutator. He agrees that small machines and machines of medium size should be built with slotted armatures; while this is in general not the case with large machines. To place the armature windings in slots should always be considered a disadvantage, even if necessary, due to the lack of space between the surfaces of the poles and armature. He speaks in favor of as few slots as possible and of slots of small depth, to make the form of the armature similar to that of a non-slotted armature. He has sometimes found it advantageous to place a part of the armature windings directly on the surfaces of the armature and the other part in slots only about half as deep as the slots in a pure slotted armature. He concludes that a dynamo is properly designed, if for a given excitation or number of ampere turns, for a minimum air space, and for a maximum induction, in the air, and if necessary, high saturation of the teeth, the armature windings are so arranged that they are as near as possible to the circumference of the armature, i. e., that the armature approaches the form of a non-slotted armature as much as possible.—*Elek. Zeit.*, Aug. 22.

H. S. Meyer.—Another communication referring to the article of Dick. He doubts whether a very small air-gap is always to be recommended. For induction motors it is, of course, required, but it is there considered to be a disadvantage. A very small air-gap has considerable mechanical difficulties and disadvantages. He thinks that it is not right to limit the saturation of the teeth to 18,000 gauss (lines per square centimeter); he has found that the best results are obtained with saturations of the teeth of 22,000 to 24,000 gauss and an air space of about 1 to 2 mm. in small machines and up to 8 or 9 mm. for large machines. He gives a slightly more general modification of a formula of Dick.—*Elek. Zeit.*, Sept. 12.

Self-Starting Single-Phase Motor.—Michel.—A description, illustrated with diagrams, of an improvement of Hasselwander. In the short-circuited armature of this induction motor, the wires in which the currents are induced and those which produce the torque, are not connected together in parallel, as is usual, but through choking coils. One end of each coil is connected to a copper ring, while the other ends are connected to each other through choking coils. The impedance of these choking coils, which are placed on the rotor, is greatly increased when they arrive at a certain position, due to the presence there of a fixed inductor, and their throttling action therefore varies as they pass this inductor. The current from those coils in which it is induced, flows chiefly through the choking coils having the lower impedance, to those coils which produce the torque, and could be forced to flow in a certain direction. The connections must therefore be such that there are always at least two paths between the inducing coils and those producing the torque, one of these paths having a lower impedance than the other. Several modifications of the device are illustrated.—*Zeit. fuer Elek.*, April 7; abstracted briefly with some of the illustrations in *Science Abstracts*, Aug. 26.

Conversion of Single-Phase to Polyphase Plant.—E. K. Scott.—An article in which he discusses how much of a single-phase plant already in use may be converted for two or three-phase working. This question is of interest as the multiphase systems come into use more and more. Of alternators, those without iron in the armature, as the Ferranti, Brush and Siemens machines, cannot, under any circumstanves, be altered to two or three-phase, while with iron-clad alternators of the ordinary type the conversion is easy. Several ordinary types of transformers can be altered to three-phase working, but this is not possible with the shell type. While it is possible to have in a three-phase system a single-phase transformer in each phase, he thinks it is much more advantageous to use three-phase transformers. In the district of St. Etienne, in France, where silk ribbon is made by a large number of small manufacturers, each owning one or two looms, about 3000 small three-phase motors of about 1½ horse-power each, are in use for driving the looms. When the plant was first put down, three separate transformers were installed in each case for each phase, with the result that the switching on and off of motors upset the lighting very much. This was cured by the installation of three-phase transformers. Other points in favor of properly built three-phase transformers are that for a given output they are much cheaper and take up much less space than three separate transformers.—Lond. *Elec. Rev.*, Sept. 13.

REFERENCE.

Direct-Current Dynamos.—An illustrated description of large direct-current generators, made by the English Electric Man. Co., at Preston. The construction of the machines is described and the results of tests are given in two diagrams.—Lond. *Elec.*, Sept. 13.

Lights and Lighting.

Arc Between Conductors of the Second Class.—Rasch.—A reply to criticisms of a statement made by him some time ago that his new arc lamp (in which an arc is formed between electrodes of materials like clay or porcelain mixed with the rare earths, like those in the Nernst lamp) has a light efficiency of 100 per cent. He claims that the Tumlirz figure for the mechanical equivalent of light, is a very valuable unit of measurement and is strictly correct as far as it refers to present methods of illumination. He maintains that his former statement concerning the efficiency of his lamp is correct, but states that it refers to the physiological and not to an energy efficiency. He claims that the principle of the method has not been understood. In a foot note he adds that it is nonsense to state that a source of light of high efficiency should not radiate heat (but does not make it clear why this should not be so). He claims that the word "light" refers to a combined physiological and psychological effect, and that in measuring light, we measure the quantity of energy by means of such a physiological effect. Some figures of Langley showing the light effect for equal amounts of energy, for the different colors of the spectrum, are given, and from these he claims to show that when the so-called efficiency, that is, the relation of the light rays to the total rays, is limited, the number of candle-power may differ enormously; for instance, for yellow it would be 2800, while for green it would be 100,000. Concerning the consumption of the electrodes in his lamp, he states that it is quite slight, and that the arc burns about 15 minutes and sometimes 3 or 4 times that, without requiring feed-

ing of the carbons or without going out. The criticism of Nernst that the consumption of electrodes would be prohibitive is, therefore, not well founded.—*Elek. Zeit.*, April 25.

REFERENCE.

Templets for Lamp Bases.—An illustrated reprint of the regulations of the German Reichsanstalt regarding the examination of templets for the bases and sockets of incandescent lamps, according to the rules of the Association of German Elec. Eng.—*Elek. Zeit.*, Aug. 15.

POWER.

Electric Power in Shipyards.—ROBERTSON.—A Glasgow Internat. Eng. Congress paper on electric power supply in shipbuilding yards and marine engine works. The advantages of electric driving in marine engine works are, saving in cost of power, flexibility of the system due especially to the use of portable tools, and a substantial increase of output at a very considerable reduction of cost for labor. These advantages are still more enhanced in shipyards where flexibility of the system is of the highest importance. The tools themselves are, as a rule, of a heavy class which can most conveniently and economically be driven by independent motors, and may thus be disposed in such positions as to reduce to a minimum the handling of the raw material. Unless in the case of special portable tools, it is not economical to use motors of less than 5 horse-power. Where machines are worked intermittently and at varying powers, it is possible by suitable grouping to arrange a motor of, say, 10 or 20 horse-power upon a shaft to drive machines which, if supplied by separate motors, would require an aggregate of more than double that power. Single motors may be used in the shipyard to greater advantage, but the tools in this case are of such a class that in very few cases will smaller motors than 5 horse-power be required. When new engine shops and shipyards are built, it is undoubtedly the best policy to adopt electric power, and in most cases it will pay to make the change in existing plants.—Lond. *Eng'ing*, Sept. 13.

Power in Marine Engine Works.—CRIGHTON and RIDDELL.—An abstract of a Glasgow Internat. Eng. Congress paper on the "Power required to drive marine engine works and for electric lighting." They describe the improvements made in a plant at Glasgow which formerly had one marine type boiler at 80-lb. pressure, supplying steam to three vertical compound engines for driving the machinery and one vertical compound engine for lighting purposes. In the new plant only one engine is used for the whole plant. Two dynamos are laid down for lighting and power purposes. These and two lines of shafting are connected to the main engine shaft with belts. Motors are laid down to drive all outlying shafting. The power in such a plant is expended in removing material from rough castings and forgings. They found that the cost of this operation was reduced by 52 per cent under the new system.—Lond. *Elec., Elec. Rev.*, Sept. 13.

REFERENCES.

Elevators.—BAXTER.—A continuation of his illustrated article on electrically controlled hydraulic elevators. He describes the general arrangement for the electromagnetic control of hydraulic elevators, when the controlling current is obtained from a primary battery of moderate capacity or from a storage battery.—*Am. Mach.*, Sept. 19.

Alternating Currents in Mines.—WALKER.—An abstract of a Glasgow Internat. Eng. Congress paper on the advantages of alternating currents for use in mines. This system is specially suitable for high-pressure distribution from a center, and for use for driving machines underground, on account of the simple and compact construction of the induction motor.—*Eng'ing*, Sept. 13

TRACTION.

Three-Phase High-Speed Traction.—In an editorial on the Glasgow Congress some critical remarks on Lasche's paper are made (see Lasche's article, ELECTRICAL WORLD AND ENGINEER, Sept. 14, 21, also Digest, Sept. 28). While this paper is highly recommended, it is regretted that the trials of the locomotive have thus far been carried out only with the locomotive mounted on rollers. Between the conditions thus established and the actual practical conditions when running on a track, there is a great gulf. Many of the most vital considerations affecting high-speed working are ignored in the former arrangement, such, for instance, as the effect of the momentum of the locomotive itself and of the train drawn by it, as well as the influence of curves and gradients. The subject of Lasche's paper must be divided into two distinct parts, which have no necessary relationship with one another, viz., use of high pressures, and the adoption of high speed. High pressures can be used on existing lines, and the question whether high-pressure alternating currents or continuous current of lower pressure are the better for railway traction under ordinary conditions, can as easily be settled on railways already constructed as upon specially built tracks. Such is not the case, however, with high speeds, e. g., 124 miles an hour. The curves and gradients of ordinarily built railways would render these speeds prohibitory. Even on a straight portion of ordinary railroad track, such speeds would almost certainly require radical differences in track construction and in the shape and size of the rail. The results of the trials on the road are therefore expected with the greatest interest.—Lond. *Elec.*, Sept. 13.

Destruction of Gas Pipes by Tramway Return Currents.—LEYBOLD.—A Glasgow Internat. Eng. Congress paper in which he gave an account of observations made in Hamburg, Germany. In a street, near the electric plant, the gas pipes were destroyed. On one side of the street is the main gas pipe of cast iron. Wrought iron service pipes cross the road to the lamps on the other side. In the middle of the road there are two lines of tramway rails, cars passing at intervals of three minutes, so that about every 1½ minutes a tram passes any particular spot. The rails are placed upon a bed of concrete 0.2 m thick. The gas pipes are laid at right angles to the rails at a depth of from 0.55 m. to 1 m. The street is paved with granite well jointed with asphalt. Holes were found in all the wrought iron pipes, the position of the holes coinciding exactly with the position of the rails. The pipes are covered with canvas soaked in boiled tar. In many places blisters were found between the iron and the tar, which were filled up with a green solution of protochloride of iron, in some places also with crystals of the same salt. How this could be formed, is evident from the fact that the earth in the vicinity contains between 0.006 and 0.04 per cent of chloride of sodium. The danger to the pipes has been removed by providing a large number of insulated return transmissions for the tramways.—Lond. *Elec. Eng.*, Sept. 13.

Emergency Repair Wagon Service in Brooklyn.—The extent of the Brooklyn system requires the quick response of repair men in case of accident, and the company has recently built a number of emergency stations with the same facilities for rapidly harnessing horses and getting the men out, as are contained in the usual fire engine houses. One of these stations is illustrated. The ground floor provides space for at least two emergency and repair wagons, as well as a tower wagon. The second floor contains the living apartments for the crew, consisting of four men. The foreman, with his family, occupies the upper floor. The company is proposing to use steam automobile emergency wagons in place of those run by horses. It is thought they will be able to reach the scene of trouble quicker.—*St. R'y Jour.*, Sept. 7, and Int. Ed., Sept.

REFERENCE.

Berlin.—In a continuation of the serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany, an illustrated description of the Berlin electrical elevated and subway railway is given.—Lond. *Elec.*, Sept. 13.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Central Station Statistics of Germany.—The very full, annual statistics, covering 23 full pages of tables, besides a long editorial summary of the public lighting stations, which existed on April 1, 1901. Private plants and pure traction plants are omitted. A new column is added this year, giving the capital investment, but this column is not complete, as only 318 of the existing 768 plants, have given the information. The capital invested in these 318 plants with together 137,508 kilowatts, is $55,939,120. It is estimated that the total capital invested in German central stations is $125,000,000. The number of central stations in 1901 is 768 against 652 in 1900. Several of the stations supply current to a number of towns—in one case 66—in a circular area with a radius of 9 to 12 miles; 81.3 per cent of all stations, against 80.4 per cent last year, use direct current, but their capacity is only 49 per cent of the total capacity of all plants, against 53.8 per cent last year. The reason is that the large number of small stations of less than 100 kilowatts generally use direct current, while the large stations generally supply three-phase or single-phase alternating currents to converter sub-stations. The number of combined three-phase direct-current plants is 43, with 86,985 kilowatts, against 38, with 41,757 kilowatts, last year. The number of combined single-phase, direct-current stations is 10, with 6874 kilowatts, against 6 with 1399 kilowatts, last year. The number of pure three-phase plants is 45, with 41,634 kilowatts, against 39, with 35,677 kilowatts. The number of pure single-phase or two-phase plants is 44, with 27.-

548 kilowatts, against 42, with 21,572 kilowatts. Two plants of together 950 kilowatts use the monocyclic system. In nearly all direct-current stations storage batteries are used. The total capacity of storage batteries in the direct-current plants provided with them is 32.6 per cent of the capacity of the dynamos. In 60.3 per cent of all stations the generators are steam driven. Water power is used in Rheinfelden with 12,360 kilowatts and in 72 smaller stations of together 3354 kilowatts. In 170 plants, with together 36,000 kilowatts, both steam and water power are used, the steam being generally the reserve. Gas machines for driving the generators are used in 39 stations, i. e., 5 per cent of all stations, but they have together only a capacity of 1.1 per cent of that of all the stations. There are in Germany 38 plants—against 23 last year—with a capacity of more than 2000 kilowatts. The largest station is the Oberspree station of Berlin, the generating plant alone having 10,770 kilowatts, and with the sub-stations 22,075 kilowatts. The capacity of all lamps and motors connected to all plants is 329,572 kilowatts, while the capacity of all stations is 352,570 kilowatts, against 230,058 kilowatts last year. Electric motors represent 38.6 per cent of the total connections. In Prussia alone 99,352 electromotors were connected to the stations; 126,965 electric meters are used in stations.—*Elek. Zeit.*, Sept. 5.

REFERENCE.

Switch Gears.—WARRILOW.—The conclusion of his article on the design of switch gear. In this part he deals with direct-current switchboards controlling low pressures and carrying heavy currents. —Lond. *Elec. Rev.*, Sept. 13.

ELECTRO-PHYSICS AND MAGNETISM.

Transmission of Electric Waves Through Liquids.—NORDMAN.—An account of experiments in which he investigated how far Hertzian waves penetrate a conducting liquid. He experimented with sulphuric acid, sodium and potassium chlorides, and magnesium sulphate solutions. The maximum thicknesses traversed by the waves in the four liquids were 5 mm., 18 mm., 32 mm. and 41 mm., respectively. The general result is that transparency to Hertzian waves varies in the same sense as resistance, but not quite so rapidly.—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

REFERENCE.

Disruptive Discharge in Electrolytes.—JOHNSON.—An account of experiments in which he confirmed the result, found by Broca and Turchini, that a disruptive discharge may take place in an electrolyte in very much the same way as it does in a dielectric.—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Storage Battery.—BAINVILLE.—An article on the new Edison nickel-iron battery. He gives a review of Kennelly's paper. He thinks it is still too early to express an opinion regarding the practrical value of the battery, but he makes the following critical remarks Kennelly's data as to the capacity of the lead accumulator are too unfavorable to the same and the capacity per weight of the new Edison cell, as given by Kennelly, is therefore not better than good light traction lead cells. He claims that in the Edison cell the electrolyte is difficult to handle and must be protected against air. The e. m. f. of discharge of the Edison cell is much less constant than in the lead cell. He does not believe that only a small quantity of electrolyte is required. He says that the quantity and volume of the electrolyte cannot remain constant during discharge on account of evaporation and for the reason that "the oxygen and hydrogen are necessarily furnished by the electrolytic decomposition of water"; (this is evidently wrong; if he makes the somewhat old-fashioned assumption that during the discharge of the Edison cell oxygen is set free at the iron electrode and hydrogen at the nickel hyperoxyde electrode, so that at the former iron oxyde is formed and at the latter the nickel hyperoxyde electrode is reduced and water is formed, it is evident that for any molecule of water which is decomposed to give oxygen and hydrogen, another molecule of water is formed at the nickel plate, hence the total quantity and the concentration of electrolyte are not changed.) He claims it will be difficult in practice to find an easy method for determining the moment when the charge is completed. He thinks the Edison cell will not compete with stationary lead cells, but that its field may be for automobile.—*L'Elec.*, Aug. 31.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Induction Meter.—SCHROTTKE.—A very long, profusely illustrated paper read before the Electrotechnical Society, of Berlin, in which he describes an induction meter of Siemens & Halske. The general arrangement is shown in the adjoining diagram. *A* is a ring, formed of thin sheets of iron, with four pole pieces *E E* and *F F*. Inside there is a laminated iron core *C* around which there is placed a very light drum *B* of aluminum, which is movable around the axle *D*. The winding of the pole pieces *F F* consists of a few thick turns, that of the pole pieces *E E* of many thin turns, the former is the current coil, the latter the voltage coil. If the current in the former is *I* and in the latter *i*, the torque produced upon the aluminum drum is pro-

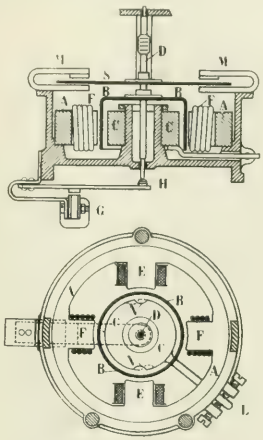


FIG. 1.—INDUCTION METER.

portional to the product of *I* and *i* and the sine of the phase difference between them. This shows the difference between induction meters and dynamometric meters, as in the latter the torque is proportional to the cosine instead of the sine. He therefore proposes to distinguish both groups as sine and cosine instruments, respectively. What is wanted, is the measurement of the energy, i. e., the product of the current, e. m. f. and the cosine of the phase difference between them. When an induction meter is used, it is therefore necessary to use a device by which the current in the voltage coil of the meter is out of phase by 90 degs. against the e. m. f. producing it. This device is a bridge arrangement, shown in the adjoining diagram where *R R D* are non-inductive resistances and *S S* the voltage coils of the meter. An induction coil, *Drsp*, is in series with this arrangement as shown in the figure. He shows that the current in the voltage coils *SS* is in quadrature with the e. m. f. between the terminals P_1 and P_2. The device is very simple and practical, as it can be easily adjusted by varying the diagonal resistance *D*, and the sensitiveness can be easily changed by varying the resistances *R* and *R*. The energy consumed in the voltage coils in meters for 120 volts is about a watt. He says that it would not be practical to try to lower this energy consumption. The magnetic brake is shown in the first figure, where

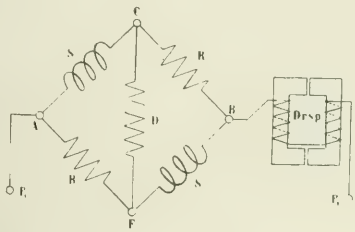


FIG. 2.—DIAGRAM OF CONNECTIONS, INDUCTION METER.

S is an aluminum disk running between the poles of strong permanent steel magnets *MM*. The friction of the bearing is compensated by a simple device, the iron core *C* being provided with two small slots *N*, shown in the figure just opposite the voltage coils *EE*. The iron core *C* can be turned by means of the screw device *L*. When the iron core is slightly turned so that the two slots are in the position shown by dotted lines, then there is a slight dissymetry of the field of the voltage coils, which produces the desired compensation. In order to prevent the meter from running at no load, the following simple device is used. The lower rim of the movable drum *B* has

some nicks, generally four. The resistance of the drum in one direction is therefore slightly different from that in another perpendicularly to it. The drum takes a position before the poles with the voltage coils so that the current produced in it is a minimum. It can then be turned to one or the other side only by applying a certain force. To make the meter indifferent to external vibrations, the total movable system of the meter (the aluminum drum and its accessories) is kept continually in very quick artificial vibration, by means of the small electromagnet *G*, the armature of which makes the spring *H* rotate, which holds the agate bearing. The friction of the bearings is thus reduced to one-tenth. The weight of the total movable system is only 27 grams. The meter is said to stand long overloads up to 30 per cent and short ones up to 100 per cent. It has also been found to stand short circuits well. He then makes some theoretical remarks about induction meters. Frequency and wave form have only a small influence. It is of great advantage to use iron in the meter. Many other details and accessories are described.—*Elek. Zeit.*, Aug. 15.

Registering Instruments.—HOSPITALIER.—With the usual form of registering instruments, in which the needle carrying a pen or pencil at its movable end registers on a cylindrical drum, the lines are curved to the short radius represented by the length of the needle, and this curvature is often inconveniently great. To overcome this, and to make the curves approximately straight lines, he suggests securing a fork to the end of this needle in place of the pen, and placing the movable end of a very long lever between the prongs of this fork, the registering pen being carried at this end of the lever while the other end is pivoted. The curves thus drawn will have the radius of the long needle, and can therefore be made as nearly a straight line as desired, the needle of the measuring instrument being made as short as desired. The arrangement is applied in his new ondograph recently described in the Digest, but is applicable also to other forms of instruments.—*L'Ind. Elec.*, July 10; *L'Eclairage Elec.*, July 13.

A Physiological Photometer.—STANOIEVITCH.—A description of a new and very simple photometer, based upon the fact that a certain quantity of luminous energy is required to produce a visual impression upon the retina. Thus a triangular or circular patch, to be distinctly visible, requires a certain constant minimum illumination which differs with different eyes and with different conditions of the same eye, but is, on the whole, constant within, say, 10 per cent. His photometer has the form of a small telescope, 10 inches long and 2 inches in diameter. At one end is a piece of ground glass which is turned towards the source. Some 4 cm. behind it is fixed an iris diaphragm, whose aperture is at the principal focus of a convex lens. The latter produces a parallel beam of rays which illuminates another diaphragm, and the latter is again observed through another lens. In using the instrument, the iris diaphragm is screwed down until nothing is seen, and then gradually opened until the round aperture is clearly defined. The instrument is calibrated empirically. A number of luminosity determinations may be made in the streets in a single evening. But care must be taken to have the eye in the same state of fatigue. (This appears to be practically a reinvention of the Houston & Kennelly illuminometer.)—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 6.

Localizing a Fault in a Single Cable.—RAYMOND-BARKER.—An illustrated article on the method, devised by Betts, for localizing a fault in a single cable. In this method equal batteries, zinc to line, are simultaneously applied, through suitable galvanometers, to the two ends of the cable in which the fault is to be localized. At set times synchronous readings are noted at both testing stations, and, by comparison with a galvanometer constant obtained through a standard resistance, these readings are reduced to corresponding resistance values. Although these resistances vary according to changes at the fault, each simultaneous pair of resistances obtained at the two ends of the line, are strictly comparable. The present author shows that this method is well adapted to graphical illustration.—Lond. *Elec. Rev.*, Sept. 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Railway Signals.—TIMMIS.—A long abstract of a Glasgow Eng. Congress paper on modern practice in railway signaling. Only pneumatic and electric signals are practical. Among the pneumatic, he described the Westinghouse high-pressure and the low-pressure systems. Among the electric systems he mentioned that used in the United States, and described the automatic one used on the Liverpool Overhead Railway, the non-automatic system which is being installed at Crewe, and a third system which embraces a track circuit.—Lond. *Elec., Eng'ing*, Sept. 18.

Wireless Telegraphy.—COLLINS.—An illustrated article in which he describes the construction of an efficient wireless telegraph apparatus at small cost.—*Sc. Amer.*, Sept. 14.

Progress in Telegraphy and Telephony.—A summary, mostly from patent specifications, of new inventions and improvements made in telegraphy and telephony during April, May and June.—*Elek. Anz.*, Aug. 15, 18.

Fire Alarm—OHL.—A well illustrated description of the fire alarm system in the city of Hanau, Germany.—*Elek. Anz.*, Aug. 8.

MISCELLANEOUS.

Visit of the British Institution of Electrical Engineers to Germany.—E. KILBURN SCOTT.—An account of this visit which has already been mentioned repeatedly in the Digest. It included Hanover, Berlin, Dresden, Nuremberg and Frankfort, and was a great success. He attributes much of the great electrical progress made in Germany to suitable political conditions. The Emperor takes a great interest in every branch of science, but particularly in electricity. In Germany there are about 70,000 persons engaged in the manufacture of electrical apparatus alone, and one company employs about 17,000 persons. He then describes three electric railways inspected in Berlin. First, the Wannsee Railway operates trains composed of ten ordinary cars like those used on the Prussian State railways, the first and the last being fitted with motors. Each of these cars has three driven axles, the weight of the empty trains is 193 tons, the motors of both cars are controlled by one controller. The second road inspected was the Gross Lichterfeldt trial road, put in operation in 1899, and using three-phase current at 10,000 volts. (Reichel, ELECTRICAL WORLD AND ENGINEER, Sept. 7.) The elevated and underground road is about 7 miles long, and runs practically east and west through the central portion of Berlin. Direct current is used at 750 volts. The power station is practically completed and contains three 800-kw units. He then considers the workmen and staff of the German factories, and finds that, while the men are not paid such high wages as in Great Britain, great consideration is shown them by the manufacturers, and the appointments of the factories are most modern. Most of the work is done in piece work. A feature of the work is the orderliness to be found everywhere, which is undoubtedly due to the military training which the men have received in the army. Many of the electrical companies have branch factories in various countries, and this gives them a great advantage, not only because they are better able to judge of local requirements when a contract is awarded from a foreign country, but also because they can temporarily transfer the manufacture of apparatus from one of the works to another. He then discusses the financial situation in Germany. Much of the present condition he attributes to speculation by banks. The German law is, however, very strict with those who misuse public funds and the managers of banks that have failed are duly prosecuted. The banks are more closely associated with the manufacturing companies than in Great Britain or America—*St. R'y Jour.*, Sept. 17, and Int. Ed., Sept.

Glasgow Exhibition.—SAYER.—An abstract of a Glasgow Internat. Eng. Congress paper in which he discussed some of the chief objects of interest to electrical engineers in the Glasgow exhibition. The conductors for the arc lights are of aluminum. The British Schuckert Company has exhibited a transforming plant, for 500 volts direct current to 10,000 volts three-phase, by means of synchronous converters and transformers. The three 10,000-volt circuits are interrupted by a Schuckert high-tension switch, when about 5 amperes is flowing in each circuit, 5 amperes representing about 100 kilowatts. Each switch unit consists of two terminals, each in the form of a wire frame, mounted so as to be in the same vertical plane. At the lower side the frames are about 3 inches apart, but the rising wires diverge from each other at an increasing rate. The circuit is opened by a switch blade at the bottom of the frames, and the arc which is established is carried upwards between the diverging wires by the air-current and so stretched out until it breaks. He also referred to an electric tram car exhibited by the Brit. Westinghouse Company and fitted with the Newall track brake. In this brake the magnets in pulling towards the rails, also pull the shoe brake on to the wheel, thus increasing the adhesion at the same time the brake is applied. The brake is operated by the car motors run as generators. —Lond. *Elec.*, Sept. 13.

Magnetic Separator.—A well illustrated detailed description of the Waring system of magnetic concentration. This system can be characterized as a combination of two older types, one being the drum type with magnetic fields created in peculiarly formed grooves, extending annularly around the drum, the other having magnets which oscillate from side to side directly across a flowing stream of material. The Waring system of magnetic concentration and classification is in use at Webb City, Mo., for the purification of zinc blende ores, the extraction of blende from pyritic jig stuff and for the experimental separation of pure zinc, copper and iron material from complex sulphide ores. The system is said to be very successful in practice. The method of treatment of the ores is described. The economy of the process is pointed out.—*Eng. and Min. Jour.*, Sept. 14.

Capacity of the Human Body.—De Metz.—An account of experiments in which he measured the capacities of several persons under all sorts of conditions, and found that they were the same when the subject was nude and when dressed in close-fitting conducting material, and that, generally speaking, the capacity of a human body is the same as that of a metallic body of the same dimensions. The capacity remains the same for any charge between 100 and 1000 volts, but differs for different persons in accordance with the volume and shape of the figure. It changes rapidly when the person is surrounded by metallic surfaces, and also greatly depends upon the pose. The normal value for an erect person in the center of a hall is 0.00011 microfarad, for an individual of average stature. This is much less than the value found by other investigators. Bordier has placed the capacity of a human body at 0.0025 microfarad, and Dubois at 0.1650 microfarad.—*Comptes Rendus,* Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

Magnetic Properties of Human Blood.—Gamgee.—Faraday found that blood, although containing a large proportion of iron, was diamagnetic. Pluecker showed that the blood corpuscles are more strongly diamagnetic than the liquid in which they flow. The present author has examined the magnetic properties of the crystalline blood-coloring matter, in the condition of utmost available purity. He comes to the conclusion that the blood coloring matter, oxyhaemoglobin, as well as carbonic-oxide haemoglobin and methaemoglobin are decidedly diamagnetic, while the iron containing derivatives haematin and actlaemin are powerfully magnetic. A preliminary study of the electrolysis of oxy-haemoglobin and carbonic-oxide haemoglobin renders it probable that, in the blood coloring matter, the iron containing group on which its physiological properties depend, is an electronegative radical. According to analogy, the iron in such a compound would possess diamagnetic and not paramagnetic properties.—Communicated to the *Brit. Royal Soc.*, June 20; abstracted in Lond. *Elec.*, Sept. 13.

International Engineering Congress at Glasgow.—An editorial on this congress, which is said to have been a striking success. The hope is expressed that it will be found practicable for the leading engineering institutions of Great Britain to unite in arranging for similar conferences to be held regularly, at intervals of a few years. The value of such a congress to engineers is discussed. Some notes are added on the papers on electrical subjects. (All these papers as far as published have been abstracted or referred to in other columns of the Digest.)—Lond. *Elec.*, Sept. 13.

New Books.

Mechanical Drawing. Written for the use of the Naval Cadets at the United States Naval Academy. By Lieutenant-Commander F. W. Bartlett, U. S. N. New York: John Wiley & Sons. 188 pages, 132 illustrations. Price, $3.

This, as stated in the title, is written for the use of naval cadets at the United States Naval Academy, and is an epitome of the methods there used. The author states he has endeavored to eliminate any personal peculiarity of method and to base the treatise on the methods in use in the drafting offices of the United States Navy. The book very properly confines itself strictly to the mechanical part of mechanical drawing, if such an expression may be permitted. That is, it makes no attempt to go into the geometrical theories upon which mechanical drawing is based, but deals rather with the detail methods in the actual drawing operations. In this respect each point is covered very fully and with exact detail. The proper use of instruments is specified in great detail, as well as all the particulars of making a working drawing, from stretching the paper on the drawing board to the standard hatching for different materials. The whole book is a testimony to the thoroughness with which United States Naval Cadets are instructed, and though the work is evidently merely an instructor's compilation as distinguished from an authoritative treatise, yet many a draughtsman who thinks himself well qualified will find in its pages many hints of value.

Original Papers by the Late John Hopkinson, D. Sc., F. R. S. Edited, with a Memoir, by B. Hopkinson, B. Sc. Two volumes. Vol. I., Technical Papers. Vol. II., Scientific Papers. Cambridge: University Press. Vol. I., 294 pages; Vol. II., 393 pages. Price, $7.

These volumes form a worthy and interesting tribute to a man of great originality and power. He was singularly gifted with both physical and intellectual vigor, winning boat races, foot races and mathematical prizes. John Hopkinson was essentially both a mathematician and a practitioner. For him pure mathematics had but few attractions. The papers which are printed in these volumes show how practical was the bent of his mind, and how repeatedly he threw the results of his logical deductions into arithmetical and utilitarian form.

The papers printed commence with one bearing date of 1874 on "Group Flashing Lights," in connection with lighthouse work. They number 52 in all and terminate with a paper on "Alternating-Current Electrolysis," read before the Royal Society in November, 1893. Although we question the judgment with which these papers have been divided into technical and scientific, and believe that the best presentation of them would have been simply in their order of date, yet taken in any order they represent a copious and valuable addition to applied physical science. The papers will be valuable for purposes of reference.

The Memoir with which the first volume commences is interesting, as giving glimpses of the private life of this very gifted man. Unfortunately, it tells nothing of the tragic circumstances under which he met his death among the Swiss Alps in August, 1898. No library of electricity or applied physics can be complete without these volumes.

In addition to the scientific papers here reprinted, a separate chapter might well have been contributed upon his inventions and practical achievements. He was an independent inventor of the three-wire system, which was invented about the same time in this country by Edison. He also invented the series-parallel control and operation of direct-current motors, and reinvented the synchronous operation of alternating-current motors. The only serious criticism that we have to find with these memorial volumes is that they do not pour out the full worth and measure of John Hopkinson's meed.

Practical Electric Railway Hand Book.—By Albert B. Herrick. New York: Street Railway Publishing Company. 407 pages, 344 illustrations. Price, $3.

This book can be aptly described as the Haswell of the electric railway engineer, containing as it does a large volume of useful information on almost every subject with which he desires to become familiar. The book is essentially a reference book and no attempt has been made to adapt it for continuous reading, though an effort has been made to classify and group like data together. The descriptions are of the briefest and most concise character, and although tests and technical work identical with electric railway engineering is given large space, matters of practical interest are predominant and much mathematical and theoretical data of scientific interest only has therefore been omitted. The book is intended to cover matters of practical value incidental to design, construction and operation of electric railways from the design of the power house to the rail return. It is therefore replete with steam and electrical engineering tests, and civil engineering is representd so far as it pertains to electric railway construction. Not the least feature of value of the book is the discussion of American apparatus and materials. It gives an immense amount of data concerning them which could otherwise only be obtained by extensive correspondence with the manufacturers and accompanying tedious delay.

As the object is to compress a large amount of information in a small number of pages, descriptions wherever necessary are most brief, and where possible the results of tests or computations are given in the form of tables or curves. The diagrams are very clear,

and where they refer to illustrations of standard apparatus they are dimensioned.

The book is divided into nine sections and two appendices, an enumeration of which will assist in giving an idea of its scope: 1. General tables. 2. Tests. 3. The track. 4. The power station. 5. Line. 6. Car house. 7. Repair shop. 8. Equipment. 9. Operation. Appendix: 1. Storage battery and boosters. 2. Underground conduit.

Heretofore the recourse of the electrical railway engineer for such information as this book contains has been an intimate knowledge with an up-to-date set of trade catalogues, a knowledge of the whereabouts of mathematical tables and formulæ and their use, reference to electrical and mechanical text books of engineering procedure, an extensive acquaintance with the material market, and his own note book.

The above information concentrated in convenient form has long been sought after, and it fills a much-needed want. The book contains much of Mr. Herrick's original work, and the results of his 20 years' experience, and much interesting data on subjects which he has made his specialties, among which may be mentioned the inspection and testing of equipments, feeder systems and ground returns.

The railway engineer will find this book more useful on his desk than in his bookcase, for even though he have at hand all of the data which it includes, the time saved in search for references is a consideration well worth the value of the volume. A book of this character requires to be thoroughly cross-indexed, and nine pages of fine print are devoted to this purpose.

BOOKS RECEIVED.

MILL BUILDING CONSTRUCTION. By H. G. Tyrrell. New York: The Engineering News Publishing Company. 40 pages, 36 illustrations. Price, $1.

THE CONSTRUCTION OF A GASOLINE MOTOR VEHICLE. By C. C Bramwell. New York: Emil Grossman & Brother. 149 pages, 86 illustrations.

PRACTICAL HINTS ON JOINT WIPING. For Beginners in Plumbing. David Williams Company, New York: 66 pages, 41 illustrations. Price, 25 cents.

POCKET BOOK OF ELECTRICAL ENGINEERING FORMULÆ. By W. Geipel and M. Hamilton Kilfour. New and enlarged edition. New York: D Van Nostrand Company. 829 pages, illustrated. Price, $3.

PARALLEL TABLES OF LOGARITHMS AND SQUARES. Feet, Inches and Fractions of a Foot Expressed in Decimals of a Foot and Advancing by 1-32 of an Inch. By Constantine Smoley, C. E. Cleveland, Ohio: Constantine Smoley. 212 pages. Price, $3.

Compound Engine Controller.

BY RALPH J. PATTERSON.

When the fly-ball governors now in use are overworked their uncertain control of the cut-off of the low-pressure cylinders, especially in engines of the Corliss type, calls for an improvement which will enable engines to respond to the demands of their loads the moment they are called upon, and securing for them the best regulation and highest efficiency under rapidly fluctuating loads of railway and general power plants.

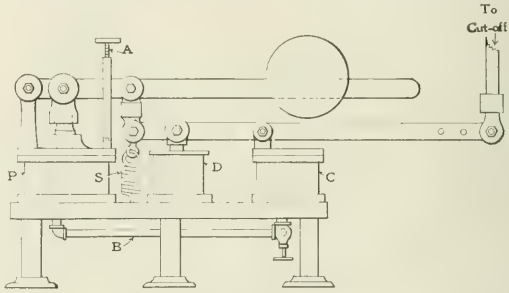
The Corliss engine, or, speaking more broadly, the engines with releasing valve-gear, have for a long time, and do now, hold the record of the highest efficiency of any type of engine. Improved methods of manufacture and closeness of regulation which can be obtained with fairly steady loads, together with economy of running, have caused many users and purchasers of engines to have a preference for this kind. As the compound Corliss type is the most economical engine to use, it is desirable to employ it for electric lighting and power, but upon its application to these uses, it was found that the regulation was not satisfactory, and this together with the fact that high speed was considered advantageous, gave an opportunity for other types of engines to encroach upon the field.

The compound engine controller, illustrated herewith, assures the closest regulation and increases the economy. It controls the cut-off on the low-pressure cylinder, without burdening the fly-ball governor usually put on these engines, and the distribution of steam in each cylinder can be made proportional to its size and share of the load. It enables Corliss engine builders to increase the speed and power of their engines, and use cheaper, lighter and more sensitive governors. Only slightly less in importance is the feature of control of the receiver pressure, maintaining it constant under varying loads, and for use in mills, factories, etc., where steam is utilized for heating vats, buildings, etc.

Somewhere between the condition which enables us to use all the exhaust for heating, and the conditions where it is needed only intermittently, or partially, the compound engine with condenser, will be found most desirable. In the latter case by the use of the controller to which this relates, the receiver pressure will be maintained constant without attention from the engineer, and whether there is much or little steam drawn from the receiver for heating purposes. The economy of using steam in this way is very apparent. The method of accomplishing this is not so simple as appears at first sight.

In the apparatus illustrated, *C* is a condensing chamber, to which a pipe from the receiver of the engine connects at the top. *P* is a piston chamber, and contains a movable piston which operates the levers, the movement of which varies with the tendency of the receiver pressure to raise or lower, and rests on water from the condensing chamber through pipe *B*, seen underneath the platform. The dashpot *D* prevents the vibration of the levers, due to the "kick" of the cut-off mechanism.

In operation the tendency of the pressure in the receiver to increase causes the piston to rise in its chamber, moving the upper or weight lever, and this in turn pulls the outer end of the lower lever down whenever the cut-off lengthens on the high-pressure cylinder



COMPOUND ENGINE CONTROLLER.

or the heating outlets are suddenly closed, thus lengthening the cut-off of the low-pressure cylinder and keeping the receiver pressure uniform.

It is thus seen that the cut-off on the low-pressure follows the cut-off on the high pressure at once, aiding very materially in controlling the speed of the engine. This operation is reversed in case the cut-off on the high pressure shortens or the heating outlets are opened.

The adjusting screw *A* is made to prevent the lever from operating too far, so the cut-off will not work. The spring *S* is made so that it will compensate for the inertia of the weights and also gives a quicker return of levers when the weight is falling. There is an air vent, not shown, which prevents air from collecting under the piston *P*, where it would form a kind of a buffer.

These controllers are in operation in several plants in Massachusetts and Georgia, and give excellent satisfaction, so much so that it has been deemed advisable to give others a chance to test their merits for themselves. They are manufactured by the Patterson Engine Controller Company, 43 Milk Street, Boston, Mass.

The Lincoln Synchronizer.

The accompanying illustrations show the Lincoln synchronizer, which furnished the subject of a paper read at the recent Buffalo meeting of the American Institute of Electrical Engineers, and the principles of which were given in the report of the meeting which appeared in these columns.

Placed conspicuously, the synchronizer may be turned about to any desired position, where the governor attendant and electrician can see its movements plainly, and note by the needle whether the alternator being started is running too slow or too fast. Synchronism is denoted by the upper vertical position of the needle. When revolving to the right, the dial indicates that the speed is too fast; to the left, that it is too slow. The alternator is speeded accordingly.

This synchronizer has been used in paralleling the 5000-hp alternators at the Niagara Falls Power Company's plant, where it has given the most gratifying results. Speed in synchronizing from a

FIG. 1.—LINCOLN SYNCHRONIZER.

shut-down, when it is necessary to get the plant in operation as soon as possible, is of the greatest importance, and demands promptness and accuracy. With it five dynamos have been put in parallel in as many minutes, including some interruptions due to telephoning, giving instructions to assistant electrician, etc.

In the accompanying diagram of wiring and connections, *a* are voltmeter transformers on the dynamos and *b* are similar trans-

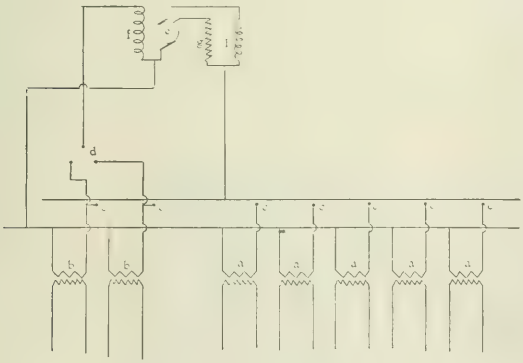
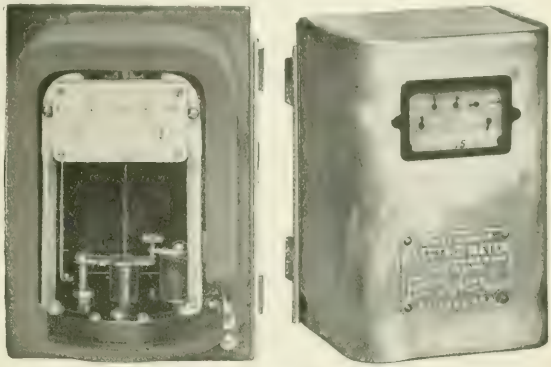


FIG. 2.—SYNCHRONIZER CONNECTIONS.

formers on the bus-bars; *c* are plug switches, *d* a two-point switch; *e* is the synchronizer armature and *f* the synchronizer field; *g* and *h* are respectively the ohmic and inductive resistances whereby a difference of phase is maintained.

Halsey Direct-Current Meter.

In our issue of Aug. 10 last was described and illustrated a new type of direct-current meter on which patents had been issued to Mr. Edward S. Halsey, of Chicago. The illustrations accompanying the article showed various forms of the meter, the principal features of which, as there summarized, being great accuracy, especially on light loads; absence of commutator, brushes and jewels, the armature being supported by mercury floatation; no deterioration of the strength of the magnets by short circuits; absence of coils; ability to stand large overloads, and an absence of continuous pressure shunt losses.



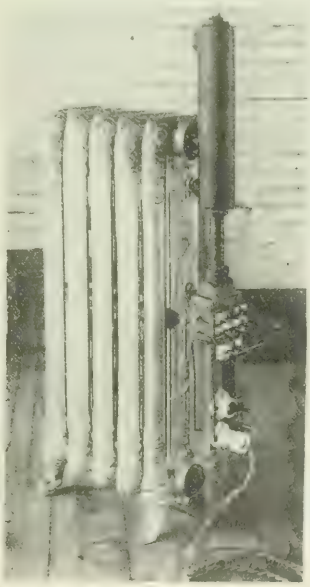
FIGS. 1 AND 2.—DIRECT CURRENT METER

Starting from the basic principles as laid down in the patent specifications Mr. Halsey has now developed a commercial form of the instrument, which is illustrated herewith, Fig. 1 showing a meter with its enclosing case removed, and Fig. 2 a similar instrument with aluminum case. The illustration (Fig. 1) represents the instrument ready for shipment, the armature and the mercury opening being locked for the purpose.

This type of meter is made in sizes of 15, 30, 60 and 100 amperes, and calibrated to read in watt-hours on any constant-potential circuit from 100 to 240 volts, or in ampere-hours for arc lights and storage battery work. It is now ready for the market.

Electric Water Heater.

A patent has been issued to Waldo F. Follett, of New Haven, Conn., on an electric water heater which, it is claimed, will largely



ELECTRIC WATER HEATER

reduce the cost of street car heating. The specific claims made in this connection are that in the case of a car from 14 to 16 ft. long,

in which ordinary electric heaters would take from 6 to 8 amperes, a car of the same length equipped with the electric hot water system would require only from 5 to 7 amperes. In still larger cars now requiring 20 or more amperes it is claimed that a saving of nearly 45 per cent could be made with the new system. Among the advantages claimed for the system is that the water absorbing the heat also acts as a cooling agent to the resistance wire, thereby permitting the use of a smaller wire than is used in the ordinary electric heater.

The heater consists of a casting which forms the flues and connecting heads and around which is wound the high-resistance wire, which is held by lava insulators and imbedded in insulating cement. The ends of the casting are made to receive iron plates fastened by screws, thus forming a casing which protects the resistance wire from injury. The accompanying illustration shows a hot-water radiator equipped with an electric water heater and an expansion tank, thus forming a portable heater. It has 34½ square ft. of heating surface, and contains 6 gallons of water. It is stated that this heater requires 800 watts to operate it.

Telpherage Ash Handling at Elizabethport, N. J.

Great progress is being made in telpherage, or the electrical transportation of material, as exemplified again in a plant which has recently been put in operation at the well-known works of the Singer Sewing Machine Company at Elizabethport, N. J. The work performed is the carrying of ashes from the boilers to a chute and there automatically dumping the same and returning to the starting point, or any place along the line of the boilers as may be desired. The load carried, including the bucket, is about 600 lbs. The lift is about 30 ft. The work is controlled by a switchboard located at a convenient place and is completely under the control of the man who is handling the ashes.

The telpher is of the side-bearing type, and is without any gearing or transmitting device between the motor and driving wheel. The driving wheel is placed upon the shaft of the armature, thereby avoiding all wear and tear of gears or noise. The telpher has also a solenoid brake which acts automatically, gradually slowing the telpher down at any desired place. The telpher is under perfect control and can be moved a few inches or the total length of the line if so desired.

FIG. 1.—TELPHERAGE PLANT.

Below the telpher, as shown in the illustrations herewith, is an electric hoist. It will be noticed what a long lift it has, and that no chains or obstructions are in the way while the telpher is in operation. The hoist is automatic in stopping when it reaches any desired height, independently of the will of the operator. The bucket is self-dumping and self-righting, dumping its load automatically in the chute at the end of the line, where the trigger projection from the bucket comes in contact with the tripping device. This plant is not only able to handle all the ashes produced, but is capable of doing more than double the work required.

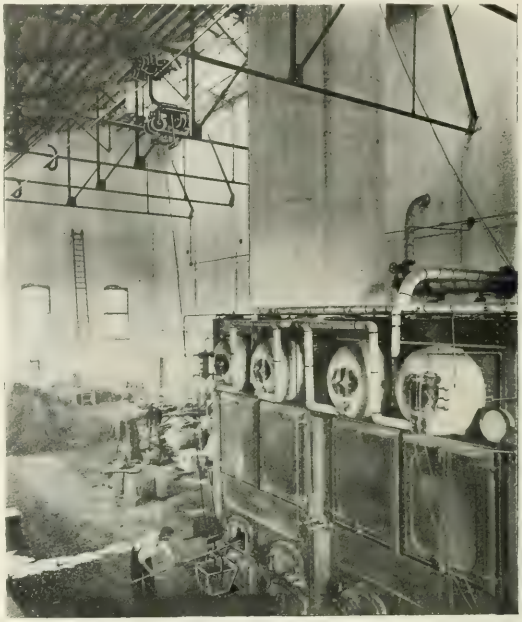


FIG. 2.—LOADING ASHES AT THE BOILERS.

The costs of operation and maintenance of this plant are stated to be exceedingly low. There are no wheels, sheaves or chains to be oiled, merely the axle of the motor. This telpher differs from mechanical telphers, etc., in that the motors are all on one side. The track consists of steel cable supported from the girders and the results have been exceedingly satisfactory to all concerned.

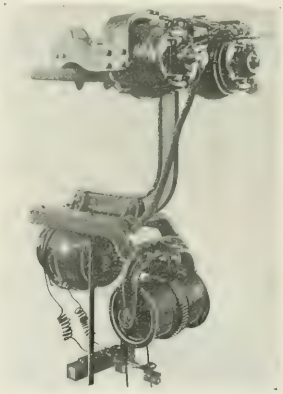


FIG. 3.—TELPHER AND ELECTRIC HOIST.

The United Telpherage Company, of 20 Broad Street, New York

City, is installing many other plants, all involving some new and important principles and departures from the ordinary standard work,

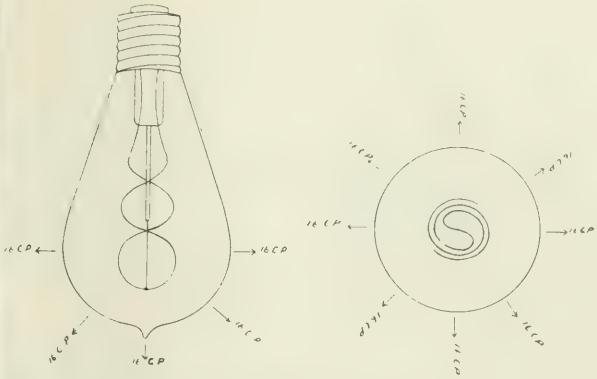
FIG. 4.—DUMPING INTO CHUTE.

but for which the flexibility of the system and the fact that it is overhead and out of the way gives it numerous special advantages.

The Sterling Incandescent Lamp.

For the past several years much has been written, and much more has been talked to central station men on the subject of the distribution of light from incandescent lamps. Authorities on illumination have, as a rule, contended that the candle-power of an incandescent lamp should be expressed in terms of spherical candle-power, but the objection has been urged against this that even assuming this method to be the only correct one, the difficulty of determining spherical candle-power is so great as to render this system of rating impracticable so far as central stations are concerned. As against the present method of rating lamps in terms of horizontal candle-power the National Electric Light Association recommended that measurements should be taken 45 degs. below the horizontal, but subsequently withdrew this recommendation. It has also been contended that the only rational system of rating is one made in terms of the light from the tip of a lamp.

The Sterling Electrical Manufacturing Company, of Warren, Ohio, has placed on the market a lamp which, it is claimed, harmonizes all of the strong points in the arguments offered for the different methods of rating above outlined. The lamp is shown in the accompanying illustrations, and the distribution of light is represented in both a vertical and a horizontal plane. Fig. 1 shows that in a vertical plane the form of filament used giving an equal illumination at every angle, except, of course, that corresponding to the base of the lamp. Fig.

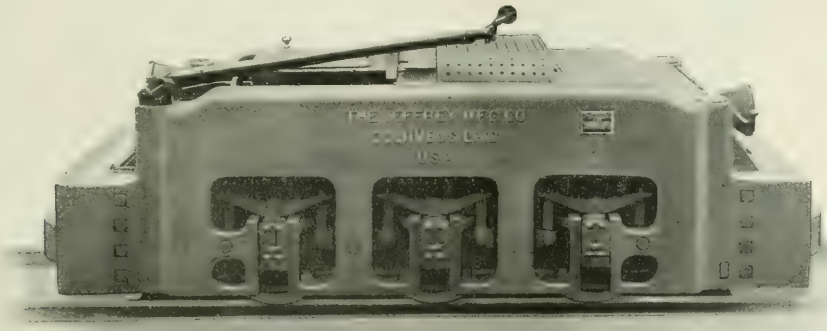


FIGS. 1 AND 2.—DISTRIBUTION OF LIGHT.

2 shows that the illumination is precisely the same at all angles in a horizontal plane. It is claimed that this is the only lamp made that will give the same measurement in candle-power when revolved or stationary and at any angle.

A Recent Type of American Electric Mining Locomotive.

The coal operator who opened his mine but a few years ago, and employed mules for hauling his coal, soon found that some quicker means was necessary for delivering coal to the tipple. The convenience and simplicity of electric haulage was early recognized, and the increasing demand for electric locomotives is ample evidence that they have met every requirement of the mine. The necessity for locomotives of large capacity has grown with the output of the mine, but the original low and narrow entries have proved a serious obstacle to their use. To meet the demand for a locomotive of large hauling capacity and yet of so compact a form that it can be used in the average entry, the Jeffrey Manufacturing Company, Columbus, Ohio, has brought out among its later designs the 20-ton locomotive shown in the illustration.



MINING LOCOMOTIVE.

The rated draw-bar pull of this locomotive is 8000 lbs. The speed

ranges from 6 to 10 miles an hour, depending on the load. Under test the locomotive developed over 11,000 lbs. draw-bar pull before the wheels slipped. The motors, however, are of ample capacity to skid the wheels on the best track when using sand. It is equipped with three 60-hp motors, each geared to an independent axle and pair of drivers. Dividing the power between three motors effects a great saving in the width and height of the locomotive over one of the same capacity having but two motors.

The drive wheels are pressed on and keyed to special hammered open hearth steel axles. The wheels themslves are of the open plate cast iron type with chilled thread. The axle journal bearings are of a type which meets the approval of the Master Car Builders. They are made of a very tough and durable bearing metal, and are of sufficient size to make the pressue on the journals well within the safe limit. The wheels being inside the locomotive frame, the axle journal bearings are accessible for oiling, or for renewing the linings. The journal boxes are dirt-proof, which insures long life to the bearings.

The frame of the locomotive is of massive iron castings, rigidly bolted together with heavy steel bolts, and supported by equalizing leaf springs, which rest in suitable chairs on the journal boxes. The frame covers are of sheet iron hinged in such a manner as to allow easy access to all interior parts of the locomotives. The brake mechanism is very simple but effective. Pressure on the six brake shoes is equalized by a system of levers. The brakes are operated by a screw which is keyed into the hub of the hand wheel. No ratchets and pawls are necessary for locking this brake mechanism, as the screw makes it self-locking in any position. The mechanical advantage is such that the operator can easily skid the wheels of the locomotive. Sand boxes of large capacity are provided at both ends of the locomotive and the operating levers for the sand valve are placed within convenient reach of the operator.

The motors are water and dust-proof. They are wound for either 220 or 500 volts. The motor frames are of cast steel, designed to meet the exacting requirements of mine service. The armature shafts are made of high-grade crucible steel, and both the armature shaft and axle bearings are made of the best bearing bronze obtainable, carefully bored to alignment and scraped to fit before assembling. The commutators are made of drop-forged copper segments insulated with the best mica.

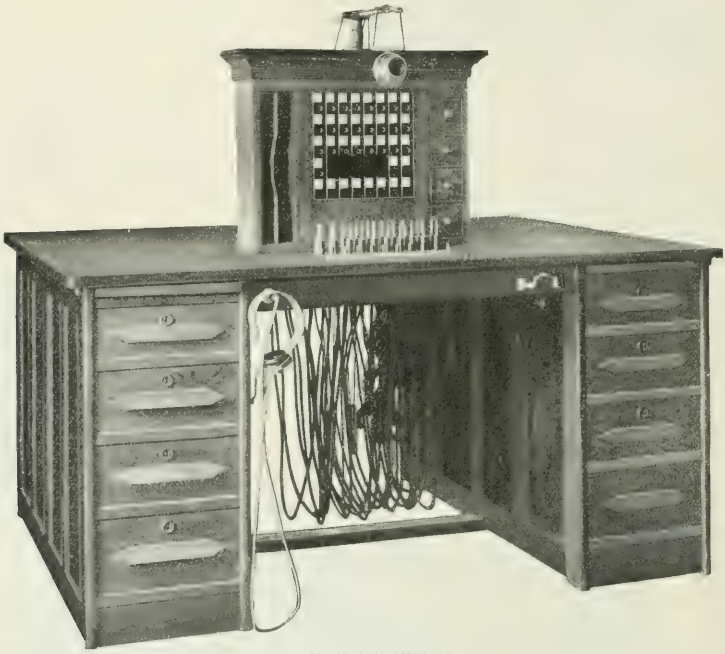
The controller used on the locomotive is the Jeffrey Class 9. It has specially large, milled contacts, and is so arranged that the motors may be run either in series or in parallel. The operating levers are conveniently located. The resistance coils, which are of ample capacity, are located at the top of the locomotive, and so arranged that there is a constant circulation of air about them, which keeps them cool. On either side of the locomotive frame is a cored receptacle for the Jeffrey standard trolley base which admits of the trolley pole being placed to suit the mine wiring.

Every motor used on the Jeffrey locomotive is given a full-load and overload test being placed in position. After the locomotive is complete, it is placed in a special testing frame and made to run the equivalent of several miles under load in both directions. It is also subjected to a series of severe electrical and mechanical tests in order that any defects of any sort may be discovered before shipping.

The machine shown in illustration is stated to be the largest and most powerful electric locomotive for mine use which has yet been built.

Eureka Telephone Apparatus.

In the accompanying illustration is shown one of the latest types of switchboards made by the Eureka Electric Company, of Chicago. It is a toll line and chief operator's board, equipped with the new Eureka lever, and with the Eureka tubular drop. All contacts of this board are made on hard rubber of thickness efficient for any strain that can be placed upon a switchboard.



TELEPHONE SWITCHBOARD.

An Electro-Mechanical Railway Switch.

Mr. Gwynne E. Painter, of Baltimore, Md., has lately patented what is termed an electro-mechanical switch for suburban lines, which is operated by a passenger and electrically reset by a passing car, and not only signals to a car to stop at night, but also lights a lamp while waiting.

On the part of the arrangement handled by the passenger are the directions, "To stop cars at night, push down handle." When this handle is pushed down, the lights above are lit. This gives light for the passenger while waiting and also a signal to the motorman to

stop. Once the light is lit, it cannot be put out again, except by the car itself.

The switch operated by the passenger is encased in an iron box and

FIG. 1.—VIEW OF SWITCH.

so thoroughly insulated as to be impossible to give a shock. It consists of only one magnet and an armature. This magnet is 1 inch by 2, and wound with No. 26 wire. When it is in shunt with 500-volt railway current passing through five 16-cp lamps in series, there is only a difference of potential of three volts. The short circuiting device on the trolley which resets the switch after it has served its purpose consists of a U-shaped piece of brass, and is fastened to the trolley by laying the wire in the bottom, then placing a bar on it, which is made fast to the U by screws. This bar will then clamp as well as support the trolley. A part of one side of this U piece is insulated both from itself and the trolley.

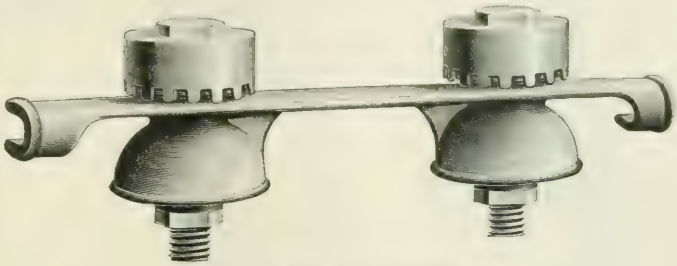
A wire from the trolley leads to one end of the magnet in the switch box; the other end is made fast to the frame and magnet core. It will be seen that the circuit is broken until the armature is raised up and touches the core, when the current then passes through the armature, to the lamps, thence to the ground completing the circuit. At the same time, it causes the magnet to hold the armature

FIG. 2.—OPERATING THE SWITCH.

to itself, and thus maintain the lights in operation. When the car arrives and the passenger is on, the trolley wheel runs on a short-circuiting device; as has been before stated, a part of the U is insulated from the other, and the trolley wheel connects these both together. This will cause the current also to go through a wire from this insulated part to the frame and core of magnet, which practically short circuits it. This makes the magnet so weak that it will not hold the weight of its armature, which drops back to its original position, thereby opening the circuit and putting out the lights. It has been calculated that if the trolley wheel rests only 1-20 part of a second on this U, it will reset the switch.

"Twin" Type of Trolley-Wire Hangers.

In the construction of single-track electric roads built on modern lines, it is usual to employ two trolley wires instead of one, in order to avoid the necessary complication of overhead frogs and switches required where only one trolley wire is used with switches at the turnouts. The twin type of trolley wire hanger has been designed to



"TWIN" TROLLEY WIRE HANGER

properly support two parallel trolley wires and maintain them at a fixed distance apart, and this type of hanger has been found superior for this purpose to the use of two single hangers on account of the greater rigidity in the support of the two wires in respect to each other.

A form of twin hanger manufactured by the Ohio Brass Company, of Mansfield, Ohio, is shown in the accompanying cut. This style of hanger is also made in both single and double curve forms for use on curves, and each of these is a modification of the regular forms of the corresponding hangers for single trolley wire suspension.

Telephone Systems in Private Houses.

The private house of to-day, instead of being equipped with a speaking tube as was the custom a few years ago, generally has a modern telephone system connecting the various departments with each other. The main advantage of the telephone over the speaking tube is that one outlet or one telephone can be used to communicate to all of the different stations, whereas when the speaking tube was used a separate mouthpiece was needed for each and every station. As to locating these outlets for the telephone, a very convenient place is near the casing of the door, as it is not practicable to place any heavy article of furniture near a door. Caution should be used in first discovering which way the door is to swing.

The wire cable, which is used in connecting the various stations, should run as far from the water pipes as possible on account of breaks in the pipes which are liable to occur and the moisture from which would injure the wires, make cross connection, cause leaks of current and soon destroy the vitality of the battery. A cable having a weather-proof insulation is preferable, not only on account of the properties which prevent moisture from entering the same, but also because a cable of this kind is not attacked by rats or mice, which by gnawing the insulation are apt to cause crossing or grounding.

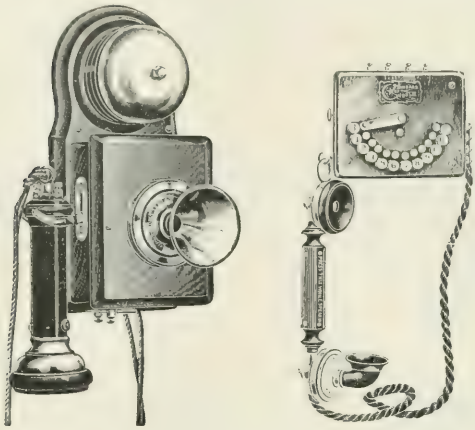
Wall pockets or receptacles for holding the telephone are very use at the outlets, for while keeping the telephones fully covered, they do not deface the walls, and by their use many of the connections can be made inside and a buzzer or a bell can be placed within for the purpose of calling that station. The telephone itself can be very small and compact, and by using a hand microtelephone in connection with a selective switch, an instrument having capacity of 15 stations will occupy a space of only four or five inches square.

There is no limit to the flexibility of a system of this description, as any station can call all the departments or it can be so wired as to call only a certain few. Arrangements should be made for bringing the cable to a point where it can be attached to wires going to the stable, greenhouse, etc., these connections being especially convenient for the lady of the house, as in ordering the carriage for a drive, etc.

By a simple attachment in the owner's chamber, the telephone sys-

tem can be instantly converted into an alarm system, and all the bells be made to ring at one time by the simple pressure of a special lever. This can be used in case of fire, burglars or sickness, and is very valuable in suburban residences.

As to the construction, the cable itself should be installed while the house is in process of construction and should be put in place before the studding is covered with lath and plaster. The instruments themselves should not be placed on the wall until all the workmen



FIGS. 1 AND 2.—TELEPHONES FOR PRIVATE RESIDENCES.

have left the building for good, as telephones are apt to be regarded as an object of curiosity by workmen doing other work and oftentimes considerable damage is done by their carelessness.

The accompanying illustrations show two simple instruments which are well adapted for household purposes, such as above described, and are reasonable in cost. These and other patterns are made by the Ericsson Telephone Company, No. 296 Broadway, New York City.

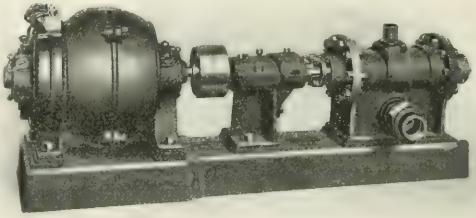
Electric Canal-Towage.

Work on the construction of the line of the Miami & Erie Canal Transportation Company has been in a fair state of progress for some weeks, and the Cleveland Construction Company, which is building the line, reports that the first division of the canal, from Cincinnati to Dayton, will probably be in operation by Jan. 1. The entire line from Cincinnati to Toledo will be completed, it is claimed, by Jan. 1, 1903. The project presents a number of new departures in electrical engineering, not the least of which is the fact that the cars will be equipped with alternating-current motors.

The Construction Company has recently placed contracts with the Westinghouse Company aggregating over $80,000. To start with, there will be six motor cars, or electric locomotives, for towing the canal boats. Each will be equipped with two 125-hp alternating-current motors. In the city the current will be delivered at 380 volts and in the country at 1100 volts. Along the first section of the line there will be four transformer stations, and current will be delivered from lighting plants in the various towns at 33,000 volts. When towing boats the locomotives will have a speed of three miles an hour, but by cutting out one of the motors this can be increased to six miles an hour, when it is desired to cut loose from the boats.

Motor for Electro-Hydraulic Plant.

Conveying water by an electrically operated pump was one of the earliest applications of the electric motor. To-day the electric motor is an important factor in supplying water in the tall office buildings where the street service is inadequate. The accompanying illustration shows a modern equipment consisting of a Lundell round type enclosed motor direct connected to a Quimby screw pump. The motor and pump are usually placed in the cellar and the water is forced to the top of the building to a pressure tank which is provided with a regulator for throwing the motor into action as often as necessary. This keeps the apparatus in perfect working condition and always ready to respond to any demand. The current may be obtained from the street or isolated plant. The design and con-



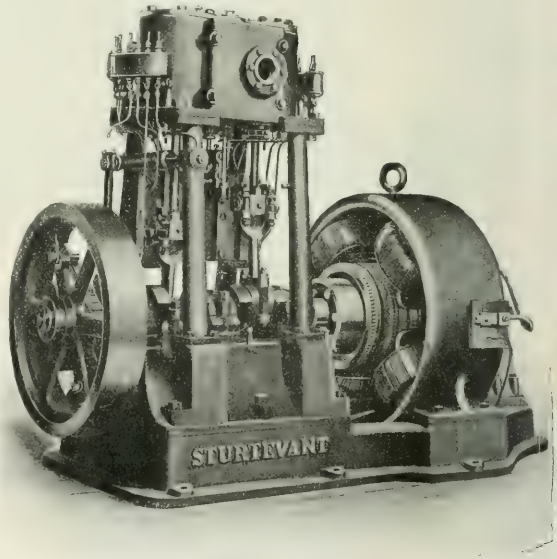
ELECTRICALLY-DRIVEN PUMP.

struction of the Lundell motor make it easily adaptable to all kinds of pump driving, and its high efficiency and remarkable endurance under exacting conditions of service give it an important commercial value.

Compact Generating Set.

In the accompanying illustration is presented one of the latest designs of a Sturtevant generating set, consisting of an open type vertical compound engine and four-pole generator. In this design the bed carries three main journal bearings, brass bushed in their lower halves and provided with continuous oiling devices in connection with oil reservoir beneath. Its interior is formed into a basin which collects all drip from water or oil. The four heavy upright columns are securely fastened to this bed, and to their upper ends is bolted the single cylinder casting, comprising the two cylinders, which are of relatively large diameter and short stroke. Two piston valves are operated in unison by a single rocker and yoke, each regulating the admission of steam to one cylinder.

The cross heads are of the slipper type, with projecting cross-head pins. The connecting rods have yoked cross-head pin ends and are



GENERATING SET.

of large size. Complete sight feed oiling arrangements are provided for all bearings. These engines are built for an output at 150 lbs. of 47.5 and 60 horse-power.

The armature shaft is direct connected to the engine shaft, and carries an armature of the barrel wound toothed drum type with slotted disks of carefully annealed sheet steel, which after being coated

with an improved insulated varnish is mounted upon a cast iron drum. This drum is provided with longitudinal air ducts, which connect in turn with radial ducts passing through the core and by means of small blades or vanes inserted in these ducts, compel the circulation of a constant current of air, thereby greatly facilitating ventilation and insuring an extremely cool running armature.

The winding for all low voltage machines is of copper bars. High voltage or very slow speed machines have the armature wire wound with machine formed coils, which coils are thoroughly insulated before being placed upon the core. The magnet frame is of special magnet steel and has the field cores cast therewith. The ring is cast in one piece.

The commutator consists of drop forged copper segments, mounted upon and secured between cast iron flanges of spider construction which allow a circulation of air inside as well as outside and conduces to low temperature. Carbon brushes only are used in these machines mounted in holders of the sliding socket type with easy facilities for adjustment and removal. A full load run for a sufficient length of time to bring every part to its maximum temperature has never been found to produce a temperature rise exceeding 40 degs. C.

Belt Conveyors as Ash Handlers.

The disposition of the ashes from a large power plant is not less a matter of interest than the bringing in of the coal. Street railways offer a large field for the application of special methods, and we illustrate herewith a 16-inch Robins belt conveyor in use at the Ninety-sixth Street power plant of the Metropolitan Street Railway Company, in New York City. The maximum capacity of the plant being 70,000 horse-power, the ash problem is a serious one, but this conveyor has for two years handled all the ashes produced, and is still in excellent condition. In the Robins conveyor pure rubber is the only material which comes in contact with the substance conveyed. For this reason the conveyor is entirely unaffected by the sulphurous acids which are present in all coal ashes and which have a strongly corrosive effect on iron and steel. A revolving brush effectively removes anything which may stick to the belt, and thus prevents dripping of ashes and water on the return run.

CONVEYOR HANDLING ASHES.

Storage Battery for Telegraphic Use.

The Electric Storage Battery Company, of Philadelphia, appreciating the demand for a battery of small capacity especially adapted to telegraph and fire-alarm service, has placed on the market three types of the "Chloride accumulator" known as the B. T., C. T. and P. T. cells, having a capacity of 6, 12 and 24 ampere-hours, respectively at the eight-hour discharge rate. These types are of novel construction, the positive and negative plates having their lugs or straps cast or burned together so that the "couplet," as it is termed, is shipped to the purchaser in one section by reason of which the only labor required in setting up a battery of these elements is to insert the plates in the jars. This makes the installation a most simple matter, and avoids the necessity of connectors or lead burning. Two plates constitute a complete element of this type, and the simplicity of installing together with the high standard of excellence which characterizes all types of the "Chloride accumulator," makes this new type a most up-to-date battery equipment for telegraph and fire-alarm stations.

D. & W. Fuses at Buffalo.

One of the interesting exhibits of the Pan-American Exposition is that of the D. & W. Fuse Company, of Providence, illustrating a remarkable development of that specific type of apparatus, viz., fuses. This company has on exhibition a complete line of enclosed fuses for various services from 250 volts and less up to 10,000 volts, exhibiting not only the various types of fuses but also fuses of different capacities for different circuits. In addition to this, it shows a complete line of porcelain cut-outs for various work, such as motor protection, lighting, transformers, etc.

Its exhibition of subway boxes is also remarkable, inasmuch as it is, we believe, the only concern now manufacturing an extensive line of subway boxes equipped with enclosed fuses. These boxes are by no means experimental, since this company has been manufacturing and installing them for a considerable time, and this portion of its exhibit will be found particularly interesting to those who contemplate work in that direction.

FUSE EXHIBIT.

Its line of service switches, transformer and junction cut-outs also contains much of interest to all central station superintendents.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 3½ per cent; time money, 4½ per cent for all dates on high grade securities. Mercantile paper is quoted at 5 per cent for the best names for four to six months, and 5½@6 per cent for others not so well known. In the stock market there was greater activity, which, however, was mainly at the expense of prices. The influences which affected the market were related partly to monetary conditions and partly to the position of certain stocks and stock market interests. The principal incident of the week was the heavy break in Amalgamated Copper and in the stock of its auxiliary, the Anaconda Mining Company. This was a result of the reduction of the Amalgamated's dividend from an 8 per cent basis to one of 6 per cent per annum, followed as it was by the reduction of the Anaconda Company's dividend. The general railroad list was unfavorably affected by the break in copper. United States Steel stocks exhibited strength the latter half of the week on reports that, notwithstanding the strike, the earnings for the quarter were fully equal to those of the first three months after the corporation's organization. Electric and traction securities felt the depressing influence of the general market, and in all cases the closing quotations show declines as compared with the prices at the close of the previous week. General Electric wavered between 256½ and 261¼, closing at 260, which is a net loss of 3⅞ points; Western Union lost 1⅛ points, having fallen as low as 89¾, the closing price being 91⅜. Brooklyn Rapid Transit fluctuated between 65½ and 69½, closing at 67, the net loss being 2¼ points. Metropolitan Street Railway closed with a net loss of 1¾, closing at 164½ ex dividend. Following are the closing quotations of Tuesday, Oct. 1:

NEW YORK.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
American Tel. & Cable	—	—	General Carriage	1	1
American Dist. Tel.	—	—	Hudson River Tel.	114	114
Brooklyn Rapid Transit	67⅛	64⅛	Illinois Elec. Veh. Trans.	¾	—
Commercial Cable	—		Metropolitan Street Ry.	166¾	162½
Electric Boat	18	16	N. E. Elec. Veh. Tran.	—	—
Electric Boat pfd.	44	40	N. Y. Elec. Veh. Tran.	10	10
Electric Lead Reduction	2	2	N. Y. & N. J. Tel.	166	166
Electric Vehicle	3½	1	Tel. & Tel. Co. of Am.	6	5
Electric Vehicle pfd.	7	4	Western Union Tel.	91½	91
General Electric		257½			

BOSTON.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
Am. Tel. & Tel.	164	159	Mexican Telephone	2¼	2
Cumberland Telephone	—	—	New England Telephone	—	—
Boston Electric Light	—	—	Westinghouse Elec.	—	—
Erie Telephone	38	39	Westinghouse Elec. pfd.	—	—
General Electric pfd.	—	—			

PHILADELPHIA.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
American Railways	40¼	41	Phila. Traction	95¼	95¼
Electric Storage Battery	65	60	Philadelphia Electric	5½	5½
Elec. Storage Batt'y pfd.	65	60	Pa. Electric Vehicle	½	½
Elec. Co. of America	7	7	Pa. Elec. Veh. pfd.	½	½

CHICAGO.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
Central Union Telephone	45	—	National Carbon pfd.	83	83
Chicago Edison	170	168	Northwest Elec. com.	38½	37
Chicago City Ry.	201	202	Union Traction	17¼	17½
Chicago Telephone Co.		255	Union Traction pfd.	58	58
Northwestern Cable	17½	18			

SALE OF PITTSBURG TROLLEYS.—The Monongahela Traction Company, owning 25 miles of track in Pittsburg and up the Monongahela Valley through Wilkinsburg, Braddock, Homestead, Duquesne and McKeesport, and the Pittsburg & Birmingham Traction Company, owning 28 miles of track in Pittsburg, have been sold to the Widener and Elkins syndicate, of Philadelphia, according to the best information obtainable. Both lines are controlled by W. T. Mellon. He built the Monongahela line and a few months ago purchased the Birmingham property. The Monongahela Company is capitalized at $1,000,000, and is bonded $2,400,000. The Pittsburg & Birmingham has $3,000,000 stock and $3,500,000 bonded debt. The Widener and Elkins people control the Philadelphia Company, of Pittsburg, which controls the gas and electric business of Allegheny County, and the United Traction Company, which absorbed ten street railways in Pittsburg and Allegheny City. The purchase is understood to be a final step in the matter of combining all traction interests of the county, including the Consolidated Company, of Pittsburg, the big concern of which the late Senator C. L. Magee was president, into the one corporation. The scheme is further said to contemplate the merger of all companies in Allegheny and Philadelphia counties.

BOSTON EDISON.—The annual meeting of the Edison Electric Illuminating Company will be held Oct. 8. Stockholders will be asked to approve an issue of $750,000 additional stock. Should the new issue be authorized, stockholders will be given the privilege of subscribing for the new stock at the ratio of 1 share for 10, and at a price to be fixed by the gas commissioners. Of the 30,000 shares of Boston Electric Light Company stock, 29,500 shares have been deposited with the Old Colony Trust Company under terms of consolidation with the Edison Company.

WOODS MOTOR VEHICLE COMPANY.—Acting on the request of O. J. Friedman, one of its largest stockholders, Judge Kohlsaat in Chicago has appointed Max H. Whitney receiver of the Woods Motor Vehicle Company. Mr. Whitney qualified promptly by giving a $100,000 bond. It is said the action is brought with the intention of reorganizing. "The business is solvent and there is no reason why it should not continue," said Attorney Smith. "The assets are $250,000, and the liabilities less than $120,000."

WORCESTER TRACTION.—At a special meeting of the directors of the Worcester Traction Company resolutions were adopted to decrease the preferred stock from 20,000 to 400 shares and that the 19,600 shares of preferred stock previously called for redemption be cancelled. The resolutions give notice of a meeting of the shareholders for Oct. 7 to take action on the directors' recommendation. President Thomas C. Barr said that the directors' action is one of the final steps in winding up the company's affairs.

DIVIDENDS.—A quarterly dividend of 1½ per cent has been declared by the directors of the Central & South American Telegraph Company, payable Oct. 8. The Washburn Wire Company has declared the regular quarterly dividend of $1.75 per share on its preferred stock, payable Oct. 1 to stock of record Sept. 26. New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 15.

CONNECTICUT RAILWAY & LIGHTING.—Application has been received by the committee on Stock List, New York Stock Exchange, to list Connecticut Railway & Lighting Company's $15,000,000 1st refunding mortgagee 4½ per cent 50-year gold coupon bonds of 1951.

Commercial Intelligence.

THE WEEK IN TRADE.—According to reports made to the mercantile agencies trade in nearly all lines is still running full, and in some the tide is still rising, as shown by a firmer tone or actual advances in the level of prices. The features in distributive trade are the good tone of advices from the jobbing West, Northwest and Southwest, and on the Pacific Coast, and the better retail trade reported at the East, due to the seasonable weather. In the iron trade there appears to be exceptional activity, with orders extending well into next year. Steel rails are in good demand, and so active has been the inquiry that the amount of old orders to be carried over for delivery next year is estimated at from 250,000 to 400,000 tons. The business failures for the week, as reported by *Bradstreet's*, numbered 197, as against 158 the week previous and 169 the same week last year. Copper was depressed and nominal. Some business was done for early shipment, and there was a good inquiry for October and November shipment. Lake is quoted, 16½c.; electrolytic in cakes, wire bars and ingots, 16¼c.; cathodes, 16c., and casting stock, 16c.

CABLES AND TELEPHONES IN GREECE.—United States Consul Jackson, of Patras, under date of Aug. 23, 1901, reports that the Eastern Telegraph & Cable Company is constructing a third cable from Zante via Patras and the Corinthian Gulf to Syra, the object being to offer a more direct wire communication between Europe and India and Australia. The two old cables will be devoted principally to local needs, the volume of business having greatly delayed rapid communication and justified the laying of the third. There is, further, under serious consideration the construction of a telephone line between Patras and Athens. While the project, says the Consul, has so far taken no definite form, the business done between these two points will undoubtedly justify the undertaking. The amount of materials necessary for the equipment of such a line will be sufficiently large to merit the close consideration of American manufacturers. As soon as facts with regard to the proposed line appear, they will be furnished by the consul to those who may be interested.

SOME C & C FOREIGN AND DOMESTIC ORDERS.—The C & C Electric Company reports receipt of a contract from Mr. Charles R. Heap, 47 Victoria Street, London, S. W., which calls for a number of motors varying from 5 horse-power to 20 horse-power. These equipments are intended principally for installation in British manufacturing plants, where they will be utilized for operating machine tools. Some of the motors referred to will be furnished to the Thornycroft torpedo boat building plant at Chiswick. Domestic contracts recently secured include orders for one 90-hp and one 20-hp slow-speed variable speed motors to be used in the pumping station of the city of St. Louis, Mo.; one 40-hp special variable speed motor to drive a pump at Bushey & Hanley's Dry Dock, Jersey City; one 3-kw generating set and switchboard for Morris & Cummings Company, New York City; one 40-kw generator, also a 12-kw one for sugar plantation use ordered by H. Widener, New Orleans, La.; one 125-kw generator and one 90-hp motor for High Point (N. C.) Machine Works & Lighting Company; one 60-hp motor, one 50-hp motor, one 40-kw dynamo and one 20-kw dynamo for Miller Electric Company, of Newark, N. J.; one 40-kw dynamo for lighting purposes requisitioned for by Bedford (Ind.) Quarries Company; one 16-kw dynamo, switchboard, wiring, etc., for American Sanitary Company, Elizabeth, N. J.; one 15-hp motor and one 25-hp motor, enclosed, for Washington Navy Yard; generating sets and switchboards for Quebec Steamship Company's "Monmouthshire," and Latrobe (Pa.) Brick Company; one 25-kw generator for American Hard Fibre Company, of Newark, Del.; eight 5-10-hp motors for De Laval Separator Company, of Poughkeepsie, N. Y., and the same number of large slow-speed motors, which are to be utilized for driving blowers and ventilators in the new Stock Exchange, New York City.

CHARLES E. DUSTIN COMPANY.—Brief reference has been made in these columns to the formation of the Charles E. Dustin Company, at 11 Broadway, New York City, where it will engage in the purchase and sale of all kinds of electrical machinery, engines, boilers, etc., and also undertake a general engineering business such as the construction of electric and steam plants and other work. Mr. W. S. Barstow, formerly general manager of the Edison Electric Illuminating Company, of Brooklyn, whose recent start as a consulting engineer was noted in these pages, has been retained as consulting engineer for the new company, and will devote a large part of his time to its interests. The capital stock of the Charles E. Dustin Company is $250,000, and the company will be fully prepared to cover all special branches of the business which it now undertakes. Mr. Dustin, who is the president of the new organization, is peculiarly fitted for the business of buying and selling second-hand material, having long been identified with electrical companies as a confidential financial expert in these lines. He was the founder of the well-known Schuyler Electric Company, which was afterward absorbed by the General Electric Company, and was later made receiver of the well-known Excelsior Electric Company, during the negotiations which were then being made to purchase the Excelsior Company by the General Electric Company. It was through his receivership in this company that he became connected, as president and general manager, with Rossiter, MacGovern & Co., when, as it will be remembered, they bought the Brooklyn plant of the Excelsior Company for their own repair business. Mr. Dustin is not likely to let the opportunities in his new field of work escape him, and they are many for one of his experience and ability.

EDISON IRON ORE SEPARATION.—Mr. Joseph Lawrence Member of Parliament for the Monmouth District, who recently returned from the United States, addressing the Newport Chamber of Commerce last week, made a most interesting and comprehensive statement of the causes of American superiority in the steel trade. He told his audience that Charles M. Schwab assured him that the United States Steel Corporation could deliver steel billets in England for $16.50 per ton, whereas the lowest price for which British manufacturers could make them was $19. Mr. Schwab also informed him, Mr. Lawrence said, that when the trust had completed certain ocean transportation arrangements now pending, the American price would be still lower. In addition to this statement, Mr. Schwab called the attention of Mr. Lawrence to the fact that his steel workers got double the wages paid British workmen in the same line. Mr. Lawrence went on to draw a striking contrast between freight charges in Great Britain and the United States, showing that the cost of carrying steel from Pittsburg to New York was less than the cost of carrying it from Birmingham to Liverpool, although the distance between the two English cities was only one-quarter of that between the American cities named. Having pointed out that it would be also necessary to resort to cheaper ores, Mr. Lawrence announced that as a result of several years' study of these problems, and consultation regarding them, he and Mr. T. A. Edison would shortly begin business in Norway with the idea of supplying to Great Britain cheaper ores extracted by Edison magnetic separation process.

OUR TRADE WITH GERMANY.—A great number of protests are coming from all quarters in the empire against the paragraph in the new tariff bill which prohibits commercial treaties because of its minimal tariff on grain. The *Kreuz Zeitung*, in an article on "American Competition in the World Market," says: "Undoubtedly the American protective tariff has proved most advantageous to the economical deliverance of the New World from the Old. The United States increased their total exports from 835,000,000 marks in 1870 to 1,394,000,000 marks in 1900, while their imports increased only from 667,000,000 marks to 849,000,000 marks. Professor Blondel calls such phenomenal progress 'alarming.' This is correct; but, on the other hand, the figures show how the United States depend upon their treaty relations with countries importing their products. In that enormous prospecity have participated their agricultural and industrial products, as iron, textiles, coal, minerals, cast iron and the like. Their wheat export has continually increased, and so has their cattle raising. Germany imported in 1889 products of the United States to the value of 272,000,000 marks, and in 1898 to the value of 620,000,000 marks, or an increase of 130 per cent. Professor Blondel attributes the success of the United States mainly to the wonderful organization of labor, the matchless development of industry by means of the latest machinery, the energy of the gigantic trusts which aim at the economical conquest of the Old World, and to united commercial and scientific boldness."

CONDITIONS IN COPPER.—As to the possibilities of the copper situation, the *Engineering and Mining Journal* says: Some of the leading interests are of the opinion that the conditions in Germany will improve at an early date. This may be an optimistic view. The demand in this country is brisk at the present artificial prices, and if exports for this year were equal to those of 1900, there would be little spot copper available. Notwithstanding the present muddled condition, the prices this year have exceeded the average for last year, which was 16.19 cents for electrolytic. The price this year has averaged 16.35 cents. These prices have been so much higher than those ruling abroad, that some refiners have found it profitable to import Chili bars and other unrefined copper for refining here. The whole situation may be said to depend upon the inclination of the Amalgamated Copper Company, and as no one outside of that company knows what action it will take, the business being done is of the hand-to-mouth order. We can say, at least, that the situation is in strong hands. The Amalgamated Copper Company, together with its allied interests, control between 55 and 60 per cent of the copper production of the United States, and are in a position to dictate prices. The outside interests are, however, getting the greater benefit from the present condition.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material from the port of New York for the week ended Sept. 25: Antwerp—2 cases electrical machinery, $150; 18 cases, $1,515. Argentine Republic—52 cases, $1,171; 30 cases, $3,800. Amsterdam—1 case, $20. Azores—1 case, $46. British East Indies—7 packages, $460. Brazil—16 packages, $715. Bristol—9 cases, $500. Bale—1 case, $30. British Australia—113 packages, $9,939; 151 packages, $8,708. Berlin—4 packages electrical machinery, $50. British Possessions in Africa—3 cases, $58. Cuba—24 cases, $419. Chili—12 packages, $207. Central America—32 packages, $288. Ecuador—1 package, $54. Glasgow—1 package, $47. Havre—14 cases, $377; 2 cases electrical machinery, $90. Hamburg—5 cases, $235; 40 cases, $1,550. Japan—14 cases, $995; 20 packages, $6,600. London—141 packages, $5,100; 159 packages electrical machinery, $5,203. Lisbon—20 packages electrical machinery, $5,560; 5 cases, $146. Leeds—1 case, $101. Liverpool—12 cases, $1,643; 73 cases, $3,028. Leicester—1 package, $70. Mexico—150 cases, $9,198. Manchester—1 case, $30. Philippines—6 packages, $240. Southampton—7 packages, $346. Uruguay—4 cases electrical machinery, $275.

BRITISH GUIANA.—The Colonial Trading Exploitation & Trading Company, Bowling Green Building, is about to erect two or more plants along the Atlantic seaboard in which electrical machinery will it is anticipated, be largely employed. The company is reported to have acquired large tracts of china clay lands in British Guiana. From the various borings already made on the property it is estimated that some 23,000,000 tons of clay is in sight. The company will import the product into the United States, and will construct a plant for the processing of clay. Another plant is to be built along this seaboard for the making of masticks to be used in the construction of buildings. Motors, it is said, will be largely used in this plant. Stone crushers, mixers, etc., will also be required.

EXTENSION OF MEXICAN TRAMWAYS.—Mr. A. E. Worswick, the resident manager of the Compania Limiteda de Tranvias de Mexico (the Mexican Tramways Company, Limited), City of Mexico, has returned from his European trip, and is placing contracts for the equipment, etc., requisite for the extension of the road. The J. G. Brill Company, of Philadelphia, has secured a contract for several trucks. Mr. Worswick is staying at the Holland House.

ROSSITER, MACGOVERN & CO.—An interesting development to all engaged in the electrical and street railway field is the recent election of Mr. Clinton L. Rossiter, formerly president of the Brooklyn Rapid Transit system, to the presidency of the above well-known concern of dealers in steam and electrical machinery. Mr. Rossiter's executive ability and wide experience of affairs render him specially competent to take up the commercial questions arising in the development of electric lighting and street railway enterprises. Vice-President Frank MacGovern is known to nearly every street railway man in the country. He has built up a phenomenal business in street railway machinery by his remarkable ability and by his great popularity in the trade. An evidence of his energy and resourcefulness was afforded when at the time of the Paris Exposition a large equipment of street railway apparatus was lost on the "Pauillac," and in less than a couple of weeks he had actually picked up and loaded on to the next available steamer some 3000 kilowatts for the Compagnie Generale de Traction then waiting to install it. We are informed that the concern proposes to extend and enlarge the scope of its business, and has already established a branch office and warehouse in St. Louis, besides opening another at Cincinnati, for the purpose of enabling the company to come in closer touch with its patrons in those territories and make more prompt deliveries.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY reports a very satisfactory year in its pole business. The company entered the field about January of the present year and secured from producers in the vicinity of Escanaba, Mich., a very large stock of white cedar poles, with an idea of furnishing them to telephone companies in connection with its switchboard and telephone business. It supplied a large number of poles for the independent plants at Jackson and Detroit, Mich., and Columbus, Ohio, and also made heavy shipments for the new plants now being constructed at Alliance and Canton, O.; Iowa, Indiana, Illinois and the Southwestern States also purchased a large proportion of the stock. It was, of course, an experiment for a telephone manufacturing company to take up a distinct branch such as the pole business, but the results have been so satisfactory and worked in so well with its general business that they have decided to continue for another year. The stock is not exhausted, and the company is negotiating with those in need of this line material.

PROPOSALS FOR ELECTRICAL MACHINERY.—The London County Council, London, England, is advertising for bids on two 2500-ihp vertical steam engines coupled direct to a three-phase 1500-kw generator working at 6500 volts, each with an exciter, and for one 750-kw reversible synchronous motor-generator with exciter, and for the installation of this equipment in the generating station at Greenwich. The proposals also call for nine 300-kw synchronous motor-generators, each with an exciter, and for three 50-kw induction motor-generators for installation in sub-stations. The time for bids closes on Oct. 8. The London County Council is also inviting bids on two 2500-ihp vertical engines each coupled direct to a direct-current, 1500-kw dynamo, for installation in the station of the South London Electrical Supply Corporation. Also for three auxiliary 250-ihp vertical, high-speed, enclosed engines, each coupled direct to a direct-current dynamo, the same to be installed in the Greenwich station. This contract also closes on Oct. 8.

CATALOGUES FOR EXPORT.—The export department of the Federal Electric Company, 141 Broadway, New York, has received a request from a foreign government for catalogues, circulars and descriptive matter covering all classes of electrical material manufactured in the United States. The Federal Electric Company purposes securing as many catalogues as possible and forwarding them to its correspondents. These catalogues will be placed in the Government file, properly classified, where they will be accessible to all buyers of that country and any one else who wishes to examine them. Manufacturers desirious of being represented in this catalogue file are requested to send catalogues in triplicate to the export department of the company, and to mark on the wrapper or envelope containing the catalogues or circular matter the word "Foreign," in order that it may be known for what purpose the catalogue is sent. Mr. B. Blum is the manager.

VARIOUS ORDERS FROM BRITISH EAST INDIES.—The American electrical engineering and contracting firm of Bagnall & Hilles, of Japan, the Philippines, etc., have recently been forwarding to the United States some fair-sized orders for various electrical equipment and supplies on behalf of their Singapore offices. The Sprague Electric Company have secured a contract for motors, ceiling fans and so forth. The Perkins Electric Switch Company have obtained an order for several hundred switches. The Manhattan Electrical Supply Company, of 32 Cortlandt Street, New York, is furnishing a quantity of fuse wire, push buttons and other supplies and Bryan-Marsh & Co. have obtained an order for about 10,000 Edison base incandescent lamps varying from 5 candle-power to 32 candle-power.

PUMPING EQUIPMENTS FOR JAPAN.—Mr. T. W. Horne, an American formerly connected with the Central Railroad of New Jersey, and now established at Yokohama as an importer of American machinery for the Japanese markets, is placing some important contracts for electrical apparatus, etc., through W. J. Kingsland, 35 South William Street. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have secured an order from Mr. Horne for 15 pumping equipments of various sizes, which are to be used chiefly in connection with electrical work in the north of Japan.

TROLLEY CONTRACT IN ENGLAND.—A special dispatch from London of Sept. 29 says: The firm of J. G. White & Co., of New York and London, has been awarded a contract to build the corporation tramways of Bournemouth at a cost of £152,000 ($760,000). Especial interest attaches to the proposed lines for the reason that they will be the first ever constructed in Great Britain combining conduit and overhead trolley sections. The Bournemouth lines will be contsructed by an English company organized by Americans.

REDUCED TELEPHONE RATES.—The American Telephone & Telegraph Company has changed its tariffs all over the United States so that one can now use the telephone for a three-minute period as the minimum, instead of a five-minute minimum, as formerly, and has made the charge for the three-minute period about three-fifths of the five-minute period. The three-minute charge, between New York and Boston is $1.25 for day time, and 65 cents for night, in place of $2 and $1, respectively, for the five-minute period.

TRAMWAY RAILS FOR ENGLAND.—The Lorain Steel Company continues to make substantial shipments of rails for use by various British municipal electric traction systems. A shipment of 550 tons is about to be made to Halifax, Yorkshire, and three lots aggregating 1500 tons will go forward shortly to Manchester. The New York electrical engineering and contracting firm of J. G. White & Co. will forward, by first Australian steamer, some 50 tons of Lorain special track work for the Perth Tramways, West Australia.

EQUIPMENT CONTRACTS FOR YERKES' LONDON ROAD.—According to prominent London parties who are regarded as being in close touch with electric traction affairs on the other side, the Ganz system will not be adopted on the Metropolitan District Railway. The British Westinghouse Company, which has obtained the contract for the power house engines (36,000 horse-power), is now said to have been promised the contract for the motor equipment.

CARS FOR LISBON TRAMWAYS.—Barber & Co.'s steamship "Nordpol," which sailed last week for Spanish and Portuguese ports with the largest cargo—nearly 9000 tons, valued at almost $300,000—ever forwarded from this side to that part of the world, carried some 1400 tons of car material intended for the Lisbon Tramways. The shipment included 25 cars built by the St. Louis Car Company. These cars have Brill trucks and General Electric motor equipments.

PHONOGRAPHS FOR THE FAR EAST.—The Columbia Phonograph Co., of Bridgeport, Conn., is at present making some large consignments of phonographs, etc., to Far Eastern markets. Substantial lots are now waiting shipment to Reuter, Brockelman & Co., of Shanghai, which concern imports large quantities of American machinery, including electrical equipment and supplies. Shipments are also made to Heyn, Brockelman & Co., of Osaka, Japan.

CITY OF MEXICO TRAMWAYS.—The power house equipment of the Compania Limitada de Tranvias de Mexico (Mexican Tramways Company, Limited), which at present has a capacity for developing 2400 horse-power, is to be increased to 3000 horse-power in view of the extension of the company's system to Tacuba, which is located about 10 miles from the Mexican capital.

ELECTRIC RAILWAY SUPPLIES FOR SOUTH WALES.—Tenders are invited until Oct. 21 by the Corporation of Newport, South Wales, for a complete equipment of coal handling apparatus, an electric motor car and a repair shop equipment. Mr. H. F. Parshall, London, England, is consulting engineer, from whom specifications can be obtained.

THE CROCKER-WHEELER COMPANY desires to announce that after Oct. 1 its New York office will be under the management of Mr. Francis B. De Gress. Mail for this office should be addressed to the Crocker-Wheeler Company, New York branch, 39 Cortlandt Street.

ELECTRIC CRANE FOR ENGLAND.—The Brown Hoisting Machine Company, of Cleveland, Ohio, has received an order from Vickers Son & Maxim, Limited, makers of ordnance, etc., for a 10-ton electric cantilever crane.

THE GENERAL ELECTRIC COMPANY is about to make shipment of some carloads of various electrical machinery to Bagnall & Hilles, Kobe, Japan, for installation in a lighting plant in that city.

General News.

THE TELEPHONE.

EAST LAKE, ALA.—The Southern Bell Telephone Company will erect a building in which to locate the East Lake exchange.

HOPE, ARK.—The Hope Telephone Company has been sold to Lee J. Taylor.

SAN FRANCISCO, CALIF.—City Attorney Franklin K. Lane, of San Francisco, has been instructed by the Supervisors to institute new suits against the Pacific States Telephone & Telegraph Company for failing to pay license on its nickel-in-the-slot telephones. The original cases were dismissed on a technicality.

SAN FRANCISCO, CALIF.—The Freeport Telephone & Telegraph Company was recently incorporated with Courtland, Calif., as the principal place of business. Directors: William Johnson, T. W. Dean, W. J. Smith, G. B. Greene, P. G. Rhiel, L. D. Greene and H. F. Isham. Capital stock, $50,000; subscribed, $10,400.

ATLANTA, GA.—The Southern Bell Telephone Company will build a $30,000 addition to its exchange. Plans are being prepared by Bleckley & Tyler.

TREMONT, ILL.—The Independent Telephone Company is building a line from this place to Dillon.

MT. CARROLL, ILL.—The Central Union Telephone Company intends to reconstruct its lines in this city.

MONMOUTH, ILL.—Chas. C. Hook is constructing a telephone line in Warren County for the independent company.

ST. JACOB, ILL.—The Kinloch Telephone Company was granted a franchise at a special meeting of the town board.

RANTOUL, ILL.—The Rantoul Village Council refused to give the Bell Telephone Company a franchise to operate in this village.

JONESBORO, ILL.—The Jackson Union Telephone Company has changed its name to the Southern Union Telephone Company.

HENRY, ILL.—The Bureau County Independent Telephone Company is building a line between Princeton and Bureau Junction.

WOODSTOCK, ILL.—A. B. Wager has sold out his telephone exchange to a syndicate composed of Judge C. H. Donnelly, George W. Field and D. R. Joslyn.

CHICAGO, ILL.—The Neoga Telephone & Telegraph Company, Neoga, capital stock $2,500, has been incorporated by John A. Baughman, Daisy Baughman and Mamie A. Sheehan.

MORRISON, ILL.—The Whiteside Harrison Telephone Company has been succeeded by the Whiteside County Telephone Company. The new company has been organized with a capital stock of $120,000. Directors: Hon. H. H. Evans, of Aurora; F. H. Case, of Chicago; Hon. D. D. Hunt, of De Kalb; E. J. Conklin, of Joliet, and Charles Bent, of Morrison.

EL PASO, ILL.—The El Paso Telephone Company, recently incorporated, has been organized by the election of Dr. R. E. Gordon, president; Jos. Bonner, secretary and manager, and A. S. Shephard, treasurer. The company is making an effort to purchase the plant of the Peoria & Eastern Telephone Company. If it is successful in securing this property it will have 300 local subscribers, besides farm lines. If it does not purchase the Peoria Company's system it will build one of its own.

ZIONSVILLE, IND.—The Citizen's Telephone Company, capital stock $10,000, has been incorporated.

CROWN POINT, IND.—The Crown Point Telephone Company is building its new line between here and Merrillville.

ROSSVILLE, IND.—The Home Telephone Company, of this city, has been organized and incorporated; capital, $12,500. The company will extend its lines into the farming districts.

GASTON, IND.—The Central Union Telephone Company is completing a branch exchange at this place, made necessary by the demand of the farmers as well as the town. Party lines are being constructed and $1 a month will be charged.

FRANKFORT, IND.—About twenty co-operative companies, representing towns and rural districts covering practically all of western Indiana and eastern Illinois, controlling nearly 10,000 telephones, have consolidated under the name of the People's Telephone Company. Six miles of trunk line will connect the systems with this city, where connection is made with the wires of the new long-distance company of Indianapolis.

INDIANAPOLIS, IND.—The officials of the new Long-Distance Telephone Company brought 225 girl operators of the system from their posts of duty to this city last Saturday for an annual gathering and reception, with a view of making acquaintances and an exchange of ideas. The entire party was given a trolley ride and a reception and banquet at night at the Proplaeum. President Sherrin, of the company, acted as toastmaster and complimented the young women for their strict attention to the affairs of the company. A number of the young women made interesting talks along the same line. Dancing followed the banquet.

FRANKFORT, IND.—For two years, a score or more of co-operative telephone companies have been putting in telephone systems in the smaller towns and rural districts in western Indiana and eastern Illinois. Recently these systems were consolidated under the name of the People's Telephone Company, and the various systems, representing a total of 7,000 telephones in actual use, were connected. The representatives of the consolidated companies have contracted with the Central Energy Telephone Company of this city for connection with its service, and through the Central Energy to have connection with the new long-distance telephone system. This is the most important telephone deal in the State in years, and was secured by the new company after a prolonged struggle with the Bell Company.

LOGANSPORT, IND.—The granting of a 40-year franchise to Thomas Thorwood, of Ft. Wayne, and Walter J. Uhl, of Logansport, by the City Council, empowering them to construct and operate a telephone system in Logansport has ended a long and bitter contest. The citizens insisted upon having but one telephone system, and at the expiration of the Bell Company's franchise next January the new company will have a clear field. The new franchise provides for a restriction in rates to $15 per annum for residence and $25 per annum for business houses until one thousand individual telephones are in operation, when the business rate may be increased to $30.

OTO, IOWA.—A new telephone system is among the possibilities for Oto.

MISSOURI VALLEY, IA.—Another rural telephone line is being built to Keiffer, of Hanover, Pa., is secretary.

MARTINSBURG, IA.—J. T. Brooks and L. L. Bollin, of Hedrick were in town looking after the interests of the new telephone line which will soon be completed to Hayesville.

AFTON, IA.—The Afton Mutual Telephone Company, whose incorporation was recently noted in these columns, is using Kellogg equipment throughout. Its switchboard has a capacity of 150 lines. It has eight miles of toll line to Orispe, and will at once build a line to the north, a distance of twelve miles.

DES MOINES, IOWA.—Judge S. F. Prouty, in the district court here, decided against the Iowa Telephone Company, holding that it is a trespasser in the streets of the city, because it has no franchise. The Mutual Telephone Company, the Iowa's rival, brought suit to oust the latter. The Iowa Company's defence was that it did not require a franchise to use the streets of the city because the streets are highways, and the company is authorized by the State law to use the highways for its poles. Judge Prouty holds that the streets of a city are not highways, and that the city has a right to restrict their use for telephone purposes, though the telegraph companies have a right to use them without franchises, since they do not do so to the extent as do telephone companies, but come on railway right of way. The Iowa company will appeal, its attorney being confident of securing a reversal.

RICHMOND, KY.—Work on the telephone line between Berea and Livingston, via Wildie and Conway, will soon be commenced.

COVINGTON, KY.—The Cincinnati Telephone Company, capital stock $10,000, has been incorporated by J. H. Becker and Peter Knadley.

HODGENVILLE, KY.—The Cumberland Telephone Company will at once begin the construction of a telephone line from this place to New Haven, Ky.

LOUISVILLE, KY.—The joint committee on contracts has voted to make a recommendation to the general council to reject a contract made between the city and the Cumberland Telephone & Telegraph Company, whereby this company was to be paid $11,000 for placing the fire and police wires in underground conduits. The Home Telephone Company has offered to do the work for a much lower figure. It is said that the city will of necessity have to do something to improve its fire alarm system.

JENNINGS, LA.—The Cumberland Telephone Company is putting in a new exchange at this place.

SHREVEPORT, LA.—The Shreveport City Council granted permission to M. D. Shaw the right to construct and operate a new telephone system in Shreveport.

HAGERSTOWN, MD.—Hanover, Pa., parties have bought a controlling interest in the Maryland Telephone Company and will extend its lines to Martinsburg and Shepherdstown also into Virginia and Pennsylvania. John K. B. Keiffer, of Hanover, Pa., is secretary.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company has comenced operating its exchange with a portion of its subscribers, and is adding to the number as fast as telephones can be put in and connected by the present gang of workmen. New applications for the automatic service are coming in freely on account of the satisfaction given. The Strowger automatic telephone system is used, the same system as that installed in New Bedford some months ago, but with important improvements.

ELMDALE, MICH.—The Citizen's Telephone Company has its lines nearly completed to this place from Saranac.

DETROIT, MICH.—The Livingston County Telephone Company has been granted a franchise by the Village Council of Brighton. This is the new independent company organized to compete with the Bell Company in Livingston county.

MINNEAPOLIS, MINN.—The Stevens County Telephone Company, of Morris, has filed articles of incorporation. The incorporators are C. R. C. Johnson, H. L. Hulbert, George F. Darling and George F. Darlicy, of Morris. The company has a capital stock of $10,000.

MINNEAPOLIS, MINN.—Direct telephone communication between Minneapolis and Winnipeg will be established within a month by the Bell Telephone Company of Canada operating in connection with the American Bell Company whose lines now reach as far north as Neche, N. D.

MINNEAPOLIS, MINN.—The Northland Telephone Company has been incorporated here with a capital stock of $25,000. It will be a long-distance associate of the Zenith Telephone Company, the local independent line, and it proposes to give service to the iron range and the surrounding country, including a connection with the Consolidated Telephone & Telegraph Company, which will give independent connection with the twin cities.

CLINTON, MO.—The Mutual United Telephone Company, capital stock $15,000, has been incorporated by G. Lingle, S. T. Neill, W. F. Hall and others.

ST. LOUIS, MO.—The Capital Telephone Company, of Jefferson City, has purchased the telephone line formerly operated between Jefferson City and Hickory Hill. It will be made a part of the local system of Jefferson City.

ST. LOUIS. MO.—The Arizona & New Mexico Telegraph Company, capital $15,000, has been incorporated, with headquarters at Clifton, Ariz. Incorporators and directors: James Colquhoun, Harwood J. Simmons, Alexander Veitch, Mark J. Egan and George Frazer, all of Clifton. The company intends to build a telegraph and telephone line from Clifton to Lordsburg and to Hachita, either with wires or without wires.

RALEIGH, N. C.—The Interstate Telephone Company will install a new switchboard and make other improvements in its exchange.

WINSTON SALEM, N. C.—The Bell Telephone Company has completed connections with this town, thus giving a long-distance service.

WOODSTOWN, N. J.—The Interstate Telephone Company has made application to the Borough Council for franchise privileges.

JERSEY CITY, N. J.—The Wireless Telegraph Company of America has been incorporated here; capital, $3,000. Incorporators: Lee De Forest, Clarence E. Freeman, Edwin H. Smythe, Charles Siedler, M. F. Stires, Jr.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has purchased the Barnes mansion at Clinton and Atlantic Avenues, Brooklyn.

ROCHESTER, N. Y.—The Canandaigua Board of Trustees has granted a franchise to the Inter-Ocean Telephone & Telegraph Company for the establishment of an exchange in Canandaigua with privileges of erecting poles and stringing wires.

ALBANY, N. Y.—The New York State Telephone Company has been incorporated, with a capital of $2,500,000, to operate in Buffalo. The directors are William D. Barnard, of St. Davids, Pa.; Henry Shafer, of Chicago; Richard G. Park, of Westchester, Pa.; C. M. Clement, of Sunbury, Pa.; William F. Mackey, of Buffalo; Edward Davis, of Philadelphia, and Ward R. Bliss, of Chester, Pa.

ALBANY, N. Y.—The Frontier Telephone Company was incorporated on Sept. 30 with a capital of $500,000 to connect by telephone Buffalo, New York City and intervening places and Cleveland, Ohio. The directors are Irving A. Stearns, of Wilkesbarre, Pa.; Alvan Markle, of Hazleton, Pa.; James M. Thomas, of New York City; E. C. Lofkin, John B. Weber and Charles B. Hill, of Buffalo, and Frederick R. Green of Fredonia.

MIDDLEPORT, N. Y.—The new exchange of the Home Telephone Company has been in operation for a couple of weeks. The Home Company now has a larger number of subscribers than the Bell Company and the list is constantly growing. The Home Company will use the toll lines of the Middleport Telephone Company for the nearby towns for awhile. There are now three telephone exchanges here.

BOLIVAR, N. Y.—Steps have been taken by prominent men of this place for the formation of a local telephone company to operate independently of the Bell interests. As yet the organization has not been completed, but everything thus far is decidedly in its favor. It is expected that long-distance connections will be made at Wellsville through the toll lines of the Inter-Ocean Telephone & Telegraph Company. This will put Bolivar into communication with a large portion of the State and be a valuable service for the Bolivar merchants.

GREENSPRING, OHIO.—The Greenspring Telephone Company has increased its capital stock from $8,000 to $15,000.

NEW LEXINGTON, OHIO.—The Central Union Telephone Company has been granted a franchise to operate an exchange and toll line.

COLUMBUS, OHIO.—Among the large cities in Ohio having independent telephone service more extensive than that of the Bell Company is Columbus. The Citizen's Telephone Company of this city has about 5000 subscribers to the Bell's 2500.

DAYTON, OHIO.—The publisher of a Dayton daily paper has completed arrangements with the local telephone company by which the suburban subscribers of the paper are to be supplied with the latest news over the wire at 7 P. M. daily.

CLEVELAND, OHIO.—The Consolidated Telephone Company, through G. H. Ginther & Company, investment brokers, of Cleveland, is offering for subscription bonds of the company to the amount of $382,000, covering the exchanges now in operation, and those nearly ready in New York State. In a prospectus just issued the properties are described in part as follows: At Ithaca the Consolidated Telephone Company has just purchased an automatic system with 125 telephones in operation, with rates of $36 for business and $24 for residences. This plant is to be remodeled at once with a complete central energy system. It is anticipated that there will be 800 to 1000 subscribers in this town at an early date. Ithaca will make an exceedingly good long-distance town, as three-fourths of the students at Cornell University live in central and western New York, and will use the long-distance lines. The exchange at Hornellsville is in operation with 500 subscribers, as against the Bell Company with less than 200. The Corning exchange is in operation with 650 subscribers, half of whom are connected at the present date. The Wellsville exchange will be in operation in the very near future with 125 subscribers connected. The Valley Telephone Company, which will operate in Waverley, N. Y., and Sayre and Athens, Pa., is being constructed, and there is every reason to believe this will be a very profitable exchange. The amount of bonds to be issued on the plants mentioned will be approximately as follows:

	No. of Telephones.	Total bond issue.
Hornellsville	800	$40,000
Corning	800	60,000
Wellsville	300	22,500
Waverley, Sayre and Athens (Valley Telephone Co.)	800	60,000
Watkins	300	22,500
[illegible]	200	15,000
[illegible]	800	72,000
Inter-Ocean Telephone & Telegraph Company (Long Distance)	200 miles.	90,000
		$382,000

The securities are 6 per cent., 20-year gold bonds. They will be redeemable at any interest bearing period after five years from date at 105. There is also a sinking fund provision amounting to 2½ per cent. per annum upon the total amount of bonds issued and outstanding, except as to Hornellsville, where the bonds will be redeemable ten years from date. The bonds are to be sold at 95 per cent of par value, 25 per cent payable upon execution of bond and the balance in three monthly installments.

CLEVELAND, OHIO.—The Columbus Citizens Telephone Company, which has been in operation about a year, is already on a dividend paying basis, and is proving one of the most promising of the properties of the Federal Telephone Company. The statements for July and August and for the first eight months of 1901 are as follows:

	July.	August.	Eight months.
Gross earnings	$13,155.18	$13,667.38	$99,105.07
Operating expenses	6,177.95	6,580.31	46,575.22
Net earnings	6,977.23	7,087.07	52,529.85
Surplus	4,085.57	4,795.41	34,867.77

LAWTON, OKLA.—People are opposing the building of a telephone system until there is a city government to sell a franchise.

WASHINGTON, PA.—Permission was granted to the West Penn Telephone Company to erect poles in the borough.

HARRISBURG, PA.—It is announced that the United Telegraph & Telephone Company has obtained control of the Southern Telephone Company, which operates a system in Cumberland, York, Adams and Franklin counties, and that the acquired lines will be connected with the system being installed in this city.

HARRISBURG, PA.—The Cumberland Valley Telephone Company has been organized at Harrisburg, with the Dauphin County Telephone Company, the Southern Pennsylvania Telephone Company, the Cumberland Valley Telephone & Telegraph Company, the Hanover Telephone Company and the Adams County Telephone Company as the underlying and constituent companies. The new company will have its headquarters in Harrisburg. The principal officers are B. F. Meyers, of Harrisburg, president; W. B. Barnard, Philadelphia, vice-president; Frank E. Ziegler, Harrisburg, secretary, and S. L. John, McSherrystown, treasurer.

MITCHELL, S. D.—The Faldreau Telephone system is being enlarged and improved.

COLTON, S. D.—The citizens of Colton have decided to put in a local telephone system, which will be extended to adjoining farms.

ALEXANDRIA, S. D.—The Fairview Telephone Company has been incorporated with a capital stock of $2,000, by F. A. Gregory, N. Van Tassel and Wm. Newman.

WOODBURY, TENN.—A telephone exchange is being put in at Woodbury.

DECATUR, TENN.—The Meigs County Telephone Company will extend its lines, about ninety miles of wire having been bought for the purpose.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has purchased the Rockwood telephone system. Connection will at once be made with all long-distance systems.

TERRELL, TEX.—A new telephone line between this city and Crandall has been completed and put in operation.

CALVERT, TEX.—E. D. Atkinson is organizing a company to establish a telephone system between Calvert and Mayfield.

BONHAM, TEX.—At a meeting of the Electric Railway Company the recent franchise tendered by the city was accepted and work began at once. The line will traverse all principal business and residence streets.

AUSTIN, TEX.—The independent telephone movement in Texas is having a rapid growth, and it will be but a short time until the exchanges and toll lines of the Lone Star Telephone Company, which is at the head of several projects, will cover the State. Exchanges are already in operation at San Antonio, Waco and Houston and are in process of construction at Austin, Temple, Corsicana, Taylor and a number of other places. Toll lines have been built connecting the southern points in Texas with Indian Territory and Arkansas points and an eastern line is now being built to New Orleans by way of Galveston and Beaumont.

RICHFIELD, UTAH.—The Bell Telephone Company will not build its line from Mt. Pleasant to Scofield until spring.

SALT LAKE CITY, UTAH.—Salt Lake City will soon have telephonic connection with San Francisco, Chicago, New York, and other Eastern cities. The completed line from San Francisco to the East will cover a distance of 4500 miles. This long circuit will be made possible by the closing of the gap in North Dakota and Montana by the Rocky Mountain Bell Telephone Company and the Northwestern Company. The first named company will build eastward from Billings, Mont., to the boundary line between Montana and North Dakota, a total distance of 200 miles, and the Northwestern Company will build west from Bismarck, N. D., to meet the extension from the West.

WYTHEVILLE, VA.—The farmers in the surrounding county are discussing a proposition looking to the establishment of a mutual independent telephone system similar to one operated in Augusta County.

PETERSBURG, VA.—A telephone line is to be built between Petersburg and Prince George County Courthouse by a company soon to be organized. The company will be composed of citizens of Petersburg and Prince George County.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 235 subscribers in August, making a total number of 22,505 subscribers on Aug. 31.

ASHLAND, WIS.—For the first time in twenty-two years, the toll line service of the Wisconsin Telephone Company in Wisconsin was suspended on the afternoon of Sept. 19. The order went out that from 2:35 until 2:40, Eastern time, the 600 odd toll line stations in the State should be silent, during the time that the burial of the President was actually taking place at Canton, Ohio. This made the system silent in Wisconsin between 3:35 and 3:40 o'clock.

ELECTRIC LIGHT AND POWER.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has decided to install a water-power plant at Coquitlam Lake, 20 miles from Vancouver. Mr. Horne-Payne, who has already invested £900,000 in British Columbia, has organized the company in England to construct and operate the plant. The company will be known as the Vancouver Power Company. A tunnel will be driven through a mountain separating Lake Beautiful from Coquitlam Lake, a distance of two miles. Fifteen thousand horse-power is available. The plant will cost $500,000, but maintenance will not be over $15,000 a year for 5000 horse-power, which is about what will be needed.

ASHBURN, GA.—The Southern Electric Supply Company, of Macon, Ga., has completed an electric light plant for J. S. Betts & Company, for use in their mills and stores. Later the lights will be extended to other portions of the town.

KOKOMO, IND.—The city is completing a new modern electric light and water works plant.

FORTVILLE, IND.—The Town Council has granted a franchise and entered into a contract with I. N. Slabler, of Fairmount, giving him a 25-year contract for an electric light plant.

OTTUMWA, IA.—The Ottumwa Electric & Steam Company has been reorganized under the name of Ottumwa Traction & Light Company.

NEW ORLEANS, LA.—Arrangements are now being completed for the removal of the offices of the consolidated company, including the Carrollton Railroad Company, the Edison and the Merchants Electric Companies, into the Edison Electric building on Baronne Street. Officers have been elected as follows: Mr. J. K. Newman, president; Jos. H. DeGrange, vice-president; W. V. Crouch, secretary, and W. B. Bockway, assistant secretary. The official name of the consolidated concern is the New Orleans & Carrollton Railroad, Light & Power Company. The charter, which has been prepared, sets forth that the capital stock is $7,500,000.

BANGOR, MAINE.—The water-power plant of the city electric lighting station has been shut down, and from now until the new lighting equipment is ready for use the machinery will be operated by steam power. The new wheels are four in number—three of them 57-inch and one 33-inch, and they will replace three old wheels. They will develop, at minimum head of water, about 450 horse-power, and at ordinary head about 1000 horse-power, and there will also be installed a 450-horse-power steam engine. New electrical equipment will be installed.

NORWAY, MICH.—M. Spitzer has completed plans for an electric light plant, to be built in connection with a pumping station for the city of Norway. It will cost $22,000.

MARQUETTE, MICH.—The Electric Light and Power Commission, which controls the municipal electric light plant, has decided to abandon its flat rate and insist on the general installation of meters in the buildings of all light consumers, the power business remaining on the present basis.

McINTOSH, MINN.—The village Council at its last regular meeting granted to Mr. Anton Jensen a ten-year franchise for an electric light plant, to be completed by Jan. 1, 1902, the Council reserving the right to purchase the said plant at the end of five, eight or ten years.

ST. LOUIS, MO.—The preparations for the installation of electric power instead of steam in the immense Anheuser-Busch brewing plant are well under way. The power-house is being built. The brewery intends to do away with all its 24 steam engines and to install motors and dynamos in their places. The power equipment when completed will consist of four generators of 500-kw capacity each, which will be run by four 800-hp upright engines. The total capacity of the plant will be 3000 horse-power. The outlay for the introduction of electricity will be very heavy, but an immense saving will be made. Half of the new power plant is expected to be ready for occupation by Jan. 1.

ST. LOUIS, MO.—The Citizens' Electric Light & Power Company has applied for permission to lay conduits on several streets in St. Louis. It has also bought property at the foot of O'Fallon Street, and has plans ready to begin the erection of a large power plant. The Citizens' Company was organized about five years ago, with a capital stock of $3,000,000, and a second payment of the stock has been called for. The company will begin at once an aggressive campaign to get contracts for lighting and power. The company is composed of practically the same stockholders as the Kinloch Telephone Company and the Kinloch Long-Distance Company. The officers are: Julius S. Walsh, president; August Gehner, first vice-president Rolla Wells, second vice-president; Breck. Jones, treasurer; Philip Stock, secretary; W. Roy McCanne, assistant secretary, and Chas. H. Ledlie, general manager and chief engineer. The directors are, with the above: Chas. H. Turner, Sam M. Kennard, Adolphus Busch, W. J. Lemp, C. Marquard Forster, William F. Nolker and Henry Nicolaus.

TRENTON, N. J.—The Phœnix Gas & Electric Company, capital $1,000,000, has been incorporated by William D. Lippincott, Walsh Banyard and David Rambold.

NEWARK, N. J.—Howard W. Hayes, counsel for the National Electric Light, Heat & Power Company, has applied to Chief Justice Depue for a writ of certiorari to have reviewed the action of the Orange Common Council in awarding the lighting contract to the United Electric Company. The bid of the National Company was $15 per lamp lower than the bid of the company which got the contract.

ITHACA, N. Y.—The plant of the Dolgeville Electric Light & Power Company was sold in Herkimer recently to satisfy mortgages. Richard L. Storrs, representing the Herkimer County Electric Light & Power Company, bid in the property for $20,000. The purchase includes Dolgeville and Little Falls franchises and the Herkimer Company will operate the plant in connection with its present business.

COLUMBUS, OHIO.—The city of Columbus has called for bids on electric street lighting. The Columbus Electric Company, the only company in the field, has offered to bid on 650 lamps, but the city wants only 600 lamps.

MARION, OHIO.—The Marion Electric Light & Power Company held its annual meeting last week and elected directors as follows: E. Huber, E. Durfee, G. W. Kling, C. W. Leffler, C. Harraman, W. L. Warner and H. Strelitz. Officers: C. W. Leffler, president, manager and treasurer; E. Huber, vice-president; H. Strelitz, secretary. The annual report showed the company had had a very successful year.

CINCINNATI, OHIO.—The electric float of the night pageant during the second week of the Fall Festival, which ended Saturday night, Sept. 28, was the feature of the parade. It was the result of several months' arduous labor on the part of A. C. Beattie, of the Lawton-Beattie Electric Company and others representing the General Electric, the Standard Electric Company, and Post-Glover Electric Company. The float was in the shape of a huge ball studded with hundreds of vari-colored 8-candle-power incandescent lamps in fanciful designs, which revolved as the float moved. The power came from the overhead trolley system of the Traction Company. All the floats in the pageant were lighted in this manner.

HARRISBURG, PA.—The People's Steam, Heat & Power Company, of Easton, Pa., has been incorporated, with a capital stock of $1,000.

HARRISBURG, PA.—The Schuylkill County Electric Company, of Pottsville, and the Corry Electric Light & Power Company, of Corry, have been incorporated, each with a capital stock of $10,000.

PITTSBURG, PA.—Negotiations are now on foot and may be closed any day, which will form a combination of all the electric traction, power and lighting interests of Allegheny County, aggregating a capitalization in stocks and bonds of $106,800,000. The companies to consolidate are: The Philadelphia Company, which distributes natural gas throughout this section, and which is the largest company of its kind in the world; the Consolidated Traction Company, with 112 miles of street-car tracks; the United Traction Company, with 117 miles; the Birmingham Traction Company, 28 miles; the Monongahela Street Railway, 28 miles; the Allegheny County Light Company, and the Monongahela Electric Light & Power Company.

THREE RIVERS, QUE.—The Three Rivers Gas, Heat & Power Company has been incorporated.

SIOUX FALLS, S. D.—The new city electric light system has been placed in operation over a considerable portion of the city, and works to perfection. The present down town, or business district, now lighted by the Cascade Milling Company, will be continued under the direction of the company until the city authorities can arrange for the new lights in that part of the town, but in the course of a few days the entire system will be controlled by the city.

COOPER, TEX.—The Cooper Electric Light Company has been succeeded by the Cooper Electric Light & Manufacturing Company.

SALT LAKE CITY, UTAH.—The Mary M. mine, of Provo, Utah, will be equipped with electric machinery, including pumps, drills and hoist.

SALT LAKE CITY, UTAH.—The American Falls Power, Light & Water Power Company filed its articles of incorporation at Pocatello, Idaho. The company is capitalized for $300,000. All the stock has been subscribed. The directors are J. H. Brady, D. W. Standrod, A. F. Caldwell, all of Pocatello, and R. Rounds and A. B. Scott, of Idaho Falls. The principal place of business will be Pocatello. The purposes for which the company is organized is twofold; the utilizing of the power of the Snake River at American Falls, to generate and transmit electrical energy, primarily for Pocatello, and the construction of canals for irrigating the lands around American Falls. President Brady stated that work on the power plant will commence within thirty days, and that by July next year he will have the power into Pocatello. It is understood the Oregon Short Line Railroad will be a heavy consumer of this power, as the plans for the new shops to be built there contemplate the use of electric motors instead of steam power.

SPOKANE, WASH.—Articles of incorporation were filed by the Wallace Light & Water Company of Spokane, with a capital of $125,000. The incorporators and trustees are E. J. Dyer, president of the Exchange National Bank; Robert E. Strahorn, real estate, and Attorney R. J. Danson.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—In connection with the consolidation of the Mobile Street Railway Company and the Mobile Light & Railway Company under the name of the Mobile Light & Railway Company, it is stated that improvements to the extent of $500,000 are projected. W. H. Patterson, of Atlanta, was elected president of the new company. Nearly half of the new capital is Atlanta money.

FRESNO, CALIF.—The Fresno City Railway Company has been incorporated with an authorized capital stock of $500,000. It will construct an electric street railway system 43 miles long.

LOS ANGELES, CALIF.—The Los Angeles and Pasadena Electric Railway Company will make extensive improvements, and put in a new engine and machinery, to the amount of $15,000 before Jan. 1.

LOS ANGELES, CALIF.—The owners of the Temple Street Cable Railway of this city have decided to adopt electricity as the motive power of the line and a new electric plant will be installed at a cost of $60,090 to $75,000.

HARTFORD, CONN.—The project for a through street railway line from Hartford to Worcester, sixty miles, and ultimately to Boston, is making progress. The Stafford Springs Street Railway Company, which recently secured a franchise to operate a trolley line from Rockville through various towns and villages to the Massachusetts State line at Monson, has organized, and is prepared to build as soon as preliminary details are adjusted.

ATLANTA, GA.—Attorneys of the Atkinson corporations on Sept. 23 gave out a statement regarding the rumored consolidation of the local electric railway interests. The statement in part says: "A conditional trade has been entered into by which certain financial concerns have agreed to purchase the stock and bonds of the Atlanta Railway & Power Company, held by Mr. Hurt and associates in Atlanta. This trade is proposed to be consummated to morrow

(Sept. 24) in Baltimore. It is not the purpose of this trade to consolidate the two companies."

CHICAGO, ILL.—The Citizen's Electric Street Railway of Chicago, of which Price McKinney, of Cleveland, is chief financial backer, will ask for a franchise from the City Council of Chicago for a line on Jefferson Street through the center of the city.

LA PORTE, IND.—The Michigan & West Shore Traction Company has filed articles of incorporation, with a capital stock of $1,350,000.

INDIANAPOLIS, IND.—Track-laying has begun on the Indianapolis and Martinsville line between this city and Mooresville. The grading and bridge building is progressing on the last division.

CHESTERFIELD, IND.—The electric road has practically ruined the passenger traffic of the steam road out of this city. The station maintained here since 1852 has been abandoned by the steam road.

GREENFIELD, IND.—The Indianapolis & Greenfield Interurban Company is distributing material for the extension of its line from this city to Knightstown. The work is to be finished within two months.

ELWOOD, IND.—The Union Traction Company is now distributing the steel rails for the laying of its tracks between this city and Tipton, and the new branch of the large system will be in operation by the first of the year.

NOBLESVILLE, IND.—The Central Traction Company of Indiana will open bids for the construction of a line from this city to Indianapolis and way points. The company has opened an office in this city and the construction will be pushed. Mr. Stillwell, vice-president, says the grading will all be done this year and the Tipton division put in operation.

MARION, IND.—An important deal in interurban roads has been made here whereby the Union Traction Company acquired the property of the Marion Transit Company, thus ending one of the most interesting fights that has taken place between interurban roads in the State. President McCulloch, of the Union Traction Company, decided to end the war by purchasing the competing line.

INDIANAPOLIS, IND.—The Ft. Wayne & Lima Traction Company, with a capital stock of $50,000, has been incorporated. The company is composed of the following citizens of Lima, Ohio: D. J. Cable, J. B. Kerr, W. F. Numan, W. L. Parmenter and Henry W. Neff. It will operate a street railway system in Ft. Wayne and proposes to construct an interurban line from Lima, Ohio, to Ft. Wayne.

RICHMOND, IND.—The Hamilton, Eaton & Richmond Traction Company has incorporated its central division with a capital of $200,000, which is to be increased to $750,000. The company will build an interurban railway from Hamilton, Ohio, to this city and other points in Indiana. The following officers were elected: President, John J. Hall; vice-president, G. M. Hodges; secretary, O. F. Dillman.

INDIANAPOLIS, IND.—A great interurban system is being planned to connect manufacturing centers with the Indiana and Illinois coal fields. Columbus, Ohio; Anderson and Indianapolis, Terre Haute, Ind., and Danville, Ill., are to be included in the system. The first practical efforts to develop the plan is now being made at Danville. The syndicate controlling the local street car system owns the street car plants at Ft. Wayne, Lafayette, Champaign, Urbana and Quincy. The syndicate is extending its line to Georgetown through the heart of the coal fields. It is believed that the Ohio, Indiana and Illinois idea will be carried out. The lines which can be easily connected and consolidated for the great system are rapidly filling up with manufactories and residences.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has in operation on the Worcester & Suburban line a new system of telephones. There is a telephone at every switch between Worcester and Spencer. Every car run on the line is equipped with a little box containing the transmitter and other apparatus.

BALTIMORE, MD.—The executive committee of the United Railways and Electric Company has decided to extend its Dundalk line to Sparrows Point and to push the work so as to complete it speedily. The Dundalk, Sparrow's Point & North Point Railway Company was recently incorporated for this new work, and it was organized with the following directors: George R. Webb, W. S. Franklin, Wm. A. House, John B. Ramsay, E. L. Bartlett, George C. Jenkins and Henry A. Parr. Mr. Webb was chosen president, and Mr. House vice-president and general manager. The other officers are Mr. Briggs C. Keck, treasurer, and Mr. H. C. McJilton, secretary. The capital of the new company is $250,000.

DETROIT, MICH.—The Detroit & Toledo Shore line, a link in the Everett-Moore electric system between Detroit and Cleveland, has filed a trust mortgage which secures the gold bonds issued for the completion of the road. A part of the issue will be floated in Detroit and a portion in the east. The road will be running by Nov. 15.

PLAINFIELD, N. J.—The necessary signatures having been obtained for the right of way over the proposed trolley line from this city to South Plainfield, it is expected that the road will be constructed at once.

DUNKIRK, N. Y.—It is proposed to extend to this city the new electric railway now building between Buffalo and Angola. The distance from here to Buffalo is 41 miles.

CANANDAIGUA, N. Y.—Officers of the Ontario & Wayne Traction Company, which was recently incorporated at Albany, have been elected as follows: John Raines, president; J. L. Burnett, secretary, and J. H. Pardee, treasurer and manager. The company's line will extend from this place to Pultneyville, on Lake Ontario.

YOUNGSTOWN, OHIO.—The Park & Falls Railway, of Youngstown, is making numerous improvement on its line.

COLUMBUS, OHIO.—The Columbus & Southern Railway has obtained a 25-year franchise from the Franklin County Commissioners.

CLEVELAND, OHIO.—In about five weeks the Western Ohio Railway will be in operation from Lima to Minister, a distance of 34 miles.

SPRINGFIELD, OHIO.—The Little Miami Traction Company has been granted a franchise over a new right of way into the center of Springfield.

CLEVELAND, OHIO.—E. P. Roberts & Company, engineers for the Southern Michigan Traction Company, will shortly place contracts for the construction work.

CINCINNATI, OHIO.—On Oct. 1 350 conductors on the Cincinnati, Covington & Newport Street Railway received an increase of wages from 18 to 19 cents an hour.

CINCINNATI, OHIO.—The Cincinnati Traction Company has inaugurated a new departure in the counting of its fare receipts. This will be done hereafter entirely by women.

TOLEDO, OHIO.—The Toledo & Indiana Railway has placed a contract with the Cambria Steel Company for about 35,000 tons of steel rails for the line between Toledo and Bryan.

CLEVELAND, OHIO.—M. J. Mandelbaum, just returned from New York City, denies that he has made any recent purchases in the stock of the Mineola, Hempstead & Freeport Railway, Long Island.

STEUBENVILLE, OHIO.—The Belmont County Commissioners have finally granted a franchise north from Martin's Ferry to the Steubenville, Mingoe & Ohio Valley Railway Company, which will build an extension.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway has obtained all right of way between Toledo and Lima and much has been secured between Bellefontaine and Columbus. Work will start Oct. 1 on track laying between Lima and West Minister.

NEWARK, OHIO.—The County Commissioners have granted the Columbus & Granville electric railway a franchise to construct an electric line from the north corporation line through Chatham and Utica to connect with a line to be built to Mt. Vernon. Mr. F. M. Black is secretary of the company.

COLUMBUS, OHIO.—Construction work on a number of extensions to lines of the Columbus Railway Company has been stopped and 300 men thrown out of work. Inability to secure deliveries of grooved rails, such as are required by its franchise, and delay in securing new cars are the causes of the difficulty.

DEFIANCE, OHIO.—It is claimed that prospects for the building of the Defiance, Ottawa, Kenton & Columbus Interurban Railway are now very bright. The road is promoted by H. A. Fisher, D. J. Ryan and others of Columbus, and it is stated that a right of way from Defiance to LaRue, a distance of ninety miles, has been secured and the line surveyed.

CLEVELAND, OHIO.—The Detroit & Toledo Shore Line, one of the properties of the Everett-Moore syndicate, has executed with the Detroit Trust Company as trustee a mortgage covering the line from Toledo to Trenton, Mich., for $2,500,000 to cover 5 per cent. bonds to be issued for the completion of the road. A portion of these bonds will be floated in Detroit and a portion in the East. Cars will be running between Toledo and Detroit by Nov. 15.

CLEVELAND, OHIO.—Stockholders of the Lorain & Cleveland, Sandusky & Interurban, Sandusky, Norwalk & Southern and Toledo, Fremont & Norwalk railways met in Cleveland Sept. 20 and ratified the actions of the directors of the various companies in an agreement to consolidate the properties into the Lake Shore Electric Railway. The new company will have a capital stock of $6,000,000 and will operate 160 miles of road between Cleveland and Toledo. It is stated that through cars will be placed in operation by Oct. 15.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has closed contracts for equipment to provide for the Norwalk extension of the Cleveland, Elyria & Western Railway and for the Cleveland & Southern Railway. Seven Westinghouse transformers of 300 kilowatt capacity each have been ordered for sub-stations to be built at Berlin Heights and Medina. Current will be furnished from the new power station at Elyria, and this will be enlarged considerably to take care of the additional mileage. Contracts have been closed for twelve Kuhlman cars of the largest size, to be fitted with Peckham trucks and Lorain motors.

CLEVELAND, OHIO.—The incorporation of the Lake Shore Electric Railway has been recorded at Columbus. The capital stock of the new company is $6,000,000, of which $4,500,000 is common and $1,500,000 5 per cent. preferred. The directors are Barney Mahler, J. B. Hanna, H. A. Everett, E. W. Moore, C. H. Stewart, J. B. Hoge, W. J. Gawne, W. H. Price, all of Cleveland, and J. H. Harding, of Philadelphia. The consolidated company will deliver to the Western Reserve Trust Company as trustee, a mortgage covering all its property and franchises and an issue of bonds aggregating not more than $6,000,000 will be made.

CLEVELAND, OHIO.—The general managers of the various electric railway properties of the Everett-Moore syndicate met in Cleveland recently and drew up articles for the organization of the Everett-Moore Managers' Association. It is the intention to meet every two weeks at Cleveland, Detroit or Toledo to discuss different matters of common interest. Standard methods of handling the properties will be adopted and a standard set of rules for handling employes will be one of the first steps taken. It is believed that these frequent conferences, together with inspections of the different properties, will tend to improve the service greatly.

CLEVELAND, OHIO.—The Cleveland Construction Company, which is building the Little Miami Traction line, is placing contracts for the equipment of the road. It has contracted for a temporary equipment of two alternating current motors and two 300-kw rotary transformers. There will be a storage battery station of appropriate capacity. Contracts have been closed with the Jewitt Car Company for eight passenger coaches, two baggage and one work car. They will be fitted with Christiansen air brakes and will have four 60-hp Westinghouse motors. The road will be in operation between Springfield and Xenia early next year, and it is the intention to extend it to Cincinnati.

SCRANTON, PA.—The Central Rapid Transit Railway Company, which several months ago applied to Councils for the right to lay its rails on certain streets of the city and was refused the privilege, has renewed its petition and offered the city $12,000 for the franchise.

GREENVILLE, S. C.—It is believed by some that the proposed electric railway from Greenville to the cotton mill town of Piedmont will be later extended to Belton, and thence to Anderson.

TACOMA, WASH.—The Tacoma Railway & Power Company is preparing to extend the Tacoma street railway system in the southern part of the city.

SEATTLE, WASH.—The Seattle City Railway and Leschi Park have been sold to James S. Goldsmith for $500,000. Mr. Goldsmith represents the Seattle Electric Company.

NEW INDUSTRIAL COMPANIES.

THE BROOME COUNTY ELECTRIC COMPANY, of Binghamton, N. Y., has been incorporated; capital, $100,000. Directors: F. J. Sands and D. R. Buckley, of Unadilla, and S. D. Kane, of Binghamton.

THE GRAHAM-FOX MOTOR COMPANY, of New York City, has been incorporated to manufacture motors and automobiles; capital, $500,000. Directors: Frank A. Fox and David F. Graham, Stamford, Conn.; James J. Thornley, Jr., Brooklyn; C. G. Weaver, New York City, and W. D. Blake, Richmond Hill, L. I.

OBITUARY.

MR. E. P. GLEASON. Elliott Perry Gleason, a well-known inventor and manufacturer, died at his home in Brooklyn on Sept. 26 in his eighty-first year. Mr. Gleason was born in Westmoreland, N. H. At the age of fifteen he moved to Boston, and afterward to Providence, where, in 1851, he went into business under the firm name of Mooney & Gleason in the manufacture of gas burners and similar supplies, which at that time was a new industry. Mr. Gleason perfected the Argand gas burner, which netted him a fortune. He also invented the two-hole or fish-tail gas burner tip and numerous other valuable improvements. In 1861 he established himself in New York City, where in 1871 he incorporated the E. P. Gleason Manufacturing Company. He also owned the Gleason Knitting & Manufacturing Company of Seneca Falls, and was the principal owner of the Gleason & Bailey Company, also of Seneca Falls, in which village he was known as the "workingman's friend." He was also president of the Gleason-Peters Air Pump Company, the Lawler Water Feed & Damper Regulator Company, and the Steam Boiler Equipment Company, of New York. In 1883 he began, in Brooklyn, the manufacture of glassware for illuminating purposes. He was one of the first to see the merits of electricity as an illuminant and the Gleason Company under his initiative has brought out a great many specialties in the electric lighting field. Mr. Gleason was never married, and is survived by two sisters and a brother.

PERSONAL.

MR. CAMPBELL-SCOTT, of the C & C Electric Company, returned last week from a brief European trip.

MESSRS. C. E. FREDERICK AND C. R. STURDEVANT have become associated with the engineering firm of E. P. Roberts & Company, Cleveland, Ohio.

MR. I. E. BURDICK has sold out his entire interest in the Naval Electric Company to Mr. F. G. Hall, Jr., his former partner, and has severed his connection with the company. Mr. Burdick will continue in the electrical field, but his arrangements for the future not being completed, his plans have not been made public.

MR. O. L. REMINGTON, the Australian representative of the Diamond Meter Company, of Peoria, Ill., is making a tour throughout Europe and America looking up electrical possibilities and developments in their relation to the trade of the new Commonwealth, with whose industrial condition he is thoroughly familiar. He will be at the Astor House in New York City about Oct. 21.

MR. JOHN D. ROCKEFELLER, it is said, has a private wire between his mansion at Forest Hill, Cleveland, and the Standard Oil offices in New York, and, with the aid of an operator, transacts all his business, involving millions, as though he were in New York. He uses the long-distance telephone occasionally, but never for important business. The mails he never uses. Mr. Rockefeller will remain at Forest Hill until October. Meanwhile, he devotes certain hours daily to work and has his secretary and telegraph operator constantly at his side. He never writes his messages, but simply talks to the operator as though he were engaged in conversation with another oil magnate in his New York office. When a question is asked the reply comes back instantly.

Trade Notes.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, has just entered its tenth order for Cross oil filters for the Pittsburg Plate Glass Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has a neat catalogue devoted exclusively to telephone and annunciator systems. It is complete with data on that subject. If interested our readers should send for one.

A USEFUL SOUVENIR in the form of a pocketbook has been distributed by the Peerless Rubber Manufacturing Company, of New York. The use of the pocketbook by the recipient will serve as a frequent reminder of the excellence of the company's products.

THE HUGHES TELEPHONE COMPANY, Baltimore, Md., incorporated recently, will manufacture and install telephones, making a specialty of telephones for interior use, in hotels, apartment houses, etc. Its office is at 219 East Baltimore Street. T. Quincy Scott is secretary.

THE CENTRAL ELECTRIC COMPANY, of Chicago, claims for the Columbia lamp, high efficiency, long life, uniform candle-power, and even distribution of light. It solicits trial orders from those who have not tried the lamp, and assures all customers prompt shipment.

MR. WM. ROCHE, 42 Vesey Street, New York, manufacturer of the "New Standard" dry battery, whose factory was nearly destroyed by fire on Aug. 18 last, reports that he is now ready to fill all orders promptly, he having rebuilt and rearranged his factory, and his facilities are now better than ever before.

TOOL OUTFITS.—Complete tool sets for house or shop use are made up and placed in cabinets by Messrs. Hammacher, Schlemmer & Company, 209 Bowery, New York. A recent pamphlet shows illustrations of tool cabinets of various sizes, giving a list of the tools comprising each set. The class of tools considered is carpenter's sets.

POLE BRACKETS.—The Ohio Brass Company, Mansfield, Ohio, has recently issued a very complete and varied assortment of pole brackets comprising upwards of fifty different styles, each of which is supplied in all the standard sizes commonly in use. These brackets are made of either standard weight of wrought iron pipe or structural steel tubing, as may be preferred.

THE EUREKA ELECTRIC COMPANY, Chicago, is now making an extension to its factory. Its present quarters at 143-145 South Clinton Street are inadequate to the large amount of business, and it is now adding to its building the structure numbered 147-149 South Clinton Street. This will give it double the present capacity, enabling it to catch up with its orders, and to fill several large multiple board contracts, which boards are now in the course of construction.

THE IRON CITY ENGINEERING COMPANY is putting out a 24-inch celluloid rule on which its name and address appear with its telephone numbers and a memorandum of the general work in which it is engaged. In addition to the linear measurement on the face of the rule, there is contained a metric scale, while on the reverse side are wiring formulæ, wire gauges, belting formulæ, etc. The rule folds in four sections so as to make it very convenient for carrying in the pocket.

ELECTRO-THERAPEUTIC APPARATUS.—A full line of electrical apparatus for physicians, surgeons and dentists is manufactured by the Keystone Electric Company, Philadelphia, Pa. In a pamphlet of recent issue are described and illustrated instruments for the special needs of these professions. The Keystone Company calls attention to its complete and modern factory equipment, which enables it, with the aid of skilled mechanics, to manufacture electro-therapeutic instruments of the highest grade and best workmanship.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has upon the press a very complete catalogue of its motors, generators and generating sets. Previous publications have been in the form of bulletins descriptive of special types. This catalogue will present them all, and will in some degree reveal the fact that although the Sturtevant Company has a world-wide reputation as a blower manufacturer, its business is by no means limited to the production of these useful machines, but that it is also equipped with a most complete line of engine and motor designs in small and medium sizes. In this respect, it is unique in this country.

LARGE CRANE.—The Brown Hoisting Machine Company, Cleveland, Ohio, is building for the Brooklyn Navy Yard a novel piece of machinery known as an electric pontoon crane. It consists of a traveling crane, capable of lifting a 100-ton weight, built on a large pontoon. The pontoon is 100 feet in length and the crane has an overhang at each end of 45 feet, so that the length of travel is 190 feet. At 95 feet from the center the crane can lift a 100-ton gun. The frame is so counterbalanced with automatically operating counter weights that the pontoon lists only 3 inches in lifting the weight mentioned. The crane will be utilized at the Navy Yard in transferring heavy weights to war vessels. It is to be operated by electric motors, and it is expected that it will be placed in operation some time this fall.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that its Fall business has opened up in a most satisfactory manner. This is especially true of its apparatus department, which has never before been so busy. It is exclusive agents for the Warren alternator, for alternating current apparatus, and the Eddy Electric Manufacturing Company, for direct current apparatus. It handles in connection with this apparatus, Moloney transformers, and Adams-Bagnall enclosed arc lamps. In connection with its apparatus department, it has a fully equipped engineering department, which is prepared to draw up plans and specifications for lighting plants, and, in fact, give any information and data necessary for the proposed installation of electric light and power plants. It also has a complete line of bulletins and descriptive matter, illustrating this apparatus, which will be sent upon application.

"SUCCESS."—The October number of *Success* is an industrial issue of considerable importance. Unlike the industrial issues of other magazines, however, the editors have wisely eschewed a dry record of statistics, and have woven the progress and romance of the United States in a selection of subjects that are valuable to all readers. The opening article is by Park Benjamin, who deals with "Great Problems of Invention." Dr. Benjamin graphically tells of the vicissitudes of the most successful inventors. He traces the beginning of the automobile, and, in this connection, his article is illustrated with an elaborate drawing of Edison in his laboratory, perfecting his storage battery. Charles R. Flint, one of the most prominent brokers and merchants in America, contributes a powerful paper on "How to Win, and Keep, the World's Trade." The growing trade of the Great Lakes is presented in a stirring, forcible manner by Mayor Harrison, of Chicago; Mayor Johnson, of Cleveland; Mayor Hugo, of Detroit; and Mayor Jones, of Toledo, who advocate and show the possibility and necessity of a deep waterway to the Atlantic Ocean. Robert Bruce Watson, the supervising architect of Illinois, tells, in "The Elevator Did It," how the American "skyscraper" was made possible.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED SEPT. 24, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

683,026. TROLLEY CATCHER; C. I. Earll, New York, N. Y. App. filed Feb. 26, 1901. The rope passes around a drum which is acted upon by two springs, one a light one to keep the rope taut, and the other a heavy one which is thrown into action when the wheel leaves the wire, to wind the drum.

683,045. ELECTRIC COUPLING FOR CONDUCTORS; C. Holzmann, Budapest, Austria-Hungary. App. filed March 5, 1901. A rail bond consisting of a rod fixed at one end to one rail and clamped to the other rail, the rod being split lengthwise for flexibility.

683,049. INCANDESCENT LAMP PROTECTOR; J. M. Howley, Bayonne, N. J. App. filed June 20, 1901. The lamp projects through a ring, across which is stretched a flexible diaphragm having a hole in the middle.

683,051. PAPER CARRIAGE FEED DEVICE FOR PRINTING TELEGRAPH MECHANISM; O. L. Kleber, Pittsburg, Pa. App. filed Sept. 10, 1901. Details.

683,052. ARMATURE CORE FOR ELECTRICAL MACHINES; G. Koppelmann, Schuttorf, Germany. App. filed June 15, 1901. The armature is built up of bunches of metal plates, insulated from each other and separated by spaces so that air can pass axially through the armature, for ventilating purposes.

683,062. INCLOSING STRUCTURE FOR ELECTRIC ARC LAMPS; W. H. Northall, Elwood, Ind. App. filed Nov. 12, 1901. The lamp casing is in two parts hinged together.

683,066. ELECTRIC TUBE WELDING MACHINE; O. Parapart, Cleveland, O. App. filed Sept. 1, 1900. A special arrangement of the die with respect to the conducting devices.

683,085. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; William Lawrence Voelker, of London, Eng. App. filed July 30, 1900. A cotton thread or cellulose filament is soaked in a solution of the salt or salts of the metal or metals intended to form the metallic base of a carbide, then dried, spooled and packed with powdered carbon and the carbide, and subjected to a temperature which will convert the salt into oxide. The filament is then carbonized by passing it through an electric arc while surrounded by a cylinder composed of the aforesaid base and enclosed within a vessel with hydrogen or other gas incapable of supporting combustion.

683,086. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; William Lawrence Voelker, of London, Eng. App. filed July 30, 1900. Apparatus for carrying out the process of the above patent.

683,089. PROCESS OF REDUCING OXIDS; Knut C. Wideen, Brooklyn, N. Y. App. filed Jan. 19, 1901. It is stated that at a temperature of 10,000° F. obtained by means of a solar heater or by the focussed heat from a number of electric arcs, alumina, silica, and other refractory oxids are dissociated and the metal may be recovered in pure state without the use of a reducing agent.

683,098. ELECTRIC CLOTH OR FABRIC; L. Baecker, Detroit, Mich. App. filed June 24, 1901. Zinc and copper wires are woven into a fabric for therapeutic uses.

683,107. SMELTING FURNACE; Leonard S. Dumoulin, of Flushing, N. Y. App. filed Oct. 13, 1899. (See Current News and Notes.)

683,130. TOY GRAPHOPHONE; T. H. Macdonald, Bridgeport, Conn. App. filed Feb. 21, 1899. A heavy wheel carrying the record disk is adapted to be set in motion and run a considerable time by inertia.

683,133. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS; G. L. Mason, New York, N. Y. App. filed Sept. 10, 1898. A switch device for lighting the proper lamps to produce various letters and figures successively upon a sign.

683,171. TRANSMITTER FOR EDUCATIONAL PURPOSES; C. S. Comins, Quincy, Mass. App. filed April 6, 1901. A perforated tape is used by the beginner to send signals to himself so that he may not know the signals that are transmitted, and thus learn entirely by sound.

683,172. ELECTRICAL BLOCK SIGNAL SYSTEM; S. L. Foster, San Francisco, Calif. App. filed Oct. 16, 1900. The signal on the end of a rotary shaft is rotated by two solenoids, the reciprocating movement of a common core being transformed into a rotary movement, by means of a pin and spiral slot.

683,186. THERMOSTATIC SWITCH; W. F. Singer, New York, N. Y. App. filed Jan. 14, 1901. Details.

683,213. ELECTRIC SWITCH; K. W. Mansfield and W. R. Thompson, South Norwalk, Conn. App. filed July 6, 1900. The switch is temporarily closed by a hammer blow against a ball, the displacement of the ball allows the circuit to be closed and the ball, in returning to its normal position, again opens the circuit.

683,214. SIGNAL SYSTEM; K. W. Mansfield and W. R. Thompson, South Norwalk, Conn. App. filed July 21, 1900. An interlocking arrangement for signals at the beginning and ending of a block.

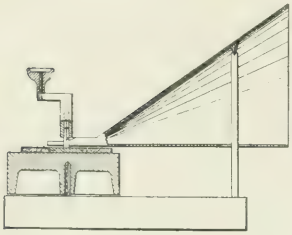
683,216. THERAPEUTIC BATTERY; J. A. Minturn, Indianapolis, Ind. App. filed June 10, 1901. The battery consists of two cells secured together end to end, with plugging arrangements for connecting one or both cells into circuit.

683,230. ELECTRIC CIRCUIT CLOSER FOR RAILWAY TRACKS; F. Sock, Magdeburg, Germany. App. filed Feb. 25, 1901. The shoe, against which a projection from the car strikes, is mounted to yield in a fore and aft direction while at the same time being pressed downward to close the circuit.

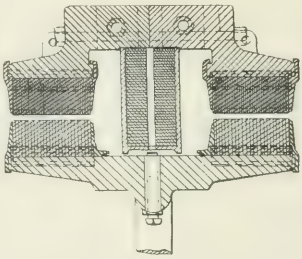
683,250. ELECTRIC RAIL BOND; S. P. Cowardin, Richmond, Va. App. filed Feb. 19, 1901. The end of the bond is a ring adapted to be clamped in an opening in the rail by means of an eyelet.

683,253. ELECTRIC GENERATOR OR MOTOR; P. J. Darlington, Montreal, Can. App. filed Aug. 15, 1898. The stationary armature ring is made in two parts joined together on a plane at right angles to the shaft and may be easily separated for inspecting the coils and hole.

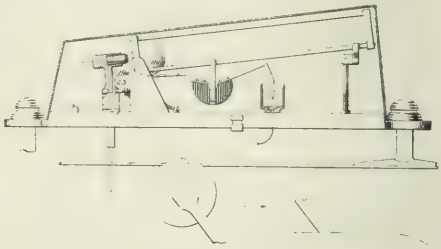
683,263. ELECTROLYTIC PRODUCTION OF CATHODE PLATES; Elmer G. Elliott and Valentine Kishner, of Perth Amboy, N. J. App. filed Dec. 29, 1900. (See Current News and Notes.)



683,130.—Toy Graphophone.



683,253.—Electric Generator or Motor.



683,213.—Electric Switch.

683,266. TELEPHONE RECEIVER; S. J. Friedman, McKeesport, Pa. App. filed Feb. 23, 1901. A clamp for the receiver.

683,279. CONTROL SYSTEM FOR ELECTRIC CARS; C. Hochenegg, Vienna, Austria-Hungary. App. filed Jan. 22, 1900. Devices whereby the control on each car is moved by gearing driven from the car axle, such gearing being controlled throughout the train from a single car.

683,283. ELECTROMAGNETIC TRACTION INCREASING APPARATUS; A. A. Honey, Tacoma, Wash. App. filed Nov. 20, 1900. The axles and wheels are magnetized to increase the attraction.

683,284. ELECTROMAGNETIC BRAKE; A. A. Honey, Tacoma, Wash. App. filed Nov. 22, 1900. The axles and wheels are magnetized to attract the brake shoes which are hung on a magnetizable brake beam to complete the magnetic circuit.

683,319. BURGLAR ALARM; W. G. McClure, Beaver Falls, Pa. App. filed Nov. 14, 1900. Details.

683,332. ELECTROMAGNETIC BRAKE; A. A. Robertson, Titusville, Pa. App. filed April 18, 1901. A ring-shaped magnet surrounds the axle and creates a braking force by inducing eddy currents in another ring carried by the axle.

683,341. ELECTRIC ALARM MAT; A. D. Shaw, New York, N. Y. App. filed June 25, 1901. Two metallic nets incorporated in a single mat and insulated from each other.

683,397. SIGNALING MECHANISM; R. Herman, Crafton, Pa. App. filed Jan. 14, 1901. In a signal mechanism, a signal having a bias to danger position, electrically operated mechanism for electrically locking the signal at caution and clear positions, and a circuit controller operated by the driving means for controlling the lock-circuit during the movement of the signal from danger to clear position, means normally acting to operate the circuit-controller during the movement of the signal from clear to danger position.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, OCTOBER 12, 1901. No. 15.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 12, 1901.

CONTENTS.

PAGE
Editorial 579
Electricity for Heavy Trains 582
Electrical Engineers of the Day XV. Charles T. Malcolmson 582
The Bay Counties, Calif., Transmission System, Colgate Plant 583
A Note on Loaded Conductors, by M. I. Pupin, Ph. D. 587
A Simple and Effective Mercury Jet Interrupter for Röntgen-Ray Induction Coils, by R. H. Cunningham, M. D. 588
The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour—III; by Walter Reichel 589
Disintegration of Wood Fibre by Alternating Currents 591
Submarine Cables and Gutta Percha 592
Growth of Export Trade 592
The Telephone Outlook in Siam 592
The Influence of Polyphase Apparatus on the Design of Railway Power Houses—II; by J. E. Woodbridge 592
The Inductor Alternator—II; by Edward Heitmann 594
Illinois State Electric Association 596
Reporting the Yacht Races by Wireless Telegraph 596
Recent Telephone Circuit Patents 597
Current News and Notes 598
LETTER TO THE EDITORS:
Theory of the Edison Nickel-Iron Cell, by E. F. Roeber 598
Digest of Current Electrical Literature 600
New Books 604
Flexible Pole Brackets 604
Band Polishing Wheel 605
Telephone System for the Manhattan Railway 605
A Carborundum Exhibit 605
DEPARTMENTS:
Financial Intelligence 606
Commercial Intelligence 607
General News 609
Trade Notes 613
Record of Electrical Patents 613
Convention of the American Street Railway Association ..... Supplement

THE STREET RAILWAY CONVENTION.

The twentieth annual meeting of the American Street Railway Association held this week in New York City has been a success worthy the occasion and the opportunity. We write while the convention is still in progress and before all the work planned has received attention, but the excellent programme laid down has already been carried through with remarkable precision and vigor, and with a smoothness worthy the highest ideals of the organization. As to the exhibit in Madison Square Garden, it can only be characterized as marvelous for completeness, comprehensiveness and costliness, in view of the fact that it lasts virtually but three days. The Garden has seen many a show staged for a month on which far smaller effort and expense were put forth. Such an exhibit is a striking evidence in itself of the superabounding vitality and activity of the street railway industry. For ourselves, we are free to confess to a keen sense of pleasure in seeing the association return to a New York from which the horse and cable have now been virtually banished by electricity, and from which even now work is going on to exile steam. All those lower agencies have "had their day and ceased to be" in the field of urban traction, after doing useful work in their day and generation; and it is certain that the street railway art could not have attained its present magnitude and importance, but for their supercession by cheaper and cleanlier electricity. From the electrical standpoint, however, the conquest of the street railway field by electricity is but a preliminary to the subjugation of the main line steam railroads of the country, the beginnings of which revolution are already upon us.

THE PUPIN TELEPHONIC SYSTEM.

Elsewhere we print an interesting article by Dr. Pupin, in which he gives numerical and graphical illustrations relating to his system for reducing the attenuation and distortion of telephonic currents in cables and long land lines. To those who have been doubtful as to the practical application of higher mathematics to the direct solution of important industrial problems, the remarkable work of Dr. Pupin in this line should be a revelation. The true reason of the suspicion with which mathematics of the higher order has been regarded by practical men has probably been due to the fact that in the past those who have been adepts in mathematics were absolutely indifferent to its practical bearing, while the so-called practical man has either lacked higher mathematical training, or the skill to apply its methods. Since the day when William Thomson made his mathematical investigation of the constants of the submarine cable, and by showing thereby the entire feasibility of the project of the Atlantic cable, rendered its realization immediately possible, we know of nothing more brilliant in the same line than the recent work of Dr. Pupin in telephony.

The illustrations given by Dr. Pupin show how vitally the good results that may be obtained from the use of inductance in telephone lines, depends upon the proper distribution of the inductance along the line. In his several papers giving at length the theory of telephone wave propagation over conductors, Dr. Pupin showed that by a definite distribution of the inductance as fixed by the wave length corresponding to the highest important frequency in telephony, an ordinary telephone line may be made to approach in its transmission properties as near as desired to a distortionless line—that is, to the ideal line for telephonic transmission. The curves given elsewhere

indicate that for a distribution of inductance entirely practicable and little expensive, a correspondence of present telephone lines with the ideal one can be made so extremely close as to approach an identity. Those who look askance at the mathematical demonstration may be reassured as to its accuracy by the fact that the Pupin system has already been successfully applied on underground telephone circuits in at least one large city, with results which fully confirm its value with respect both to improvement in the transmission and enormous saving in copper.

MERCURY INTERRUPTERS.

Dr. Cunningham elsewhere in this issue describes what appears to be a simple and convenient revolving mercury interrupter for use in the primary circuit of a Ruhmkorff coil. The Wehnelt electrolytic interrupter, although very convenient for generating cathode rays in a Crookes tube, is apt to overheat and get out of order. When such an interrupter stops working, it is likely to allow unduly powerful currents to pass through it. The mercury interrupter here described appears to have the merit of breaking the circuit when it accidentally stops. Tesla has also favored the use of a particular type of mercury interrupter for generating high-frequency currents, and it is to be hoped that a cheap practical form of the apparatus may soon find its way into the market.

THEORY OF THE EDISON NICKEL-IRON CELL

In our correspondence columns appears an interesting letter by Dr. Roeber as a further contribution to the working theory of the new Edison storage cell. As soon as this cell is brought into commercial use, a careful analysis of its electro-chemical action is to be hoped for from those interested in such investigations. Up to the present time its distinguished inventor has apparently been so fully occupied in making the cell practically capable of doing industrial work that a complete analysis of its chemical reactions does not seem to have been made, and is no doubt a difficult matter. It would seem that neither the positive, nor the negative, active substance has yet been thoroughly analyzed. The one is supposed to consist, in the discharged state, of a mixture of oxides, or hydrated oxides, of iron. The other is supposed to consist, in the charged state, of a hyperoxide of nickel. Until these active substances have been fully analyzed at the stages of charge and discharge, no reliable working equations can be obtained. All that seems to be known is that for every active atom of iron, an atom of oxygen is transferred in charge or in discharge from one plate to the other. Dr. Roeber is no doubt right in assuming that concentration changes will occur during operation, in the deeper layers of the active briquettes. It would seem likely, in fact, that the steady decline in the discharging e. m. f. of the cell is due to such changes in the active material, by which the complete electro-chemical reaction is hindered and retarded. Just as in the Edison-Lelande cell the migrating oxygen, towards the end of discharge, has to penetrate a dense mass of already oxydized active material, in order to reach the interior layers of unoxydized substance.

THE BETTS LOCALIZATION TEST.

A method of localizing a fault in submarine cables by Mr. Walter Betts appeared in the London *Electrical Review* of August 16, and was noted in the Digest of Sept. 7. The conditions of the test are graphically exemplified by Mr. Raymond-Barker in an article appearing in the London *Electrical Review* for Sept. 13, and abstracted in the Digest of this week. Mr. Betts applies simultaneously two equal e. m. f.'s to the opposite ends of the cable (zinc poles to line) through measuring instruments, and determines from synchronous readings the corresponding resistance valuations of such readings. These successive pairs of resistance readings theoretically yield the electrical distance of the fault from each end of the line by a very simple formula. This method takes into consideration the polarization e. m. f. resident in the fault and also the instantaneous resistance in the fault, only requiring that the two testing e. m. f.'s shall be equal, and that the resistances of the measuring instruments and testing batteries shall be known. The method fails, however, to take into consideration the natural or earth current e. m. f. acting along the cable from one end of the line to the other, and theoretically the test should only be applied at such moments when the earth current e. m. f. between the two ends of the line is zero. On the other hand, the earth overlap localization tests in ordinary use, while not possessing the advantage of simultaneous readings from both ends of the line, and depending only upon alternate measurements from each end of the line, with the fault artificially thrown into the center of the circuit, take into consideration both the resistance and the polarization e. m. f. of the fault as well as such natural earth current e. m. f. as may exist at the time between the two testing stations.

SOME DANGERS OF AUTOMOBILISM.

The lamentable tragedy which robbed the Nation of its Chief Magistrate put a sudden end to many public functions and private amusements, among others to the automobile contest which was in progress at the time. Unfinished as it was, this contest had gone far enough thoroughly to demonstrate that it was representative of about every element that should by the principles of fair sport and the requirements of some engineering and good business be excluded from such a competition. As a technical journal we are seldom compelled to take a stand on sporting matters, but automobilism touches us rather nearly since some of the most successful machines are purely electrical in their equipment and their design and construction is a legitimate and growing branch of the electrical arts. And in this matter we are strongly inclined to the opinions, first that automobilism is not properly a branch of sport but a part of the far more important business of transportation in general, and, second, that in so far as it can be considered as a sport it is starting out along lines that are objectionable and likely to bring it into ill repute.

We have seen within the past 15 years the electric motor replace the horse on tramways so completely that in many States a horse car unless robbed of its motive power and set up as a night lunch stand could hardly be found with a search warrant. The few remaining lines are doomed to early extinction. We believe heartily in the future of the automobile, and that it is destined to replace animal traction to an extent which can as yet scarcely be realized. But we likewise believe that the automobile is a vehicle destined for work and for pleasure rather than for the race track, that it is destined to replace the truck and the cab and the trap rather than the sulky. For this reason we earnestly deprecate speeding as an important part of its early development. The electric automobile has more than once held up its end even in such trials, but as a serious practical business, an important factor in urban transportation, the electric hansom or delivery wagon is far more worthy of consideration. The great work in hand is the displacement of animal by mechanical traction, and to this the energies of inventors and manufacturers should be bent. A motor car with a possible speed of a mile a minute is a striking engineering feat, but it is not business, and its field of usefulness is a small and inconsequential part of the region that must eventually be tenanted by motor vehicles. Moreover, its exploits are more than likely to bring the whole art into ill odor even with a public as long suffering as the American public. It would not take much added provocation to start a campaign of

repressive legislation that would be most disastrous to the proper and normal growth of automobilism. Even now there are signs of such a tendency toward restrictions, which, to be effective, must necessarily be somewhat severe.

But granting for the moment that racing pure and simple is a legitimate part of automobilism, it still should be kept in the background rather than pushed to the front. No great and permanent business has or ever can have a firm basis in sport, particularly in an expensive form of sport. Even yacht building, in which Americans may certainly take a pardonable pride, has had many ups and downs, and commercially forms but a small part even of the somewhat decayed American ship building industry. The bicycle business is a case in point. Ten years has practically finished its life as an important branch of manufacture. Deserted bicycle factories dot the suburbs of many cities, and their owners may reckon themselves fortunate if they can be utilized for other industries. The bicycle was exploited primarily as furnishing a new and attractive sport, which grew, and then passed, in popular estimation. Now the wheel is mainly a convenience and source of recreation for working people, and as such worthy to be commended, but so far as sport is concerned, it has for the most part passed into the hands of a dwindling band of professionals humping their backs behind motor-pacing machines. If the growth of automobilism is to be along the line of sport there will be a boom followed by a certain collapse, which will seriously hinder the development of the automobile's real usefulness. Now, the test which formed the text for this industrial sermon, purported to be a trial of practical endurance, but it quickly tended to degenerate into a scorching match and the endurance was mostly in the hands of the express companies in the form of spare parts. Racing is well enough in its proper place, and tests of practical operative properties are always welcome, but this seems to have been, in the main, a tinkering match varied by periodical sprints. There will always be a small legitimate demand for racing automobiles and fast light motor vehicles for various purposes, but the backbone of the business will be the carriage and working wagons for steady, reliable service at moderate speeds. Toward the production of such vehicles the best energies of the manufacturers should be bent. Once they are in common practical use the racing feature can be trusted to take proper place, for the sporting blood of the normal American will assert itself, if he has to race wheelbarrows.

Resistance in the Voltaic Arc.

Two very interesting papers on the c. e. m. f. of the voltaic arc have recently been communicated to the Royal Society of Great Britain. One is by Mrs. Ayrton, and the other is by Mr. Duddell. These papers represent opposing opinions and conclusions. Mrs. Ayrton believes that there is no active c. e. m. f. in the voltaic arc, and that there is only present the resistance of a mass of carbon vapor and a column carbon mist, both having definite dimensions, and each having a definite resistivity. According to her view, the apparent c. e. m. f. of, say, 45 volts in the arc, is all IR drop, or fall of potential occurring in this resistance. Mr. Duddell adduces measurements, on the other hand, which lead him to believe that although some 75 per cent of the apparent c. e. m. f. is due to resistance, or represents IR drop, the remaining 25 per cent is real c. e. m. f., which he attributes to thermo-electric origin.

The question is a very difficult one to analyze. With 45 volts p. d. between the carbons, there is nothing to show, on the surface, how much of this is c. e. m. f., like that in a storage cell, and how much is drop in resistance. Moreover, if we keep the length of the arc constant, and increase the current strength, we usually *diminish* the p. d. between the carbons, as though there were a negative resistance. This anomalous condition is generally admitted to be due to secondary changes in the arc, following the change in current. Duddell says, in fact, that if the current strength through the arc is varied by only three per cent, a secondary change in the arc will be thereby set up in one ten-thousandth part of a second. Consequently, all reliable resistance measurement would have to be made in less than that interval of time after changing the current. Mrs. Ayrton points out the same thing.

Mr. Duddell consequently resorted to a very high-frequency alternating-current, superposed upon the direct current of the arc, and made measurements on the alternating component. He claims to have reached a frequency of 120,000 cycles per second, which corresponds to an ether wave of 2½ kilometers in length. At such an enormous frequency, ordinary short coils of wire, by reason of their inductance, behaved more like insulators than conductors, and special measuring apparatus had to be designed. The results given are, that in the case of a 3-millimeter arc between solid carbons, carrying 9.91 amperes, 37.8 volts were due to resistance, and 12 volts to c. e. m. f. at the crater, making 49.8 volts total apparent c. e. m. f. It is intimated that if the carbons were chemically pure an indefinitely high e. m. f. would be necessary to maintain the arc; or, in other words, that the maintenance of the carbon voltaic arc at the ordinarily observed pressures is due to small impurities in the carbons. Cored carbons are carbons rendered deliberately impure in their central portions, in order still further to lower the e. m. f.

Mrs. Ayrton studied the arc by the aid of optical methods. She points out that close beneath the crater is a colorless space probably containing volatized carbon, or carbon vapor. Beyond this space is a purple column probably containing this vapor in a condensed state like mist, and outside of all is a yellow cover or sheath of flame, consisting of burning gas[illegible] the flame seems to be an insulator, the conductive path is l[illegible] carbon vapor and carbon mist. The former seems to ha[illegible] esistivity than the latter. By studying the forms of the[illegible] he optical projection of the arc, with varying current s[illegible] ngths of arc, formulæ for resistance are developed of [illegible] ic form as those derived from previous experimen[illegible] the total c. e. m. f. apparent in the arc. Consequen[illegible] considers that there is no necesity to introduce any [illegible] ve c. e. m. f., and that mere resistance will account [illegible] d facts.

In comparing the opposing dedu[illegible] researches and observers it is well to remember t[illegible] r c. e. m. f. of thermo-electric origin is to be exp[illegible] is to say, it would be reasonable to suppose th[illegible] ated vapor between two carbon electrodes at [illegible] ifferent temperatures would be likely to give rise to some residual thermo-electric e. m. f. It would not be probable at first sight, however, that such an e. m. f. would be more than a volt or so, considering how small are the e. m. f.'s met with in single thermo-electric couples. Duddell's measurements seem to indicate c. e. m. f.'s up to 17 volts in the crater. It is possible, however, that using such enormous frequencies of testing current, there may be some undetected error in his measurements. Until the matter is further investigated, we should incline to the belief that the truth lies somewhere between these two sets of results, namely, that there are small thermo-electric e. m. f.'s or c. e. m. f.'s at the electrodes, and that the great bulk of the apparent p. d. is due to resistance in the column of carbon vapor and mist.

Electricity for Heavy Trains.

As already hinted in these columns, the investigations for the Great Northern Railway into the matter of substituting electric for steam power for railroad use under the direction of J. N. Hill, the eldest son of President J. J. Hill, have convinced both of these gentlemen that there is a great saving to be made in operating trains by water power conveyed in the form of electricity.

When the plan was first broached it merely contemplated the operation of trains by electricity through the Cascade tunnel, a distance of about 2½ miles. But now the electric improvement will be applied to that portion of the road extending from Leavenworth on the east side of the mountains, to Skykomish on the west side, 66 miles. It is understood that if the electric motors are a success they will be immediately operated from Everett on the west side to Wenatchee on the east side, a distance of 141 miles, and eventually extendd to include the entire mileage of the system.

The portion of the road chosen for the first application of the experiment in electric power is one of the most difficult and expensive portions of the road to operate on the entire system. It lies through the wild and rugged Cascades, the grades are very heavy on both sides of the mountains, there are many miles of snowsheds, and every winter there are numerous slides of earth and rock, which come down from the steep mountain sides to cover up the tracks and endanger the operation of trains.

There is one important reason why the Great Northern desires to secure and adopt some new and cheaper motive power for this portion of its system, and that is because of the expense of coal, which gives both the Oregon Railway & Navigation Company and the Northern Pacific a great advantage over the Great Northern in the expense of handling freight on its coast division.

The advantage of the Oregon Railway & Navigation Company lies in its gravity route down the Columbia River from the Rock Mountains, and that of the Northern Pacific lies in hte fact that it mines its own coal at Roslyn at a cost of from $1 to $1.25 a ton, while the coal of the Great Northern costs about $2.75 for the ordinary product, which is used on the greater portion of the division, and for the Crows Nest Pass coal, which is used on all trains through the tunnel the cost is much greater.

For about 30 miles of the mountain climb on the Cascade division each loaded train running over it requires the asistance of a helper engine in addition to the regular engines, and as nearly all of the mountain trains are hauled by the big mountain engines the coal consumption is something enormous, to upward of 250 tons a day, or nearly a million tons a year, in the difference of $1.50 a ton in favor of the Northern Pacific active substitute seen that he older road has, on account of coal surcharge and disconsiderable advantage over its newer rival.

As the water power f d. All that seems of the electric power for the operation of the trains n atom of oxygen system will be taken from one or more oft he manplate to the other exist in abundance along that portion of the syste incentration chang contemplated will reduce the coal bills of the div s of the active bri, if not eventually doing away with them entirely. ly decline in the

Electri s in the active reaction is hinde s of the Day—XV.

s cell the migrating

MALCOLMSON.

Charles To to penetrate a dense m chief engineer and manager of the departme but der to reach the interricity for the South Carolina Inter state and Wes on to be held at Charleston this winter under State and National auspices, is a graduate of the Armour Institute of Technology, of Chicago, with the degree of electrical engineer. He was born at St. Thomas, Ont., Canada, Jan. 31, 1872, and graduated from the Collegiate Institution at London, Ont., before going with his relatives to Chicago. At the Armour Institute he held the record in mathematics and physics, as well as being prominent in Institute and fraternity matters. After graduation, he spent a year in the electrical factory of the Mather Electric Company in Connecticut, proceeding then to Chicago again, where he became superintendent of construction in the huge packing house of Nelson Morris & Co. During the period of the Chicago World's Fair, Mr. Malcolmson made a study of the methods of exposition intsallation, and at its close engaged in design and testing work, this including an elaborate fuse wire test of six months' duration for the Chicago Fuse Wire Company. About this time he made the acquaintance of Mr. C. B. Davis, the well-known hydraulic engineer and became associated with him in the construction of the water works system for Anaconda, Mont. Here Mr. Malcolmson's work included the design of a complete central station steam power plant to operate the lighting and street railway system at a cost of $200,000, and he also laid out plans for a $2,000,000 power transmission plant for the Washoe and Anaconda smelters. He was offered a position as designing engineer with the Anaconda Company at Butte, his work there involving the construction of two large compressor plants, a pumping station, etc., and a lighting plant. He was put in charge later of the drafting room at Anaconda, but while on a visit to Chicago in 1899, met Mr. F. E. Drake, who had been made director of machinery and electricity for the United States at the Paris Exposition, and who tendered to Mr. Malcolmson the position of chief engineer to the United States Commission. The offer was promptly accepted.

Those who visited the Paris Exposition and studied the American exhibit are familiar with the thoroughness with which Mr. Malcolmson did his work under most trying conditions, the obstacles including not only those always incident to such work, but the loss of much plant and structural material at sea, at a vital stage of the construction in Paris. Mr. Malcolmson made the plans and calculations for the famous American Machinery Building at Vincennes and for its plant and the operation of its exhibits, by steam, electricity and compressed air, and had the satisfaction of seeing it eagerly com-

peted for and bought up—lock, stock and barrel—at the close of the Exposition. In addition to this, Mr. Malcolmson had supervision of all the mechanical design and construction, etc., connected with the United States Government Building in the Champ de Mars, the American work in the electrical and machinery buildings, and the general engineering work connected with the Government exhibits, throwing upon him a bewildering and complicated mass of detail. For a time he served as active director of the mechanical and electrical department, in Mr. Drake's absence. He was also appointed a member of the International Jury of Awards in the class of electrical generators and transmission. At the close of his duties, he was most warmly complimented by the head of the United States Commission and his direct chiefs on the success that had attended his efforts.

On his return to this country a few months ago, Mr. Malcolmson proposed to accept some one of the positions in the electrical engineering field that awaited him, but having been recommended to the South Carolina Exposition authorities he assumed at once the duties of chief engineer, and is now engaged very actively on the necessary construction and equipment work of a large plant as well as in the preparation of some interesting illumination and fountain effects.

Mr. Malcolmson has not at any time been active with his pen, but on the other hand has found pleasure and recreation in artistic pursuits. While at Anaconda he modeled a plaque which was executed by the Gorhams and was presented by the city to Mrs. Phoebe Hearst, of California, in recognition of a library that she had given to the community. For the Paris Exposition, he designed the handsome lamp-post for arcs, which was a conspicuous feature of the American electrical and machinery exhibits.

The Bay Counties, California. Power Transmission System, Colgate Plant.

In the past ten months a number of articles have appeared in these columns giving some of the features of the operation of many extensive and interesting long-distance power transmissions in the far West. As was apparent to the readers of those articles, there has been a great activity in this line of work in the past five years. Commercially the results have been such as to justify longer and longer transmissions and larger investments per horse-power developed. The highest voltage line in commercial use up to April 27, 1901, was 40,000 volts, which is the pressure employed by the Telluride Power Transmission Company on its 105 miles of line supplied from its Provo Cañon power house in Utah. Two large companies now have pole lines running into Oakland, Calif., each of which was built for a line pressure of 60,000 volts. Both of these companies have transmission lines for conducting power a greater distance than any previous undertaking. The first of these to go into service was the line of the Bay Counties Power Company, 142 miles in length from Colgate on the North Yuba River southwest to Oakland, Calif., on April 27, 1901. The Bay Counties Power Company began to transmit over this 142-mile line at a pressure of 40,000 volts. All plans are laid to increase this to 60,000 volts when the line losses due to the increased load are sufficient to justify it.

The Bay Counties Power Company is a consolidation of two companies formerly doing business in Yuba and Nevada counties. The system includes in all three power houses, but the main generating station is the new Colgate plant, the completion of which now makes possible the presentation of the accompanying views of this interesting work. In the Electrical World and Engineer of Feb. 16, 1901, a brief outline was given of the work under way on the transmission system of the Bay Counties Power Company in California. In the issue of June 8, 1901, R. H. Sterling, superintendent of the Bay division of this company, described fully the long 4427-ft. span by which the transmission lines cross the Straits of Carquinez, the towers and enormous strain insulators used for this purpose being well illustrated in the article.

The Bay Counties Company, as before said, transmits 142 miles from its Colgate power house on the North Yuba River to Oakland, and it is also temporarily selling power to the Standard Electric Company of California, which has a line completed between Oakland and San Jose, and will ultimately transmit power from a point in the mountains almost due east of San Jose, to San Jose and thence to Oakland. The power which is being sold to the Standard Electric Company is transmitted over the Standard lines from Oakland to San Jose, making a total distance over which power is transmitted from Colgate to San Jose, 184 miles. The transmission in either case is the longest yet carried out commercially for any length of time. The voltage is 40,000 volts, and the form of Locke insulator was described and illustrated on page 760 of the Electrical World and Engineer of May 19, 1900. It consists of a porcelain umbrella 12 inches in diameter mounted on a glass insulator 12 inches high with a very long petticoat. The joint between the coils and the porcelain is made with sulphur and sand. The insulators of this company's line are mounted directly on bare wooden pins. The Standard Electric Company, which uses the same insulator, has placed a porcelain sleeve around the pin between the insulator and the cross-arm with the idea that this would tend to prevent the burning of the pin through small leakage from the petticoat of the insulator to the pin.

The pole line construction of this company was lately described by C. E. Dutcher before the last convention of the Pacific Coast Electric

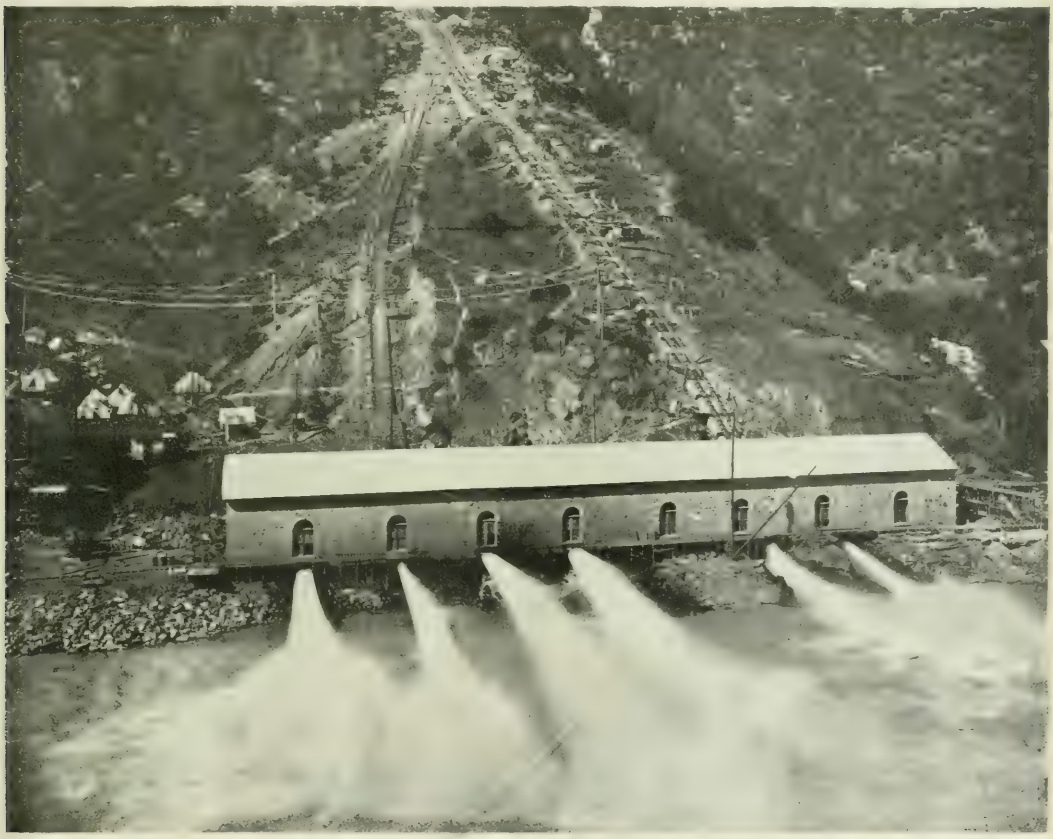


Fig. 1.—Exterior Colgate Power House.

Transmission Association at San Jose. To secure continuous and successful operation, a double-pole line was erected the entire distance of 142 miles from the company's largest power house at Colgate, to Oakland, so that should one line be interfered with the service could be continued over the other. The poles used for this line are round Oregon cedar in lengths of from 25 to 60 ft., with tops from 8 to 12 inches and butts from 12 to 18 inches in diameter. Twenty-five-foot poles are placed 5 ft. in the ground, and 60-ft. poles 8 ft. in the ground. At angles the poles are set 1 ft. deeper in the ground than this. They are shaved over the entire surface of the top to a point 6 inches below the bottom cross-arm, and painted with a dry paint applied hot. The butts are saturated with hot carbolineum from 1½ ft. above the ground line to 2½ ft. below the air line. Each pole line carries three wires on a three-phase circuit. Wires form an equilateral triangle 36 inches on a side. At transpositions the distance apart of the insulators is increased to 42 inches. Transpositions take place every mile and consist of one-third of a turn. One of the pole lines carries three No. 00 hard-drawn copper wires, and the other pole line No. 0000 7-strand aluminum cables. The joints in the copper lines are of the regular Western Union type with nine wraps on each side soldered the entire length. Joints in the aluminum line are made by thimbles, one screwing into the other and the cable held inside the thimble by the wedging of the wires in the taper bore of the thimble. The telephone lines are not transposed at any point the entire distance.

The company has three power houses, but the principal and newest one is that which it is now possible to illustrate, which is situated at Colgate on the North Yuba River. This plant has a capacity of 15,000 horse-power, and contains three units of 3000 horse-power and four units of 1500 horse-power. The generators are three-phase, 60-cycle, built by the Stanley Electric Manufacturing Company, and direct-connected to Risdon Iron Works impulse waterwheels governed by Lombard governors. This immense power house is one of the most picturesque in its location of any in the West, as can be seen by the accompanying views, which show not only the power house but the surrounding mountains and the flume and pipe lines which supply the water. The flume terminates at a point on the hillside 700 ft. above the power house. Thence five pipe lines are laid down the mountainside to the power house receiver. Each of these pipe lines is 30 inches inside diameter. At the bottom they are cast-iron and at the top steel. The flume supplying the water is 7.6 miles long, the drop is 13 ft. to the mile, and it is 7 ft. wide and about 6 ft. deep. The power house building is 275 ft. long by 40 ft. in width. An excellent general view of the power house, pipe line, penstock, flume and surroundings is shown in Fig. 1. Details of the work shown in general in Fig. 1 are given in Figs. 3 to 8. Fig. 4 is a view of the interior of the power house showing the line of generators and waterwheels. One of the waterwheels and controlling mechanism is illustrated more fully in Fig. 7. The pipe line is anchored very securely just above the power house, as can be seen from the general and exterior view of the power house in Figs. 1 and 2, and also more in detail in Fig. 5. Figs. 1 and 2 also show the streams of water issuing from the deflecting nozzle of the wheels.

Fig. 2. General View Showing Flume to Colgate.

The head of water available at this plant being 700 ft., it is, of course, impracticable to govern the waterwheels by throttling the water supply delivered by the pipe lines. The column of water coming down the pipe line at 700 ft. head should be considered as analogous to a solid body of that weight and moving at the velocity of the water. Any attemp to suddenly check the flow of a column of this kind could only result in the destruction of the pipe line because of the immense quantity of live energy in the high column of moving water. It goes without saying that care must be exercised in handling a hydraulic plant under such heads, and slight carelessness in this respect has resulted very disastrously in some California high-head plants. Although the head in the present case is only about half that used in some other

Fig. 3.—Two Miles of Flume.

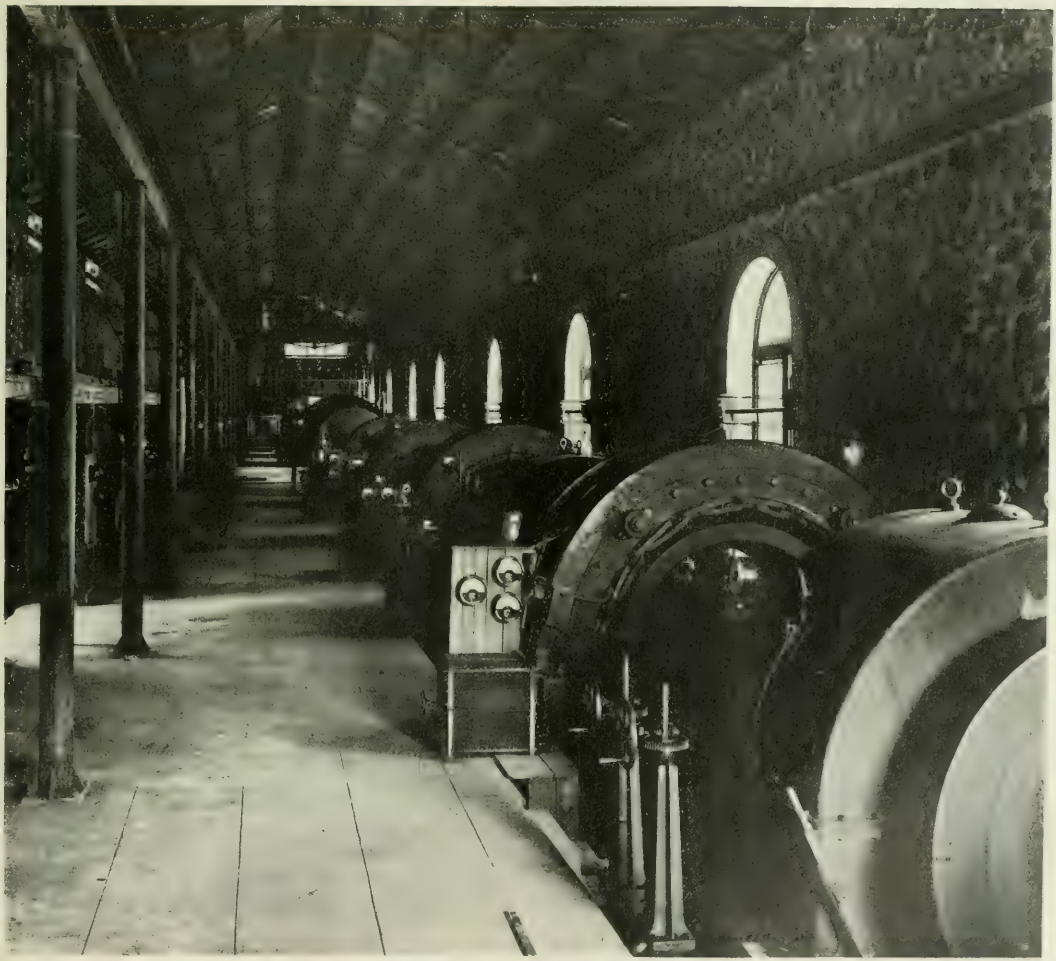


Fig. 4.—Interior of Colgate Power House.

COLGATE PLANT, BAY COUNTIES POWER COMPANY

plants in that State, great care must be taken even at a 700-ft. head. This is well illustrated by the streams issuing from the nozzles in Fig.

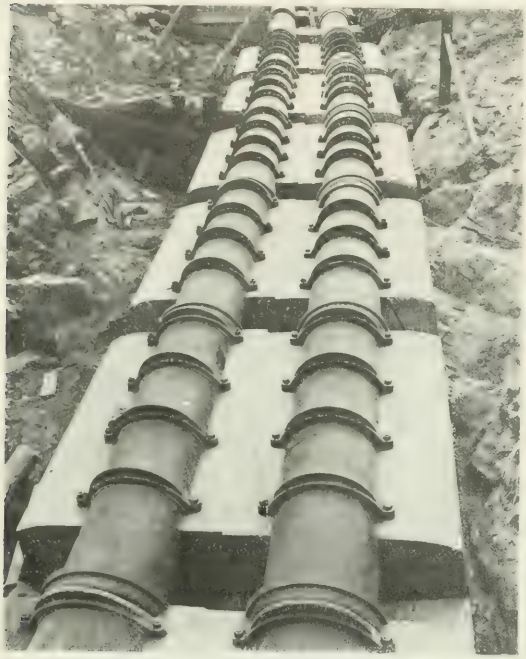


FIG. 5.—30 INCH CAST IRON PIPE AND ANCHORAGE.

2, which are sufficient to throw water clear across the river. Fittings of waterwheels around such heads as this are likely to wear out rapidly, especially if the water has dirt or grit in it, and leaks are

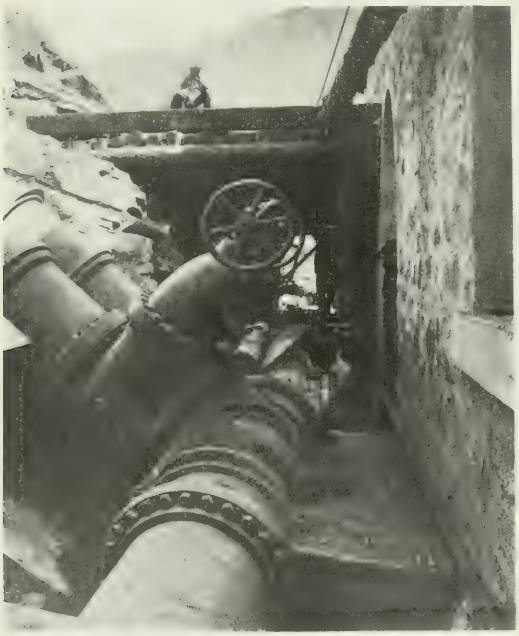


FIG. 6.—RECEIVER AND GATE VALVES.

very much the effect of drills on any surface they strike against. The only thing that can be done in a hydraulic plant of high head is to so design the parts against which the water will strike that they will be least injured by the stream, and provide for their frequent renewal.

The penstock at the head of the pipe line is shown in Fig. 8. Each

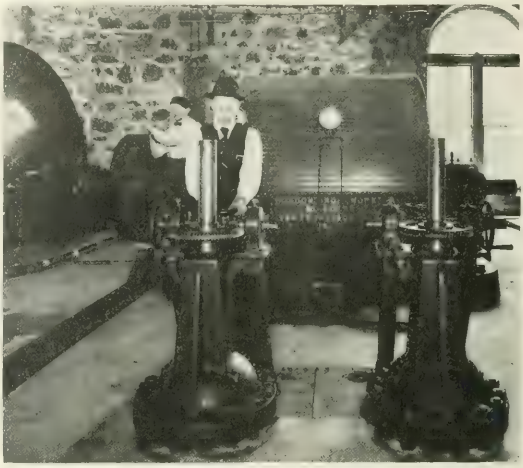


FIG. 7.—3000-HP WATERWHEEL.

of the five pipes has an air vent at this point. At the foot of the pipe line each pipe enters the receiver at the power house through gate valves. Fig. 3 shows two miles of the flume.

The method of driving exciters adopted in this power house is of more than usual interest and is the idea of T. E. Theberath, superintendent of the Yuba Division. Exciters driven from the main generators are open to the objection that any drop in speed of the main generators causes the exciters to drop in voltage, and this in turn lowers the voltage delivered by the generator exactly at the time when, if anything, increased voltage is needed. On the other hand, when the exciters are driven by independent waterwheels, as is usually done, there is some liability that the small nozzles employed on the small waterwheels driving the exciters will be clogged. That is, there is more danger of this than with the larger waterwheels driving the main generators.

In the Colgate power house the following method is used: A 50-hp exciter is driven by a 50-hp impulse wheel. Coupled directly to the other end of the waterwheel shaft is a 50-hp induction motor. This motor is connected directly to the 2400-volt bus-bars of the station. The waterwheel of the exciter is run with its valve open as for full load at all times. When less than full load is on the exciter the induction motor acts as a generator delivering energy to the main bus-bars. If the water supply for any reason is interrupted on the exciter waterwheel, the induction motor drives the exciter as if noth-

FIG. 8.—PENSTOCK AND FOREBAY.

ing had happened. In fact, this very thing has occurred. This is a novel solution of the problem of driving exciters in waterwheel plants, and one which is likely to be followed elsewhere.

A Note on Loaded Conductors.

By M. I. Pupin, Ph.D.

In my publications on wave propagation over non-uniform conductors it was shown that such conductors act approximately like their corresponding uniform conductors when the number of loads per wave length is sufficiently large. Sixteen loads per wave length was shown to be so close an approximation that experimentally no difference could be detected between the non-uniform conductor and its corresponding uniform conductor. It was also shown, experimentally, that with a small number of, say, four loads per wave length the resemblance between the two is small, and the efficiency of transmission over the non-uniform conductor is very much diminished in spite of the increased inductance. In other words, when the number of loads per wave length is small

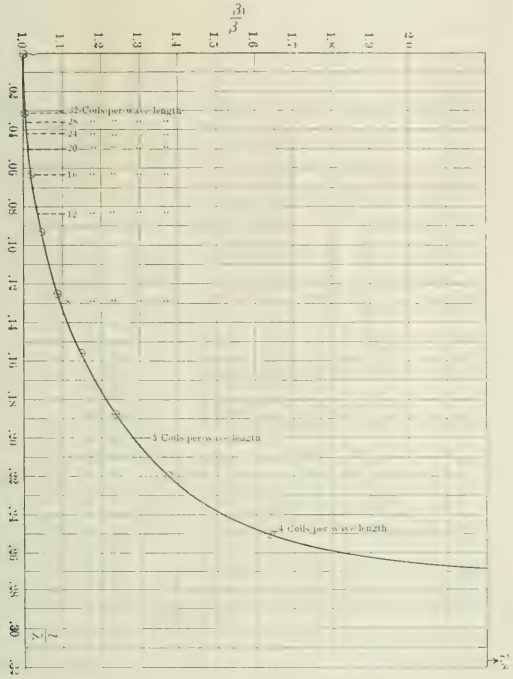


FIG. 1

the loaded conductor becomes an inefficient transmitter and, therefore, the loading is poor.

It is proposed to show in this note, numerically, the action of a poorly loaded conductor by comparing, numerically, its propagation constants to those of the corresponding uniform conductor. Numerical calculation can be readily made by formulæ deduced in my two papers referred to below. The two types of loaded conductors will be considered separately. The first type was discussed in Section II. of my paper on "Propagation of Long Electrical Waves," *Transactions* of the American Institute of Electrical Engineers, Vol. XV. (March 22, 1899). The second type will be found in a paper read by me before the American Mathematical Society, Dec. 28, 1899, and published in the *Transactions* of that society, Vol. 1, No. 3. The behavior of these two types of conductors will be found to be the same under all conditions which can arise in ordinary practice.

A. LOADED CONDUCTOR OF THE FIRST TYPE.

In this case wave propagation is expressed in terms of a complex angle $\theta = \frac{1}{2}(\alpha_1 + i\beta_1)$ which is defined by the following equation:

$$h = 4 \sin^2 \theta \text{ *} \qquad (1)$$

which can be also written

$$\sin \theta = \sin \frac{1}{2}(\alpha_1 + i\beta_1) = \frac{1}{2}(\alpha + i\beta) \text{ **} \qquad (2)$$

This equation determines completely the propagation constants α_1 and β_1 of the loaded conductor in terms of the propagation constants α and β of the corresponding uniform conductor.

For numerical calculations the real and the imaginary parts can be easily separated, thus

$$\left.\begin{aligned} \cos h\frac{\beta_1}{2} \sin\frac{\alpha_1}{2} &= \frac{\alpha}{2} \\ \sin h\frac{\beta_1}{2} \cos\frac{\alpha_1}{2} &= \frac{\beta}{2} \end{aligned}\right\} \qquad (3)$$

or what is the same thing

$$\left.\begin{aligned} \cos\frac{\alpha_1}{2} &= \frac{1}{2}\sqrt{\frac{1}{2}\left\{1 + [4 - (\alpha^2 - \beta^2)]^2 + 16\beta^2 + (4 - (\alpha^2 - \beta^2))\right\}} \\ \sin h\frac{\beta_1}{2} &= \frac{1}{2}\sqrt{\frac{1}{2}\left\{1 - [4 - (\alpha^2 - \beta^2)]^2 + 16\beta^2 + (4 - (\alpha^2 - \beta^2))\right\}} \end{aligned}\right\} \qquad (4)$$

B. LOADED CONDUCTOR OF THE SECOND TYPE.

In this case wave propagation is expressed in terms of a complex angle $\psi_s = \frac{1}{2}(\alpha_1 - i\beta_1)$ which is defined by the following equation:

$$\sin \psi_s = \sin \frac{1}{2}(\alpha_1 - i\beta_1) = \frac{1}{2}\sqrt{\alpha_1^2 + i\beta_1^2} \qquad (5)$$

that is, provided the distance between the loads is sufficiently small in comparison with the wave length on the conductor before it is loaded. This provision imposes no serious limitation since this wave length is five to ten times longer than the wave length on the corresponding uniform conductor. Equations (5) and (2) are identical, so that the second type of loaded conductor does not differ from the first.

In preparing the numerical tables from which the curves in Fig. 1

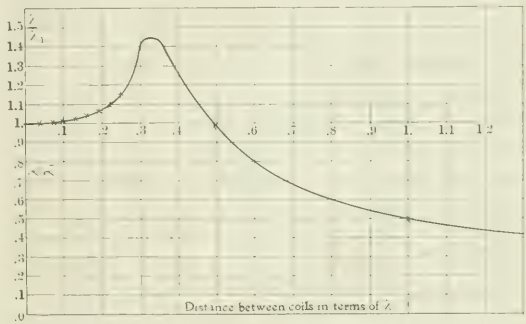


FIG. 2.

and Fig. 2 were plotted much labor is saved by considering separately the values of $\cos\frac{\alpha_1}{2}$ and $\sin h\frac{\beta_1}{2}$ in the following three intervals:

First interval: The quantity $4 - (\alpha^2 + \beta^2)$ is considerably greater than zero.

Since β^2 is very small in comparison with unity equations (4) reduce to

$$\left.\begin{aligned} \cos\frac{\alpha_1}{2} &= \sqrt{1 - \left(\frac{\alpha}{2}\right)^2} \\ \sin h\frac{\beta_1}{2} &= \frac{\frac{\beta}{2}}{\sqrt{1 - \left(\frac{\alpha}{2}\right)^2}} \end{aligned}\right\} \qquad (6)$$

Second interval: The quantity $4 - (\alpha^2 + \beta^2) = 0$ very nearly. Equations (4) reduce to

$$\cos\frac{\alpha_1}{2} = \sqrt{\frac{\beta}{2}}$$

$$\sin h\frac{\beta_1}{2} = \sqrt{\frac{\beta}{2}}$$

Third interval: The quantity $4 - (\alpha^2 + \beta^2)$ is considerably smaller than zero.

* Propagation of Long Electrical Waves; *Transactions* of the American Institute of Electrical Engineers, Vol. xv, p. 144.

**Same paper, p. 151.

[1]M. I. Pupin, Wave Propagation Over Non-Uniform Electrical Conductors, *Transactions* of the American Mathematical Society, Vol. I, No. 3, p. 276.

Equations (4) reduce to

$$\cos \frac{\alpha_1}{2} = \frac{1}{\sqrt{\left(\frac{\pi}{2}\right)^2 + 1}} \quad (18)$$

$$\sin \frac{\alpha_1}{2} = \frac{\frac{\pi}{2}}{\sqrt{\left(\frac{\pi}{2}\right)^2 + 1}}$$

A brief explanation of the symbols is desirable. Let l be the distance between the loads on the loaded conductor of the second type. It will be the length of the corresponding uniform conductor which is equivalent to one coil of the loaded conductor of the first type.

Let λ be the wave length on the corresponding uniform conductor.

Let λ_1 be the wave length on the non-uniform conductor.

Then $\alpha = \frac{2\pi l}{\lambda}$ angular distance on the corresponding uniform conductor,

$$\alpha_1 = \frac{2\pi l}{\lambda_1} = \text{angular distance on the non-uniform conductor.}$$

$$\beta^1 = \frac{l}{\lambda}$$

$$\beta_1^1 = \frac{l}{\lambda_1}$$

where β^1 and β_1^1 are the attenuation constants on the non-uniform and its corresponding uniform conductor, respectively.

In the following table the ratios of the wave lengths $\frac{\lambda}{\lambda_1}$ and of the attenuation constants $\frac{\beta_1^1}{\beta^1}$ of the loaded conductor and the corresponding uniform conductor are given for various distances between the loads, these distances being measured in terms of the wave

TABLE.

$\frac{l}{\lambda}$	$\frac{\lambda}{\lambda_1}$	$\frac{\beta_1^1}{\beta^1}$
.0313	1.001	1.005
.0626	1.009	1.02
.094	1.015	1.047
.125	1.029	1.088
.1565	1.045	1.15
.1788	1.071	1.24
.22	1.093	1.38
.25	1.15	1.64
.318	1.443	7.8
.5	1.086	40
1.0	5	34.5

length on the corresponding uniform conductor. The column headed by $\frac{l}{\lambda}$ contains these distances. The curves in Fig. 1 and Fig. 2 were plotted from the above table.

These curves were calculated for the conductor described in my paper read before the American Institute of Electrical Engineers May 18, 1900. For this conductor

$$\beta_1^1 = .0141$$

It is evident that up to about four coils per wave length they will hold true for any loaded conductor that may occur in practice.

Observe the rapid increase in the attenuation constant of the loaded conductor as soon as the number of coils per wave length becomes less than six. It is dangerously high at four coils per wave length and may be anything if that number is between 4 and π.

Observe also that the wave lengths of the loaded conductor is a definite quantity only as long as the conductor is properly loaded. On a poorly loaded conductor the wave length may be either smaller or greater than the wave length on the corresponding uniform conductor.

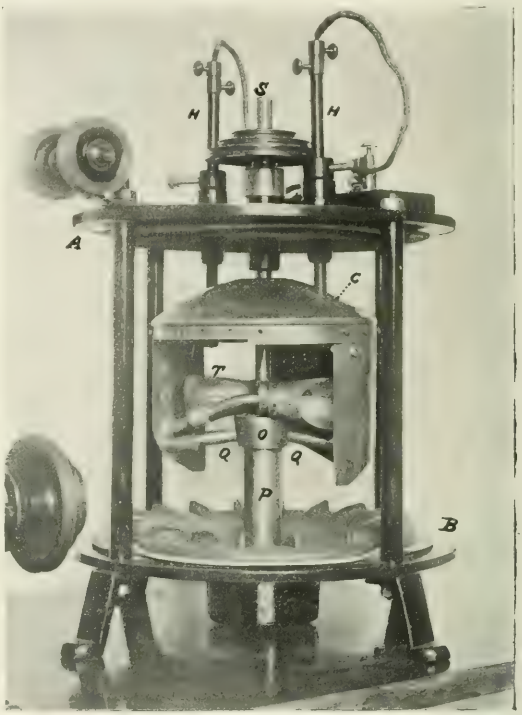
Electric Fans in Mines.

Owing to the successful use of electric fans in the lower levels of the Comstock mines, Virginia City, Nev., cross cutting can soon be resumed in the 2150-ft. level of the Consolidated California & Virginia.

A Simple and Efficient Mercury Jet Interrupter for Röntgen Ray Induction Coils.

By R. H. Cunningham, M. D.

As is well known to every one who has had any practical experience in the use of the induction coil for actuating Röntgen ray tubes, an extremely important and often trouble-giving part of the apparatus is the interrupting device required to rythmically make and break the current energizing the primary of the coil, especially when the current is drawn directly from the usual 110 or 220-volt continuous current. Thus, in order to obviate the well-known difficulties, such as flaming, sticking and imperfect interruption, that usually occur when induction coils supplied with the old style vibrating spring contact breaker are energized by currents at the above mentioned voltages, almost numberless interrupting mechanisms have been devised in late years. Of these devices undoubtedly the electrolytic interrupters of Wehnelt and of Caldwell have deservedly attracted most attention during the past three years. But



MERCURY JET INTERRUPTER

even these have their drawbacks, and when they are in action are extremely objectionable to some people, owing to the terrific noise produced and to the evil smelling, irritating fumes which are generated. Furthermore, these electrolytic devices require careful adjustment before they will begin to work, and even under the best conditions irregularities in their action frequently occur. Sometimes also, just in the midst of Röntgen ray exposure they unexpectedly explode, possibly causing a large, expensive photographic plate, and still more valuable carpets and furniture, to be spoiled and rendering the outfit useless until the interrupter is repaired. In order, therefore, to obtain a comparatively quick, frequent and regular interruption of the primary circuit unaccompanied by the above-mentioned objectionable features, and without excessive sparking, it occurred to the writer some months ago that the improved and simplified form of mercury jet interrupter described below would probably function almost ideally.

Unlike the well-known German turbine mercury jet interrupter and that of Boas, it contains no fluid non-conductor, such as alcohol or oil, which prolong the arc at the break, rapidly carbonize and con-

taminate the mercury, and are in great danger of catching fire if heavy currents are employed. It has no fixed brushes to convey current to moving parts, and when it is desired to vary the duration of the make without altering the period, thus varying the intensity of the primary current employed, the necessary adjustment can readily be performed from the exterior, which obviates the frequent opening of the apparatus and the constant risk of inhaling at such times more or less deleterious mercury vapor. Like other mercury jet interrupters, the mercury in time becomes contaminated by a certain amount of oxide and metallic mercury in the form of very fine dust, and when this dust has accumulated in sufficient quantities after five or six weeks' usage, it may readily be removed and placed in the usual iron mercury still and on distillation yields the original liquid mercury.

The plan and the mode of action of the interrupter can be understood readily from the accompanying illustration, in which the interior of the apparatus is shown after the removal of the containing cylinder and one leaf electrode.

Referring to the figure, *B* is a round, hat-shaped iron bottom, which is flanged on the upper surface near the periphery and rests upon legs by which the apparatus can be firmly screwed to a base board or a conveniently located shelf. *A* is an iron top, which rests upon the shoulders of four upright steel pillars, which are firmly bolted to the upper surfaced rim of the bottom. Centrally, the top bears a perforated boss for the shaft *S*, and laterally, two smaller bosses with hard-rubber bushings through which pass the vertically adjustible hangers or leads *H, H*, also covered with hard rubber, by means of which current is led to the even number of V-shaped steel leaves suspended vertically from the circumference of the conical disk of fibre *C*, which is perforated centrally for the free passage of the shaft *S*. The mechanism for lifting the mercury from the well and projecting it in a continuous stream against the oppositely hanging leaves or electrodes, which are of unlike polarity, consists of the shaft *S*, bearing at its lower part the Archimedean screw *P* with the hollow hub *O* and the two discharge pipes *Q, Q*. The discharging orifices of these pipes are tipped with lava, which is held in place by long, fibre screw collars. In the well of the base a number of radial vertical leaves, which just clear the revolving tube of the Archimedean screw, are placed in order to prevent rotation of the mercury when the screw is revolved. In order to render the break extremely quick the air-blast created by two trumped shaped pipes *T, T*, attached by a removable collar to a shoulder on the hub, is directed just posteriorly to the jets of mercury. As a container, a glass, an iron, or a fibre cylinder with gaskets at the top and bottom and provided with mica covered apertures is used.

The action of the apparatus is as follows: The heavy rimmed pulley, or sprocket wheel, on the pump shaft being attached by a belt, by a chain, or directly to the shaft of a suitably located electric motor, or to another source of power, if the shaft is rotated at a sufficient speed a continuous jet of mercury issues from each lava tipped delivery pipe. Hence, if oppositely located leaves are connected to the hangers *H, H*, of unlike polarity, while the jets are impinging upon such leaves, the current finds a ready path along the mercury. As the streams of mercury separate from the straight, vertical, posterior edges of the leaves the circuit is broken and any more or less conductive incandescent mercury vapor which might prolong the arc is dissipated both by the blast from the blowers and by the air currents generated within the apparatus. Further, it appears in practice that owing to the centrifugal force, and probably to a sufficient lack of cohesion of the mercury streams issuing from the jets, just as the posterior edges of the leaves are reached by the streams, the latter seem to glide off with great suddenness and immediately break into innumerable small blogules, a circumstance that seems further still to favor the quickness of the break, and to diminish the liability to arcing. As the anterior lower corners of the leaves are cut off, elevating or lowering the hangers, furnishes a ready means of controlling the duration of the make without a variation of the period. Further, the period can be varied within considerable limits by merely varying the speed of rotation of the shaft *S*, or the number of leaves can be varied after removing the nuts which keep the top in place upon the pillars and lifting the pump and coned fibre disk out of the containing cylinder.

With this interrupter and an adjustible condenser many varieties of discharge can be obtained from the secondary terminals of an induction coil, and one of the varieties appears practically similar to that produced by the Wehnelt electrolytic break, but is far steadier and subject to no sudden stoppages. As with the latter interrupter the coil should be most carefully made and the layers of the primary very carefully insulated from each other by some high-grade insulator such as micanite, as otherwise the coil will invariably break down.

When a Röntgen ray tube is connected across the coil with properly adjusted air-gaps in series with the tube circuit, if the shaft of the interrupter is rotated at from 1000 to 2000 r. p. m., a fluorescent screen placed in the path of the rays from the tube, fluorescesses with such perfect steadiness that fluoroscopic examinations become a pleasure instead of a fatiguing and more or less uncertain procedure. As an interrupter for actuating high-frequency coils of the Tesla or Kinraide types upon the continuous 115-volt current, the apparatus is exceedingly satisfactory and will also allow comparatively heavy currents to be employed.

If a suitable synchronous motor is employed to rotate the jets at a uniform rate of speed the apparatus may be employed to interrupt every similarly directed half-wave of an alternating current at any desired point, and thus to produce effects when actuating an induction coil that are practically similar to those produced by using the continuous current. Storage batteries also may readily be charged from an alternating current with the interrupter when it is actuated in the above manner with a suitable synchronous motor.

For actuating small step-down transformers such as are used by physicians for energizing their electro-cauteries where only the 110-volt continuous current is available the apparatus with a condenser of suitable capacity is highly efficient.

Before concluding this description, I shall call attention to one more very excellent feature of an interrupter of this nature, namely, the automatic manner in which it prevents the occurrence of an undue rise of current through the primary when the motive power fails or the belt breaks. If such an event happens while the apparatus is in full action the streams of mercury diminish with great rapidity as the revolving shaft quickly comes to a standstill, so that the resistance across the interrupter almost immediately becomes infinite. Similarly, the interrupter may be started with the current fully turned on and as its speed increases the resistance across it gradually falls from infinity practically to zero.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour—III.

By Walter Reichel.

(Chief Engineer Siemens & Halske Company.)

RESISTANCE COILS AND RHEOSTAT CONTROLLER.

In order to bring the car motor up to full speed soon after starting, resistance is introduced into the secondary circuit which is gradually cutout until the secondary circuit is short circuited. The motor furnishes 750 horse-power at starting, and only 250 horse-power when running at full speed, a difference of 500 horse-power.

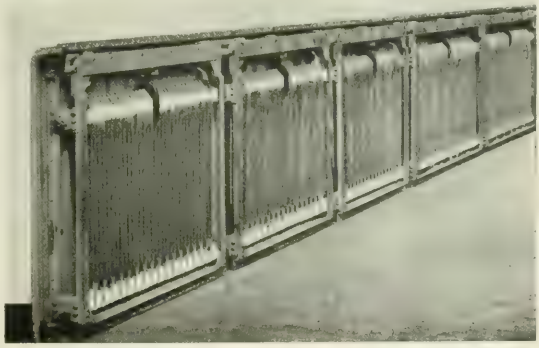


FIG. 10.—CONTROLLER RESISTANCE BOXES.

The coils must be so cut out that no serious sparking is produced. For this reason 29 steps have been selected, four primarily to cut in the motor and the other 25 for the gradual variation of the speed of

the motor. Each step therefore cuts out 20 horse-power, which is permissible in the light of past experience.

It is essential, in order to reduce the length of the connecting wires, to locate the coils and the controller as near to each other as possible, and the coils must be so constructed that the cooling areas are reasonably large and the weight kept down. The room beneath the car floor is well taken up by transformers and switches, although the length of this space is 22 meters (72.16 ft.), and it was necessary to locate the coils within the interior of the car, along the sides of the car body. For each motor and each phase a small and a large box were built, there thus being for each motor three large and three small boxes. The latter contain the four starting coils and the larger boxes the other 25 coils. The small boxes are 1140 mm. (3.74 ft.) and the large boxes 1560 mm. (5.12 ft.) in length. The height of the boxes is 1220 mm. (4 ft.) and the width 150 mm. (5.8 inches). The boxes are constructed of angle iron, and are bolted to the top and bottom girders of the car body. They are covered by sheet iron plates which are built shutter-like so as to serve as ventilators. From the top emerge the leads connecting the various boxes, while the leads to the controller emerge from the bottom. Fig. 16 illustrates a number of coils. The latter are constructed of ribbons of "Kruppine" 45 by 2 mm. (1.75 by .078 inch) in cross section supported on porcelain knobs. The lower knobs are not firmly attached, so that when the ribbons are heated they may extend along their length. The protecting plates and each individual box may be removed from the car with ease.

For each phase of each motor there has been provided a controller cylinder, three for each motor and six on each side of the car. The cylinders also lie in the direction of length of the car and are located directly beneath the large boxes, as shown in Fig. 17. The bronze contact pieces are removable, and the contact springs are mounted on two parallel steel tubes, which are supported by cast steel hangers. So as to avoid the necessity of 25 regulating contacts for each phase, the well-known a, b, c connection has been adopted, in which the coils are cut out successively first in phase 1, then phase 2 and then phase 3.

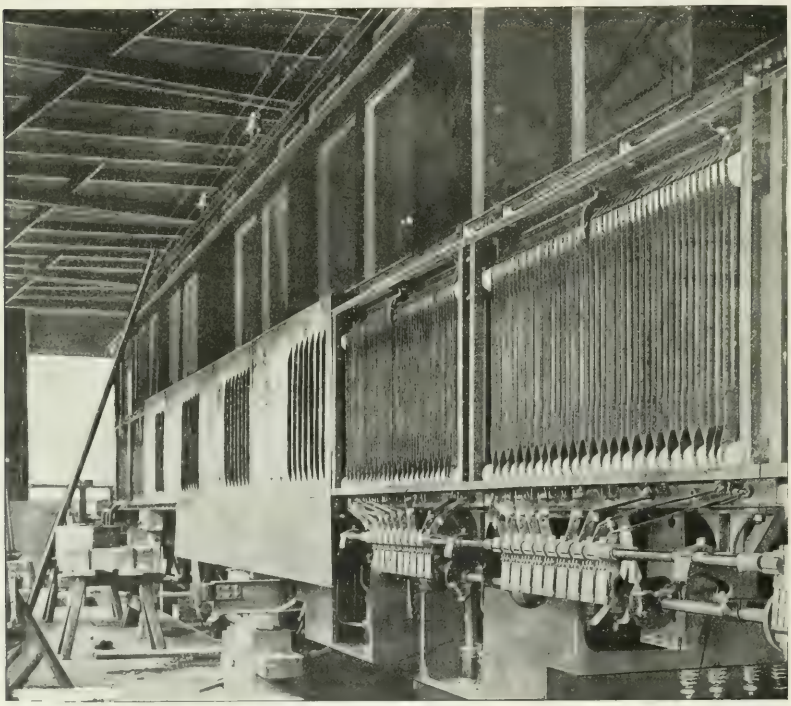


FIG. 17.—RHEOSTATS AND RHEOSTAT CONTROLLERS.

The controllers are so arranged that on the first contact the four motors are not all cut in together, but one after the other, so that the entire load is not thrown on the station suddenly and a saving of resistance material is effected. The controller cylinders are operated by means of a steel shaft, which runs under the floor from end to end of the car, and which is connected to the four controller shafts by four heavy chains having a strength of 2500 kg. (5500 lbs.), and four chain wheels. There are two ratchet wheels on the shaft for the setting of the contacts, and the shaft is operated from each platform by a set of bevel gears.

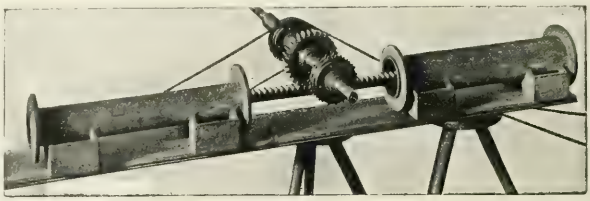


FIG. 18. COMPRESSED AIR CYLINDERS AND REAR FOR OPERATING CONTROLLER.

In order not to tax the strength of the motorman too much, there is situated at the center of the car, at right angles to its greatest dimension, a compressed air device. This consists of two air cylinders working in opposite directions, one having a greater diameter than the other. The smaller one is always under pressure while the larger one is only connected with the air tank when the car is started. As shown in Fig. 18, the pistons of the cylinders are connected by a rack which meshes into a pinion mounted on the main shaft. When the device is set in operation, the larger cylinder works against the smaller one and assists the operator in the control. When the device is cut out, the air escapes from the larger cylinder and the smaller one works alone and automatically brings the controller back to the zero position. The power exerted by the larger cylinder can be regulated, and is so chosen that the operator can stop on any desired contact. In this way the starting of the motor and the regulation of the speed are entirely under his control.

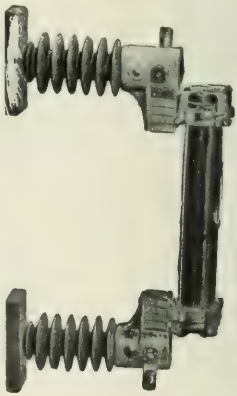


FIG. 21. MOUNTED MOTOR FUSE.

MEAN PRESSURE SWITCHES AND FUSES.

Each motor is supplied with current from transformers after it has passed through three mean pressure safety fuses (one for each phase) and a mean pressure switch. This is thought advisable for the reason

that the sparking depends upon the amount of current, which is thus cut into four parts, and because any motor which has become inoperative can be cut out of circuit by its own switch. The mean pressure switch is built according to a patent which describes means for drawing the arc in a narrow insulating tube, the arc being extinguished by the aid of a cooling ring of metal. In each phase there is a double break 140 mm. (5.4 inches); there are in all, therefore, six contacts, which are set in a circle. As the switch is operated from the platform by means of compressed air, a starting cylinder is necessary, which is situated in the center of the above mentioned circle (Fig. 19). There is one main contact piece which establishes the current and an auxiliary contact for drawing the arc. The latter only breaks after the main contact has been partly opened. Part of the contacts are stationary, and others movable on what might be called a bridge, which is raised or lowered by the piston of the cylinder. The connection between bridge and piston is, however, not a rigid one, but when the contact is closed the bridge is raised by the piston and is held in that position by a snatch hook. In opening the circuit, the piston first returns alone and only releases the snatch-hook at the end of its travel. This is for the purpose of preventing a slow break of the contacts in case the piston is released slowly by insufficient air pressure.

By this method the contacts are suddenly opened after the piston has nearly returned to its position. The several contacts, cooling rings and extinguishing tube are made of heavy material and can be easily removed. As in the case of the switches for the motors, those for the transformers are built for delta and star connections. For each transformer one switch serves for the star connection, and the other for the delta connection. Each unit of the electrical equipment will thus have four mean pressure switches, which are all placed in a strong box supported beneath the car floor, as shown in Fig. 20. The contacts are insulated from each other and from the frame by hard rubber rings, and are calculated for a pressure of 6000 volts.

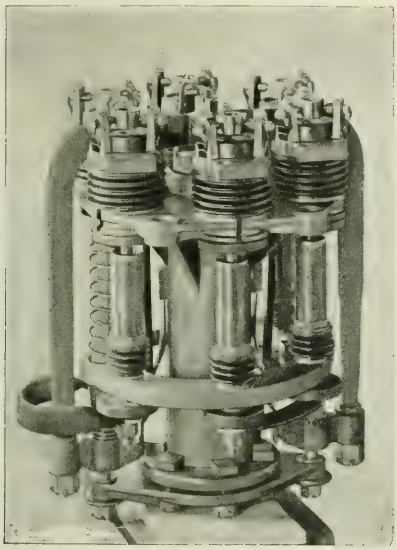


FIG. 19.—MOTOR SWITCH.

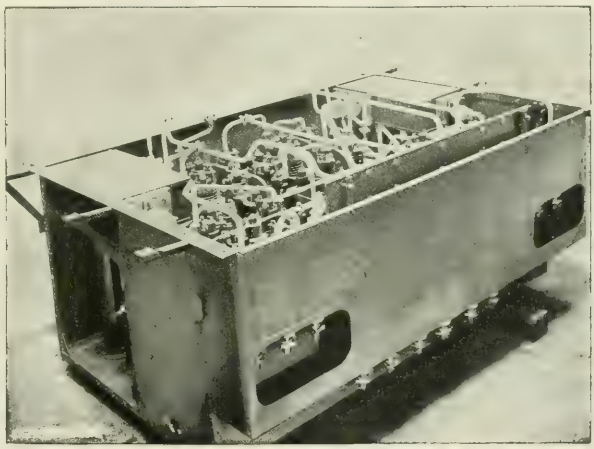


FIG. 20.—MEAN-PRESSURE APPARATUS.

The various switches are connected together by heavy, round copper bars, wound with tape, and the leads to the transformers and motors consist of insulated flexible copper cables. The binding posts are placed on porcelain insulators on the outside of the box and can be opened from the outside. The heavy rubber tubes which convey the air from the iron pipes to the switches can also be detached from the outside. The box can, therefore, be taken from the car as a unit after the electrical and air connections have been detached.

The box is built of sheet and angle iron and on the latter all the switches are suspended, being, of course, insulated therefrom. The box also contains the 550-ampere motor fuses, which are accessible through small openings at the side, as shown in Fig. 20. They are the well-known enclosed fuses, in which a number of strips are fused within narrow tubes. The high-tension vapors which are formed extinguish the arcs through the explosive effects which are produced. The fuses are supported vertically, as shown in Fig. 21, and they are taken out in a direction parallel to their longest axis. The fixed contact pieces are mounted on hard rubber posts and the two removable contacts are connected by a heavy glass tube, in which the ignition tubes are located. The vapors which are produced by the melting of the zinc strips escape through sieve-like openings in the box into pipes which lead into the atmosphere. There is furthermore in this box a small current transformer, used for measuring purposes in connection with an ammeter.

Disintegration of Wood Fibre by Alternating Currents.

A recent proposal, emanating from M. Berget, of Paris, relates to the use of alternating currents for the purpose of inducing fermentation in the agglutinants of wood fibre, thereby freeing the latter and preparing it for the manufacture of paper pulp. The materials, of which nettle stems are mentioned as a suitable example, are crushed and permitted to disintegrate in lime-water for a number of days. After draining they are stacked upon a horizontal wire cloth electrode to a height not exceeding one meter, covered by another electrode of like form and material and subjected during some hours to an alternating current of volume sufficient to maintain the temperature of the stack at 50 to 55 degs. C. Five to six amperes are required for each 100 kilos of material treated, the potential difference between the electrodes being about 40 volts. Under these conditions it is said that fermentation proceeds rapidly and continues for some days after the interruption of the current, the mass being thus prepared for the usual operations of lixiviation, bleaching, etc.

After the many assertions which have been made heretofore regarding the sterilizing power of low-potential alternating currents, it is somewhat disconcerting to find the very same means proposed for the purpose of initiating and promoting fermentation, as in the foregoing method, and in certain others, relating to the manufacture of beer, which have preceded it. The probable explanation is that under these circumstances the current itself has no proper germicidal action, but merely a secondary effect which depends upon the nature of the electrodes, upon the character of the decomposition products liberated, and upon the rise in temperature due to its passage. If so, it is evident that the growth of bacteria may be either favored or checked, or that their vitality may be destroyed, according to their specific characteristics and the conditions of the treatment. For instance, it is likely that the aerobic and anaerobic bacteria would react distinctively to the electrolytic products, and that in the case of the direct current the polarity, with its accompanying oxidizing or reducing conditions, would control the result; in fact, the entire question passes into the proper domain of the biologist.

Submarine Cables and Gutta Percha.

Botanists in France are now engaged upon the problem of acclimatizing the *Isonandra gutta,* the tree which produces gutta-percha. It seems that no other product known at present replaces the gutta-percha found in the forests of the Malay Peninsula and in certain districts in Malacca. Inferior qualities have not the requisite durability for submarine cables. The plantations in the above-mentioned districts have been so ruinously exploited by the natives that it is feared there will be a shortage in the course of 15 years, unless means are taken to protect the forests or to propagate the plants elsewhere.

The following figures will give some idea of the rapid increase in the export of the gum: In 1845, Europe imported only 9000 kilograms (19,841 lbs.) of gutta-percha; in 1857, when the Singapore supply was exhausted, the Malay Archipelago exported more than 240,000 kilograms (529,104 lbs.); in 1879, Sumatran exportations exceeded 135,000 kilograms (299,621 lbs.), and Borneo exported 1,300,000 kilograms (2,863,900 lbs.). In order to attain these figures, it is estimated that the natives must have sacrificed more than 5,000,000 trees.

Expeditions sent out by France, England, and Holland to discover the botanical origin of the precious gum, and to increase its production, have reached the same conclusion. As it is almost impossible to find a full-grown gutta-percha-producing tree, the situation will be extremely grave if urgent measures are not taken. The British Government has posted placards for the protection of the trees, with no effect. Holland has planted trees, but in insufficient number and of inferior species. Productive species have, however, been found in the Malay forests extending between the rivers of Pahang, Patani and Perat. They have been transplanted into Reunion and Madagascar, and if they thrive there will be less danger of a dearth in the supply of gum required for submarine cables.

Growth of Export Trade.

The growth in exports during the period since 1896, in which the increase in exports has been more than 50 per cent compared with an increase of less than 15 per cent in imports, has, as is well known, included all great classes of products and manufactures. Agricultural products now form 63.7 per cent of the total exports, and in 1896 they formed 63.9 per cent. Manufactures now form 29 per cent of the total exports, and in 1896 they formed 28.3 per cent. During the last year, however, the exports of manufactures have not kept pace with those of other industries. In the eight months ending with July, 1901, the latest month in which the details are accessible, exports of manufactures fell $32,000,000 below those of the corresponding months of last year, while exports of agricultural products were $57,000,000 greater than those of the corresponding months of last year. This reduction in exports of manufactures is about equally divided between copper and iron and steel, the reduction in copper exports being about $16,000,000 and in iron and steel about $16,000,000. The reduction in copper exports is chiefly due to the decreased demand for copper in other parts of the world for use in electrical and other industries. In exports of iron and steel the reduction is apparently due somewhat to the partial suspension of manufacturing activities in certain lines in the past few weeks, partially to the reduced demand abroad, partially to the reduction in prices of the articles exported, and in large part to the fact that the exports of Hawaii and Porto Rico which were included in last year's statistics, are not included in the figures for the present year, the total exports of iron and steel of those two islands in the fiscal year 1900 having been about $7,000,000.

The Telephone Outlook in Siam.

Mr. Hamilton King, the United States Consul General, writes as follows from Bangkok, Siam, under date of Aug. 1: Bangkok enjoys the advantages of an electric light plant and of an electric tram line 6 miles long, and is now laying a second line of equal length. These are all private enterprises. The service of the two plants already in operation is fairly good, and, together with the introduction of the new tram line, they mark a decided advance in the development of the city.

The telephone system of Bangkok is decidedly bad. It is owned by the Government, and forms part of the postal telegraph department. There are some 200 instruments of the Keiser-Schmidt, Berlin, make in the city at present, and to any one who has ever attempted to use one of these, it is evident that even this limited number stands as a monument to the patience and good nature of the citizens. Better results are produced every day by the American boy with his tow string and the resonant bottom of a tin can.

Yet this is a city of magnificent distances, and, taking into consideration the manner in which the palace and its surrounding public buildings are separated from the legations and consulates, the distance of the walled city from the residences of most of the foreigners, of the large foreign firms one from the other, of the old palace group from the new palace in its beautiful park, and the entire division of the old city from the new by the river, which is crossed by no bridges, few cities are better fitted to appreciate a first-class telephone system. The Siamese are a people who know a good thing when they see it, and they, together with the long-suffering members of the foreign community, would generously patronize a good telephone system, were it at once established. There should be at least 1000 instruments in use in the city, in place of 200, and this number without question would be largely increased as the fact was borne in upon the public that a telephone was invented to save time and for convenience.

There would seem to be an opening for the introduction of an improved system in Bangkok, and with the present condition of affairs, a few first-class instruments in some of the public buildings might soon work a change in the entire city.

The Influence of Polyphase Apparatus on the Design of Railway Power Stations—II.

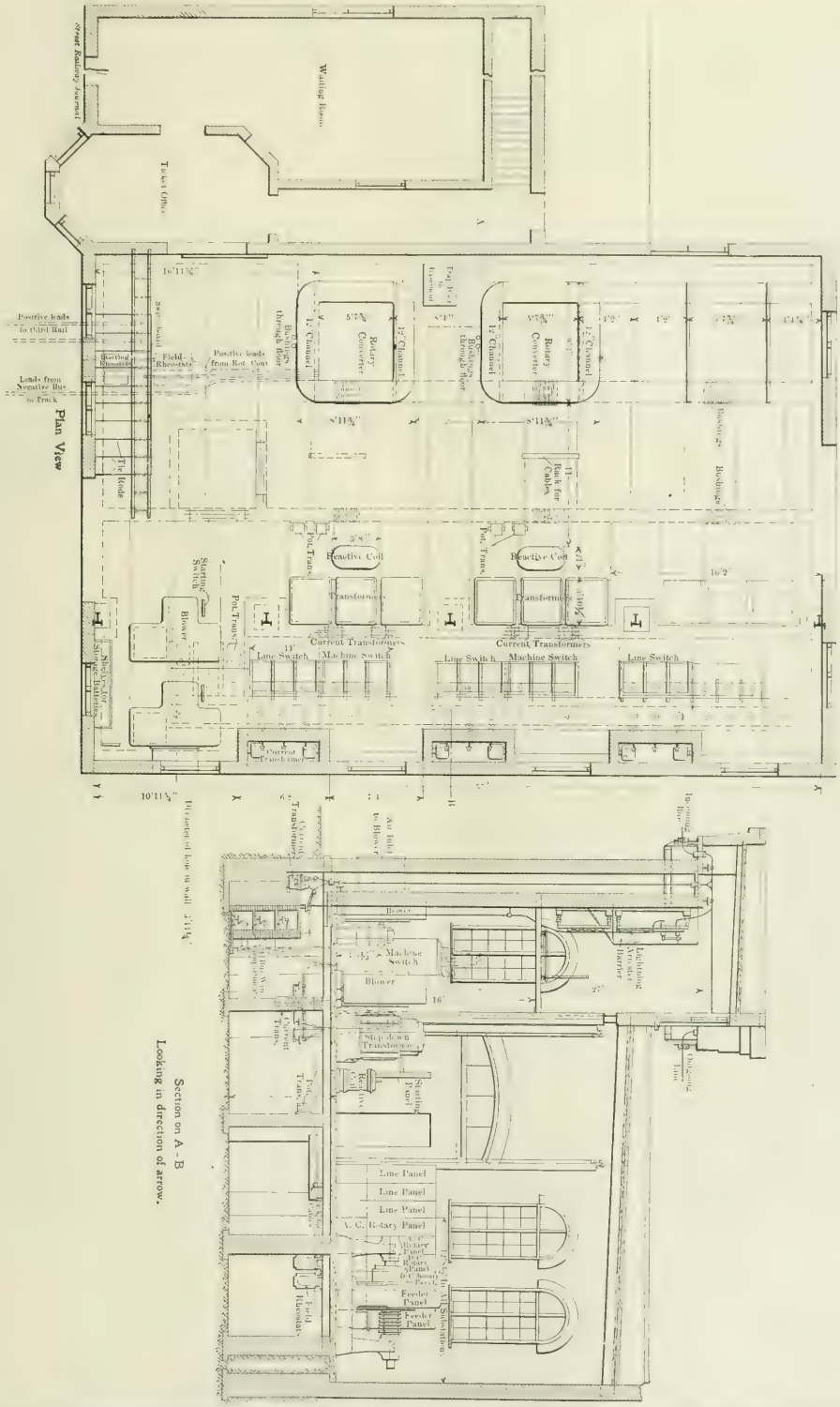
By J. E. Woodbridge

LARGE POWERS AND HIGH VOLTAGES.

On systems of extra high voltage, 20,000 volts or over, or of comparatively great contemplated generating capacity, 5000 kilowatts or over, or both, the oil switches are usually made of a type and size that precludes hand operation and necessitates some auxiliary power, preferably electric motors. The abolition of the mechanical connection between the switchboard and the oil switches allows the latter to be placed at any convenient points in the station, regardless of the location of the switchboard panels proper. This change has a great influence on the best arrangement of apparatus in the station.

Figs. 10 and 11 show the arrangement of the apparatus in a sub-station containing two 500-kw six-phase converters with air-blast transformers supplied at a pressure of 26,000 volts from a generating station which will eventually be so large as to necessitate the type of switch here shown in order that any one of the switches may break any possible short circuits with full station generating capacity connected.

In this particular station there are three high-tension lines, two incoming from the generating station via different routes forming a ring system, and one outgoing to another sub-station which is fed from the ring at this point. The oil switches of the type here shown are wired from below, on which account all high-tension leads, bus-bars, etc., are located in the basement below the oil switches, which are mounted on the ground floor. The high-tension leads from the transformers are also brought out from the transformer casings through the openings in the bases, thus keeping practically all high-tension wiring in the basement. What little must be run above the basement to reach the overhead lines is carried up in flues built into the wall. The wiring in the basement is entirely enclosed in the blast chamber. Since all high-tension wiring is thus shut away from any unintentional interference, it may be and is entirely uninsulated, no rubber covering being used whatever on the sub-station high-tension wiring. The life of rubber insulation unprotected by lead is somewhat doubtful at this high voltage, and lead-covered cable is highly objectionable at this voltage for station wiring owing to the possibility of breakdown at any point in case of any extra high potential disturbances. Bare wire, with nothing but air and porcelain insulation is thus a happy solution of the problem. All bus-wires and high-potential leads are in this case supported on ordinary pole line porcelain insulators of what are known as the "Redlands" type, such insulators being, of course, absolutely reliable in such a dry place as a blast chamber. Brick, tile and concrete slab barriers are used between the leads. The lightning arresters are in this station mounted on the face of the wire flues, a light gallery being used to give ready access to them.



Figs. 10 and 11.—Plan of Sub-Station Containing Two 500-kw Converters with Motor-Driven Oil Switches, and Vertical Section Through the Same.

HIGH-TENSION WIRE INLETS AND OUTLETS.

For this high voltage care must be taken with the insulation of the wires passing through the wall of the building. A heavy rubber covering may be used with the ordinary porcelain tubes, but this insulation is limited by the life of the rubber. A clear opening with indoor anchorages is objectionable on account of the wetting of lightning arresters or other parts at times of heavy driving storms A long creepage distance over high-grade insulation is necessary between each wire and the wall of the building where exposed to the weather. This can readily be obtained with a structure like that shown in this sub-station. Here the wire approaching from the pole line is anchored to a porcelain strain insulator of a type with several eave-shaped corrugations both above and below the fastening of the wire. From this strain insulator the wire passes upward into the building through a porcelain bushing with a corrugated top indoors and a petticoated lower portion outdoors where exposed to the weather. With an insulation of this kind no rubber is necessary. This, of course, calls for an extension of the building in the form of an overhang, not unlike a dovecote in appearance. In this particular sub-station this overhang is supported by steel work in the form of a cantilever.

This sub-station will be combined with a passenger station of the third-rail electric line which it will feed, the ticket office being located within view and easy access of the switchboard, so that one man may tend to both. Attendant's quarters will probably be combined with passenger station and separated from sub-station by fire wall.

The Inductor Alternator—II.

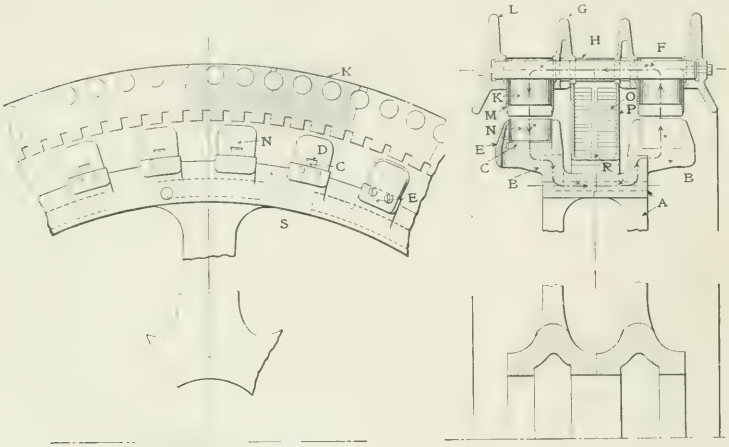
By Edward Heitmann.

MECHANICAL CONSTRUCTION.

THE following will contain a description of the principal mechanical features of a well designed inductor alternator, and at the same time discuss some of the electrical features.

Fig. 2 shows the section of a S. K. C.* alternator. The inductor consists of a cast steel spider and rim *A*, made either in two parts for small generators or in four parts for large machines, these parts being securely and firmly bolted together to form a revolving element of rigid and safe construction. The hub is usually clamped to the shaft and held in place by either one or two keys.

On the face of the rim the lugs *B* are cast, as shown in the figure, for the purpose of holding the laminations *N*, which form the pole pieces. The method of securing these laminations to the lugs can readily be seen. *C* is a key fastened to the lug by a number of screws. The laminations are slipped over the key *C*, the slot *D* (Fig. 2) fitting snugly onto the same, and the whole held in place by the retainer *E* (Figs. 2 and 3).



FIGS. 2 AND 3—SECTIONS OF ALTERNATOR.

The punchings *N* are always shaped so as to cause a distribution of flux across the pole face, such that the induced e. m. f. wave will have the closest possible approximation to a sine curve. This is effected by varying the air-gap gradually from a minimum at the center to a maximum at the outer edges, according to data determined theoretically and verified experimentally.

The entire construction is of a most rigid character; at the same time the fibre strains are taken low so the inductor will stand an increase of speed of 50 per cent with perfect safety. This robust construction, together with the fact that the revolving part contains no wire or other active material liable to injury, permits of the use of high peripheral speeds, which is a distinct advantage in designing electrical machinery in many instances. Surface speeds as high as 10,000 ft. per minute have been used in large high-speed alternators.

The metal at *S* between the pole pieces is entirely cut away. The method of construction can more readily be seen and understood from some of the following cuts of generators. This results in greatly increasing the reluctance of the leakage path, and therefore decreasing the leakage field in proportion. The effect of this field is therefore hardly appreciable, the flux itself never amounting to more than 5 per cent of the main flux. The construction of the armature is in every way as rigid and substantial as that of the inductor.

The steel bars *F* are called magnet bars, and serve the purpose of carrying the magnetic flux. The inside rings *G* are first placed over them and held apart by the pipe washer *H*. The armature punchings *K* are then slipped over the bars and finally held in place by the outside rings *L*. Heavy steel stiffeners *M* are placed at each end of the laminated iron.

It may be noted here that with the exception of the rings *G* and *L*, all the metal is active, that is, is utilized for carrying the flux. This type of alternator therefore requires no additional cast iron or steel structure to carry the armature iron, so with the reduction in the weight of the laminations made possible by the use of high densities, as before explained, the weight of an inductor alternator will not be greatly in excess over the weight of a revolving field type having the same characteristics.

After assembling in the manner described, the coils which make up the armature windings are placed in the slots. The coils are machine wound. They are carefully and thoroughly treated with insulating compounds, wrapped with a special insulating material and baked before they are placed in the machine.

The winding is of the style generally known as a concentrated winding. Owing to the specially shaped pole pieces it becomes unnecessary to distribute the coils in this type of alternator to obtain a sine wave of e. m. f. and all the advantages of a concentrated winding can be fully realized. It permits of the maximum insulation with minimum expenditure of room ensuring perfectly reliable insulation for all voltages. When it is known that for some potentials about 40 per cent of the slot is taken up with insulation, it will readily be seen what an important item this is in the economical design of alternators. It permits of readily removing a coil for repairs without disturbing a large number of other coils. In most machines of this type under discussion the coils can be dropped down between the poles pieces and then drawn out sideways, thus making it possible to remove a coil without disturbing any other part of the machine. Fig. 4 illustrates the method of removing coils very well. Sliding armatures, therefore, are unnecessary.

The claim is often made that owing to the concentrated winding the self-induction of the armature circuit must be extremely high and that, therefore, the regulation of this type of alternator must be very poor on inductive loads. A consideration of the following facts will show that this claim does not hold good. When a current flows through the armature conductors, it sets up a field surrounding these conductors, varying with the current, and thus inducing an e. m. f. in the armature winding known as the e. m. f. of self-induction, or counter e. m. f. The field is directly proportional to the ampere-turns in the slot and inversely proportional to the reluctance of the

* S. K. C. are the initials of the individual inventors of this type of apparatus—Messrs. William Stanley, John F. Kelly and C. C. Chesney.

flux path. The counter e. m. f. is directly proportional to this field and the number of turns. Hence, if the reluctance and current remain constant, the counter e. m. f. will vary as the square of the turns per slot. For this reason it might at first appear that the above contention were true, and that distributing the windings in two or more slots per pole per phase, the self-induction must be greatly descreased.

As the number of slots is increased, the reluctance cannot be kept the same for a reason that will at once become apparent. For the

FIG. 4.—REMOVABLE COILS.

sake of simplicity consider that the field set up by the armature ampere turns has two paths, one across the slot and the other around it. The reluctance of the path across the slot is inversely proportional to the depth and directly proportional to the width of the slot; in other words, this leakage field is much greater for a narrow and deep slot than for a wide and shallow one. For reasons given before, the slots in an inductor alternator can be made wide and shallow, the ratio of depth to width rarely exceeding 1.5, while with a distributed winding the slots must be made narrow and deep to accommodate the extra insulation required and to keep the machine from becoming excessive in size. In this type of machine the ratio of depth to width is usually three or more. The leakage around the slot is inversely proportional to the reluctance of this path. The fact that the teeth are worked at such high densities in inductor alternators makes the reluctance of this path very great. All this goes to show that the field which induces the counter e. m. f. of self-induction is very little, if any, greater in an inductor alternator than in a revolving field alternator, as usually designed. If the ends of the coils lie in close proximity to the iron, as they usually do, there will be

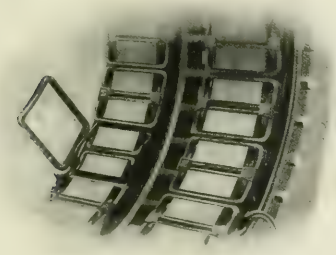


FIG. 5.—SPLIT COILS.

considerable self-induction in these parts. This can be reduced by splitting the coils, as shown in Fig. 5, which illustrates a two-coil per slot winding, which is now used entirely for voltages up to 6000.

The slight reduction of the coefficient of self-induction due to distributing the winding is made manifest by the following: The coefficient of a machine having slots 1½ inches wide by 1 5-16 inches deep, and 60 conductors per slot was measured and found to be .085 henries. New armature punchings were made and the 60 conductors distributed in three slots, each slot ½ inch by 1 23-32 inches. The coefficient was then found to be .076 henries, a reduction of about 10 per cent.

Another important factor which causes a drop in voltage is armature reaction. To illustrate more easily, the effect of this reaction, assume that there is no *CR* drop in the armature, and that the current is entirely wattless, that is, lagging 90 degs. behind the e. m. f. The counter e. m. f. will then be in direct opposition to the induced e. m. f., and the armature ampere turns directly opposed to the field ampere turns. Let *A* and *B* (Fig. 6) be two saturation curves. In *A* the machine is worked above the knee of the saturation curve and in *B* at the knee of the curve. The induced e. m. f. is 2500 volts in both cases, and the armature ampere turns are 2000. The field ampere turns are 9300. Since with a wattless load the armature ampere turns are directly opposed to the field ampere turns, the resultant ampere turns will be 9300 — 2000 = 7300. These are equivalent to 2240 volts for *A* and 2140 volts for *B*; that is, the drop in voltage due to armature reaction is greater by 100 volts for the machine worked at the lower point. Assuming the counter e. m. f. to be 100 volts for both machines, the total drop will be 360 volts or 14.4 per cent for *A* and 460 volts or 18.4 per cent for *B*; that is, working generators well

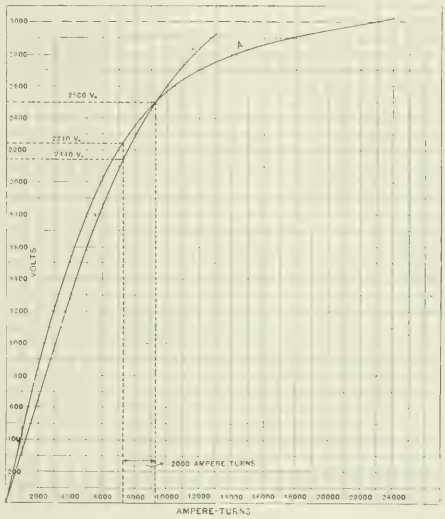


FIG. 6.—SATURATION CURVES.

above the knee of the saturation curve effects a marked improvement in their regulation, and especially for inductive loads.

For reasons given before, the armature teeth can be saturated, the core worked at very high densities, and owing to the very short magnetic circuit all other parts of this machine can be worked at high densities without unduly increasing the energy required for excitation. The inductor alternator, therefore, not only regulates well on non-inductive loads, but also regulates remarkably well on inductive loads.

The field coil, shown at *O* (Fig. 3), is made up of a wire or strip winding enclosed on three sides by a heavy brass bobbin *P*. A ventilating space *R* is left in the middle, separating the winding into two parts. Air is forced through this space, as well as round the sides of the bobbin by the poles of the revolving inductor. The winding is thoroughly insulated from the brass bobbin, while the latter, due to its secondary action, when the field circuit is broken, insures the coil from all danger of breaking down when discharged.

Having but a single coil amply designed, thoroughly ventilated and stationary, the risk of this member becoming disabled is very slight indeed. Other more general features of construction will be given in a concluding article.

Illinois State Electric Association.

The second annual meeting of the Illinois State Electric Association was held at Rock Island, Ill., Sept. 24 and 25, 1901. The association was welcomed on behalf of the Mayor by Mr. Davis, and the Hon. J. N. C. Stumway, of Taylorville, responded on the part of the association. Secretary Chubbuck reported that the association, which originally started with 22 members, had at the first annual meeting doubled that number, and that at present 85 members are enrolled.

The feature of the meeting was a long discussion on the utilization for heating purposes of the exhaust heat from electric light plants, which followed the report of a committee on this subject. The report of the committee stated that electric power stations should be able to obtain an important income from the sale of their exhaust steam. The steam mains should be of wrought iron and so proportioned that the back pressure on the engine need not exceed 2 to 5 lbs. A 6-inch pipe is required to convey about 200 horse-power of steam a mile under 5 lbs. pressure, and this will heat 2,000,000 cubic feet of space in average buildings. An 8-inch pipe will distribute over the same distance 475 horse-power of steam, which will heat 4,750,000 cubic feet of space, and a 12-inch pipe will convey 1140 horse-power of steam and heat 11,400,000 cubic feet of space.

The best covering for pipes consists of a white pine casing made of staves thoroughly kiln dried and coated with asphaltum, the lengths being joined by mortised tenons. The loss by condensation with this covering runs from 1½ to 6 per cent per mile of pipe, the percentage, of course, being smallest in the larger sizes of pipe and greatest in the warmer months when the pipes are delivering less than their rated capacity. Expansion should be taken care of by a packingless device. One hundred horse-power of steam will heat 1,000,000 cubic feet of space in the coldest weather and produce an income of from $3,000 to $4,000 per heating season, depending upon the price of coal. Assuming this to be the case, the gain will be much more than may be obtained from the most efficient engine. It was stated that compounding an engine increases its thermal efficiency to 13 per cent, and a condenser added raises this to 18 per cent, but even in the latter case, 82 per cent of heat units pass off in condensing water. When a condensing apparatus is in use it may be discontinued during the heating season.

The approved plan in the construction of steam mains seems to be a single line of pipe without returns, for by the use of economizing coils the heat from condensation and radiators is utilized in the buildings heated. The small amount of water condensed in the mains themselves should be trapped at some convenient point, and thus separated from the steam.

In the discussion, Mr. Shumway said that a great many buildings require much less steam than others to heat, and that it is impossible to make a flat rate satisfactory to both seller and consumer. Mr. Glidden, who said that he had had seven years' experience in running a heating plant, considered that if he had to do it over again he would use the hot-water system instead of distributing the exhaust steam direct for heating. At the same time he had been very successful in using steam direct. Mr .Shumway said that his plant runs during the day in the winter to furnish heat to its customers. The coal bill increased, but the receipts from the heating more than paid the entire coal bill for the plant. As to depreciation, he recently saw some steam mains taken up at Springfield that had been in the ground 11 years, and he had tried very hard to buy the pipe because he regarded it just as good as the day it was laid underground. Referring to the construction of the covering, he said it is of a hard indestructible character. It is lined with tin to reflect the heat back to the mains, is soaked with asphaltum or covered with tar and paper, pipe tiles being laid along the mains to drain off the surface water. He believed that his great grandchildren will find that the distributing mains he laid are just about as good as to-day. He has known of pipes laid for 30 years that are in excellent condition with the exception that there is some decay at the mortise and tenons. In his opinion 2 per cent would be amply sufficient to set aside for depreciation.

Another report on the subject of exhaust steam heating was presented by Mr. Hayes. He said that with modern steam pressures of 125 to 150 lbs. the low pressure necessary for exhaust steam heating if of small account in the economy of operation. As to the casing for the pipes, the mortise and tenon wooden conduits above referred to, lined with tin in order to prevent too rapid deterioration, are absolutely essential to prevent corrosion from rust or electrolysis. In some cases wooden troughs or boxes have been substituted for these with disastrous results.

The following list of cities was given, having more than one mile of steam heating mains: Scranton, Pa., 15 miles; Overbrook, Pa., 33,169 ft.; Wilkinsburg, Pa., 26,000 ft.; Cedar Rapids, Ia., 8300 ft.; Topeka, Kan., 7200 ft.; Lockport, N. Y., 2½ miles; Pottsville, Pa., 7700 ft.; Grand Rapids, Mich., 6000 ft.; Champaign, Ill., 5280 ft.; Danville, Ill., 1½ miles; Atlanta, Ga., 5 miles; Allentown, Pa., 37,300 ft.; Seattle, Wash., 6500 ft.; Springfield, Ill., 20,518 ft.

At Erie, Pa., the station is situated nearly 3500 ft. from the first customer. In conclusion, it was stated that a central station that has day and night business sufficient to justify undertaking the selling of exhaust steam, can depend upon favorable returns upon the investment, and experience has shown that a customer who has once adopted this manner of heating very rarely makes a change.

Mr. Langford said that in his plant a box is used for encasing the pipe, made with plank with two air spaces, which may be described as three boxes, one inside the other, with a half air space between, the boxes being covered with two layers of paper and tiles used underneath the boxes for drainage. In ten years absolutely no deterioration has occurred. In this case there are two pipes in a box, a supply pipe and a return pipe. The system is a hot water one. Water going out at 180 degs. comes back with a temperature of 172 to 175 degs. with no radiators connected. With all radiating connections made there is about 30 degs. drop in the temperature. The rate charged is 12½ cents per square feet of radiator. In zero weather a temperature of 180 to 190 degs. is sufficient, but in this case some live steam is used in heating the water. This was done about five weeks during last winter. The average radiation for a seven to eight-room house is 500 square feet. Certain rules are used to figure the amount of radiation required in any room and the customer is charged on this basis and may put in as much radiating surface as he chooses. There is an air pump at the station and a ¾-inch air pipe. Mr. Shumway recommended that pipes should only be laid in profitable districts and not run long distances away merely to get a few customers. Mr. Langford, whose station employs the hot-water system, said that the radiators can be so regulated by means of a thermostat that the temperature of a room will not vary more than 1½ degs. through extremes of weather.

Danville was selected as the next place of meeting of the association, and the following officers were elected for the ensuing year:

President, S. S. Davis, of Moline; first vice-president, W. F. McCullough, of Beardstown; second vice-president, John W. Glidden, of DeKalb; third vice-president, W. Steinwedell, of Bellville; secretary, H. E. Chubbuck, of Quincy; treasurer, D. Davis, of Litchfield. Executive Committee: W. B. McKinley, of Champaign; R. L. Allen, of Joliet; F. W. Little, of Peoria; J. N. C. Shumway, of Taylorville, and F. J. Baker, of Chicago.

Papers were read at the meeting by Mr. William S. Hine, of the Western Electric Company; Mr. Porter, of the Lea Company, and Mr. Ryan, of the General Electric Company, the title of the latter being "Enclosed Arc Lamps for Street Lighting."

Reporting the Yacht Races by Wireless Telegraph.

A practical test of the wireless system of telegraphy was made in reporting the yacht races off Sandy Hook last week and the week previous, and viewing the results from a commercial standpoint, the system was found wanting in one vital point. It was shown that the problem of securing immunity from interference remains to be solved, at least so far as the systems under test are concerned. When there were no disturbing influences present the several systems appear to have worked satisfactorily, but owing to their interference the net result was far from satisfactory.

The Associated Press chartered the steam yacht "Mindora," and had her fitted out with a complete equipment of Marconi apparatus The "Mindora" followed the yachts around the course each day and reporters aboard sent frequent bulletins to headquarters, announcing the details of the race. The wireless messages from the "Mindora" were received at a station located in the hotel at Long Beach, L. I., and from there transmitted to the New York office by telegraph. The Marconi Wireless Telegraph Company sent the entire equipment and staff of operators to this country from England expressly to report these races.

The "Mindora's" topmast was removal, and in its place was spliced

a longer spar for the purpose of supporting the antenna or aerial wire. The total height of the mast from the deck was about 106 ft. The wire was not run down the mast, as is usual, but hung from the mast-head and drawn taut so as to form one side of a triangle whose opposite side was the raking mast, the base being the horizontal distance between the mast and wire. It was insulated throughout its entire length, except at the lower end, where it was connected with a cable leading down through a skylight to the instruments in the cabin. Judging from the character of the joint it is evident that resistance loses much of its terror in a system of this nature. It was what is ordinarily called a bell-hanger's joint, being a loose turn of the ends of the wires around each other. The cable leading to the instruments had a stranded conductor and was protected by a waterproof flexible covering.

The instruments were placed on a temporary wooden bench at the foot of the companion way, and included two large spark coils (only one of which was used), a battery of Leyden jars, a condenser and inductance in one large box, an ink recording instrument, and a box containing a Siemens relay and the coherer, besides a bank of incandescent lamps used to reduce the voltage in charging the storage battery from the yacht's dynamo. The entire equipment was English except the lamps, and the enamel rheostat. The continental code was used in sending dispatches, and the operation of the system, when free from interference, seemed to be very satisfactory. The signals received from the land station were recorded very clearly on the tape, and messages were exchanged with great freedom.

More or less annoyance and trouble were experienced, however, through the interference of another system of wireless telegraph; in fact, there were three systems in use. The second was that known as the de Forest system, and was used by the Publishers' Press Association. In order that both systems might be used without interfering with each other, it was agreed that the time be divided between the two, the Associated Press taking five minutes and the Publishers' Press the next five minutes, and so on, alternately. This plan worked all right for a time until the third system appeared on the scene. The third party was very unwelcome, and seems to have had no other purpose in view than to upset the carefully arranged plans of the two press associations. The result was that while the third man was sending out his waves the other two systems were *hors de combat.*

The transmission speed of the Marconi system was about 12 words per minute, and the greatest distance from the land station to the "Mindora" was about 20 nautical miles, as measured on the chart.

On the tug Edna V. Crew, which carried the Publishers' Press outfit, the aerial wire was a distinctive feature. It was a ladder-like structure, four vertical wires being held parallel to one another by cross pieces, and suspended from the mast head. It is claimed that the de Forest system sends out very powerful waves, but its real value in this respect was not demonstrated, owing to the breaking down of the insulation of an important piece of apparatus. In this system a motor of special design is used in place of the induction coil, and it was the motor that failed. An induction coil was substituted for it, and with this foreign element in its make-up the system was used throughout the races. The Publishers' Press had land stations at Sandy Hook and Seabright. It is stated that signals were transmitted over an extreme distance of 22 miles before the failure of the apparatus.

The operation of the Marconi and De Forest systems was witnessed by Lieutenant A. M. Beecher, of the United States Navy, who was detailed for the purpose by Admiral Bradford.

The Marconi interests were in charge of Mr. W. W. Bradfield, from the company's headquarters, the operator on the "Mindora," also from London, being Mr. A. Gray.

The system operated for the Publishers' Press was that of the American Wireless Telegraph Company, the inventor, Mr. de Forest, hailing from Chicago, where most of his experimental work was carried on.

Recent Telephone Circuit Patents.

In the case of grounded circuit lines or metallic circuit party lines equipped with selective signals and, consequently, having permanent grounds, supervisory signal plug circuits of the usual type cannot be used, since they would furnish a path for the current through the supervisory signal without respect to the operation of the telephone switch at the subscriber's station which must necessarily control the supervisory signal. A patent granted Oct. 1 to Frank R. McBerty provides an automatic clearing-out device for such circuits.

Referring to Fig. 1 the supervisory signal is an electromagnetic indicator instead of the usual incandescent lamp. Each electromagnetic indicator is permanently shunted by a non-inductive resistance for the purpose of cutting out the resistance of the magnet windings with

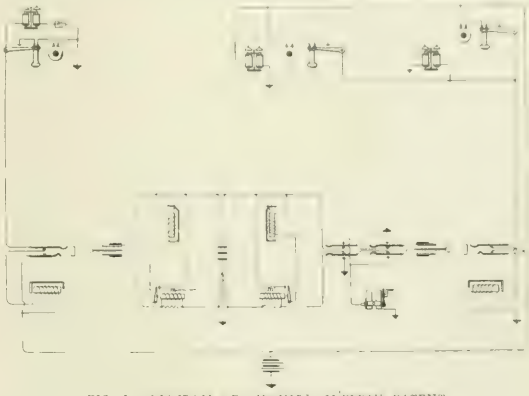


FIG. 1.—DIAGRAM OF CIRCUITS, M'BERTY PATENT.

respect to telephone currents. Each electromagnetic indicator is controlled by a relay in the cord circuit. In the case of the grounded circuit line the relay is operated by a battery, one pole of which is grounded and the other connected normally to the subscriber's line by means of the answering jack and line signal operated by this battery.

When the plug is inserted in the answering jack the path for the current from this battery is diverted from the line and line signal through the controlling relay, which is then excited and closes the contact which brings the supervisory signal in circuit with the common battery, thereby causing the supervisory signal to conceal its target. When the bridge at the telephone station is broken, the current ceases to flow through the relay, which then breaks the circuit of the supervisory signal and allows the latter to display its target. In the case of the metallic circuit line the controlling relay is operated by the common battery, finding itself in the circuit made by

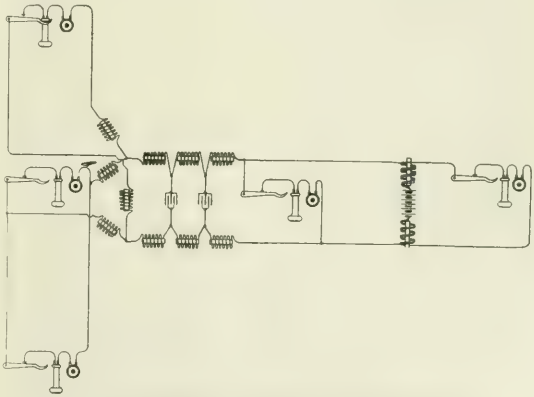


FIG. 2. DIAGRAM OF CIRCUITS, SCRIBNER PATENT.

the two sides of the split repeating coil, the two branches of the line and the bridge established at the telephone station in use.

As soon as the bridge is removed by the replacing of the receiver on the switch hook, this circuit is broken and the relay is released, thereby breaking the circuit of the supervisory signal and causing its target to be displayed. This arrangement of the relay on the side of the cord circuit attached to the metallic circuit line having selective signals obviously precludes any interference with the operation of the relay by the existence of the permanent grounds on that line.

A patent granted the same date to Charles E. Scribner refers to an

arrangement of telephone circuits enabling several lines and stations to be supplied with energy from a single center without cross-talk between the several lines and without great waste of energy caused by the apparatus introduced in the circuit to prevent the cross-talk. The invention is an improvement to one forming the subject of a patent granted to C. E. Scribner and F. R. McBerty in 1896.

The speaking currents (Fig. 2) are localized in the several circuits joined together to a common source of supply, by means of the insertion of impedance coils of high impedance but low resistance at the junctions between the circuits; bridges are made between the impedance coils on opposite sides of the circuits by means of condensers of high capacity. In the older method resistance coils were used for these bridges, which, while effective in preventing cross-talk, caused a waste of current that is entirely obviated by the use of condensers, equally effective in preventing cross-talk between the various circuits.

An automatic signaling system for telephone exchanges is the subject of a patent granted the same date to James L. McQuarrie. This refers to an elaboration of the present system of automatic ringing in use on "B" boards manufactured by the Western Electric Company, by the addition of an automatic device for connecting a phonograph or other special signal after a given lapse of time to the line of the calling subscriber to inform him, in the event of the called subscriber failing to answer, that his correspondent does not respond to the signal of the exchange. The device is equally applicable to incoming trunk or "B" lines to notify the subscriber operator at the originating exchange of the same fact.

The operation is extremely ingenious, the existing apparatus of the relay switchboard being cleverly utilized to make the ringing and "don't answer" signal entirely automatic. When the plug is inserted in the jack of the called line a path for the ringing current is found by means of the relay armature of the supervisory signal, which is inert by reason of the receiver of the called station being on the hook. The ringing current is automatically applied at intervals, according to present methods until, at the end of a certain time, a step by step movement throws a switch which connects the special signal to the calling line. The calling subscriber being then notified by the special signal that the subscriber he wants does not answer replaces his receiver and so lights up his supervisory signal. The operator then has both lights, that on the called line not having gone out at all, and she promptly disconnects the two plugs and so restores all apparatus to its normal position.

The apparatus, while naturally very complicated, is most ingeniously worked out and is a striking illustration of the automatic character with which the large telephone switchboard has become invetsed since the introduction of the common battery system.

CURRENT NEWS AND NOTES.

THE ST. LOUIS EXPOSITION.—The design of the Electricity Building of the St. Louis World's Fair, to be held in 1903, has been assigned to Messrs. Walker & Kimball, architects, of St. Louis. The dimensions of the building will be 525 by 600 ft. Compared with Electricity Building at the Columbian Exposition in Chicago, the St. Louis building will have 77,000 square feet greater area. The Chicago building was far from filled with electrical apparatus.

THE YACHT RACES were followed with a great deal of interest by electrical people, many of whom, through the courtesy of friends, were enabled to see the "Columbia" win in the fine struggle with the "Shamrock," under ideal conditions of comfort and enjoyment. Mr. W. S. Gould entertained a number of well-known electrical folk on his beautiful yacht "Neaira," from day to day, while the Roeblings, as usual, were generous hosts, Mr. H. L. Shippy extending a lavish hospitality on board the "Nerita." Mr. R. A. C. Smith on the "Catania" made a host of electrical friends at home. Mr. Frank J. Sprague had the pleasure of spending one of the days on board the beautiful "Erin" as a guest of that genuine British sportsman, Sir Thomas Lipton, owner of the "Shamrock."

AUTOMOBILE RACES IN PROVIDENCE.—On Oct. 17 the Rhode Island Automobile Club will hold a race meet, with the sanction of the Automobile Club of America, at Narragansett Park, Providence. There will be three races of five miles for steam, gasoline and electric vehicles. The electric carriages are to be of 12 hors-power or under, and the prize will consist of two cups. The fourth race is for all vehicles over 12 horse-power, the distance being 10 miles, and the fifth race, 10 miles, is a sweepstakes for all winners of other races. The prizes are two cups for the fourth race and one cup for the fifth. Messrs. R. Lincoln Lippitt, F. E. Perkins and H. G. Martin constitute the committee on tours, runs and contests.

WIRELESS TELEGRAPHY ON CUNARD STEAMERS.—The steamer "Umbria," of the Cunard line, has been equipped with a complete set of Marconi wireless telegraph apparatus, and her sister ship, the "Etruria," will soon be similarly provided. The steamers "Campania" and "Lucania," of the same line, have been fitted with the system for some time, and are using it with much success. The "Lucania," which arrived at Queenstown on Sept. 21, from New York, communicated with the "Campania" in midocean and going in the opposite direction. According to reports by cable, the shortest distance between the two steamers during the time they communicated with each other was 33 miles and the longest 65.

THE PROPOSED PACIFIC CABLE.—In our issue of Sept. 28 reference was made to the incorporation of the Commercial Pacific Cable Company for the purpose of laying a telegraph cable across the Pacific Ocean from the United States. The matter has been brought to the attention of President Roosevelt, and is now receiving the consideration of the Cabinet. A Washington dispatch states that President Roosevelt and his advisers look favorably upon the enterprise. The company is seeking Government permission to land its cable upon the shores of the United States, the Hawaii Islands and the Philippines. The President has referred the matter to the Attorney-General for his opinion on the legal points involved. The business of the Government will be allowed right of way over all commercial business, and in time of war the cable will be turned over to the United States. The company offers to guarantee the completion of 8000 miles of the cable within eight months. It does not ask for a monopoly.

TANGENTIAL TRACTION ELECTRIC RAILWAY SYSTEM.—Referring to the description in our issue of last week of the tangential railway system of MM. Dulait, Rosenfeld and Zelenay, of Charleroi, Belgium, we have received further information concerning details as follows: Current is transmitted along the line at 15,000 volts, and transformers at intervals reduce this voltage to 5000 and supply the windings of the track stator. The stator is divided into sections of about 1600 ft. each, and the phases are grouped in star relation by a switch controlled by a small three-phase motor shown in Fig. 1 of the article of last week. This switch is operated at the instant the axle of a car comes on a given section. The rotor of the little motor is normally in an open circuit, which is closed by the axle of a car, the motor then operating the switch whereby current is admitted to the section entered. A counter-weight again opens the circuit when the car has passed from the section considered. The air-gap, or distance between the track stator and the construction on the car corresponding to the induction motor rotor is about half an inch. With this large air-gap the reluctance is, however, small, owing to the large area which the arrangement permits to be used, and the induction is reduced to about 1000 gausses.

LETTER TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with great interest the full account of the discussion which followed Dr. A. E. Kennelly's Institute paper on the new Edison iron-nickel cell, as published in the recently issued Nos. 6 and 7 of the A. I. E. E. *Transactions.* I should like to make, with your permission, a few remarks on the electro-chemical theory of this cell, and more especially on some points about which there seems to be no general agreement.

Any one who undertakes at present to develop a theory of the Edison cell, must, of course, rely upon the correctness of the principal claims made by the inventor that the electrolyte is not changed and that the total result of a charge and of a discharge is that oxygen

disappears at one electrode and that the same quantity appears at the other electrode. Dr. Kennelly's statement that the cell is an "oxygen-lift," seems therefore quite a happy characterization of the general resulting action in the cell. On the other hand, several speakers in the discussion, and more especially Mr. C. O. Mailloux, have rightly pointed out that it would be of interest to sketch the ionic mechanism by which the transfer of oxygen is brought about. Dr. Kennelly says about this oxygen transfer: "Now, the action, of course, by which this transfer takes place is much more complicated, and I have not attempted to carry it out; in fact, I do not know it. Unless we all know accurately what the compound was and just exactly what the salt of nickel was—it is only assumed to be nickel peroxide—we could not attempt to map exactly the actions that occur." I do not think that the latter argument can be sustained; in fact, there is no reason whatever to defer a discussion of the mechanism of ionic migration in the electrolyte on account of our ignorance of the exact chemical constitution of the electrodes. When we know what the electrolyte is and when we also know that the only change in the electrodes is that the one is oxidized and the other gives off oxygen, we possess all the data required to sketch the mechanism of ionic migration in the electrolyte.

Indeed, we are able to form an idea of what takes place in the electrolyte, from several points of view. For instance, from the old-fashioned one which lays the whole stress upon the water and assumes that it is the water which is decomposed in an aqueous solution, with the result that hydrogen is set free at the cathode and oxygen at the anode. If we could assume this to be the case in the Edison cell, we would, during discharge, get the following reactions of the hydrogen and oxygen ions with the nickel peroxide and iron electrodes, respectively:

$$NiO_2 + H_2 = NiO + H_2O$$
$$Fe + O = FeO$$

The nickel hyperoxide is reduced, the iron is oxidized. Furthermore, the equations show that when one H_2 ion an one O ion are set free at the electrodes—which represents the disappearance of one H_2O molecule in the electrolyte—another H_2O molecule is formed at the nickel plate, so that the constitution, the quantity and the concentration of the electrolyte are not changed.

This view leads therefore to a general explanation of the claims regarding the resulting action in the Edison cell. But it is, as I said before, based upon somewhat old-fashioned assumptions. Since the so-called electrolytic dissociation theory has come into fashion, we take a view nearly opposite to that just sketched, and assume that the water is inactive and that in a KOH solution, as in the Edison cell, it is the positive K ions and the negative OH ions which, traveling with certain speeds, accomplish the transportation of electricity through the electrolyte. A theory of the electro-chemical action of the Edison cell, based upon the views of the dissociation theory, was given by me in this journal in its issue of June 29, 1901. I have shown there that the general resulting action in the Edison cell can well be explained in this way, and I have also drawn conclusions there as to local concentration changes at the elecrodes which will enable an examination of this theory to be made by experiment.

What I want to emphasize here is that the conclusions drawn in my former article are in no way dependent upon the chemical constitution of the electrodes. The lifting of one atom of oxygen through a given KOH solution from one electrode to the other must be brought about by a certain mechanism of ionic migration, and this mechanism cannot depend upon the constitution of the electrodes. This mechanism must be the same in the Jungner silver-copper cell as in the Edison nickel-iron cell. It must be the same whether the chemical constitution of the nickel electrode at the start of discharge of the Edison cell is NiO_2 or Ni_2O_3, or something else—if only the resulting action is the disappearance of one atom of O at this plate. It must be the same whether NiO_2 is reduced to NiO—as I had assumed, in order to write the equations in a convenient and easy way—or $2\,NiO_2$ to Ni_2O_3—which Professor A. L. Marsh considers to be more probable (Electrical World and Engineer, July 27). As I have said in my former article, the conclusions drawn there regarding the processes in the electrolyte, are independent of the nature of the electrodes—always supposing, of course, that the only change in the electrodes is the transportation of oxygen from the one to the other.

While the mechanism of the ionic migration and the phenomena immediately resulting therefrom, such as local concentration changes at both electrodes, do not depend upon the chemical nature of the electrodes, the latter is of importance for the e. m. f. of the cell. For, if we neglect the small correction term, due to the coefficient of the e. m. f. of the cell, we can calculate the e. m. f. from the heat-toning of the resulting chemical action by means of Thomson's rule. Thus, if we assume that the resulting chemical reaction in the Edison cell is

$$NiO_2 + Fe = NiO + FeO,$$

the e. m. f. of the cell corresponds to the difference of the formation heat of FeO (from Fe and O) and the formation heat of NiO_2 (from NiO and O). If, however, the chemical reaction is

$$2\,NiO_2 + Fe = Ni_2O_3 + FeO,$$

the e. m. f. corresponds to the difference of the formation heat of FeO (from Fe and O), and the formation heat of $2\,NiO_2$ (from Ni_2O_3 and O). Should, however, the nickel compound at the beginning of the discharge not be NiO_2 at all, but perhaps Ni_2O_3, and the resulting chemical reaction

$$Ni_2O_3 + Fe = 2\,NiO + FeO,$$

the e. m. f. corresponds to the difference of the formation heat of FeO (from Fe and O) and the formation heat of Ni_2O_3 (from $2\,NiO$ and O).

Only for the third of these three cases are the numerical thermo-chemical data available. The formation heat of FeO corresponds to 1.47 volts. According to Michalowski, the combination of $2\,NiO$ and O to Ni_2O_3 is an endothermic reaction, corresponding to —0.04 volt. The e. m. f. of the nickel-iron cell would therefore be $1.47 - (-0.04) = 1.47 + 0.04 = 1.51$ volts. The initial voltage of discharge of the new Edison cell after recent charge is given by Dr. A. E. Kennelly as 1.5 volts. The question which of the above reactions—or, perhaps, still another—takes place in the Edison cell, is also of importance for calculating the weight of active nickel compound required for a given number of ampere-hours, as has been pointed out by Professor Marsh.

I should like to take this opportunity to make a few belated remarks on the editorial in your issue of July 6 in which you have been good enough to discuss my article in the preceding issue. You say that "Superficial concentration changes would necessarily occur by the electro-chemical combinations formed, even if the ions did not move past one another." This is exactly correct so far as it goes, but it is insufficient for the complete calculation, as will be seen at a glance, when one considers the two equations which I have given for the reactions at the two electrodes:

$$NiO_2 + 2\,K + H_2O = NiO + 2\,KOH$$
$$Fe + 2\,OH = FeO + H_2O$$

These equations show that there disappear from the electrolyte 2 K ions and 2 OH ions which represents the disappearance of 2 KOH molecules from the electrolyte; further, on account of the chemical combinations formed at the electrodes, there disappears at the nickel plate one H_2O molecule, and there are formed 2 KOH molecules at the nickel plate and one H_2O molecule at the iron plate. We know exactly where the latter changes take place—those which are due to the chemical combinations formed at the electrodes. But from the above equations, we cannot say the exact locality where the two KOH molecules disappear in the electrolyte which furnish the two K ions and the two OH ions set free at the electrodes. To complete the calculation, one must have recourse to the experimentally determined "transport numbers," as I have done in my former article.

In another part of the editorial you say that "while variations of concentration tend to occur at the electrode surfaces during charge and discharge, yet owing to the thinness of the solution layer these variations can readily cancel and annul each other by diffusion." This statement in this form seems to me misleading. "Surface" of an electrode, in the electro-chemical sense, is not only the outside visible surface, but includes also any part of the electrode at which electro-chemical action takes place. The outside visible surfaces of two opposite electrodes are very near together in the Edison cell. In the beginning of the discharge the molecules of the iron and nickel compounds in these outer layers will be oxidized and reduced and concentration changes tending to develop there may easily annul another. But when the discharge goes on, the outer layers of the active masses will have been oxidized and reduced, respectively, and the seat of electro-chemical action (the "surface" of the electrodes in the electro-chemical sense) will be transferred into the inner parts of the porous active masses. Concentration changes will then develop in the electrolyte in the pores of the active masses, and these concentration changes cannot so easily cancel each other.

Although, for the reasons given in my former article, I believe that diffusion acts quicker in the new Edison cell than in the lead

accumulator, yet local concentration changes should become observable in the Edison cell, especially with quick discharges or charges. It must be considered that in order that the concentration changes can annul one another, the electrolyte must pass through the outer pores of the active masses which act somewhat like a diaphragm. It is a well-known experimental fact that when a lead accumulator has been charged and is allowed to rest on open circuit, the concentration of the electrolyte between the plates increases for quite a while. Such an increase has been observed in lead accumulators of the pasted grid type for even 48 hours after completed charge (Pfaff. *Zeitschr. f. Accumulatoren und Elementenkunde*, 1901, June 15). This is evidently due to the fact that during charge the concentration in the pores of both plates had become higher than the concentration of the acid between the plates, and it shows how slow the action of diffusion is in this case in annulling the differences of concentration.

PHILADELPHIA, PA. E. F. ROEBER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Commutating Dynamo Machinery.—HOBART.—An abstract of his Glasgow Internat. Eng. Congress paper on "Modern commutating dynamo machinery, with special reference to the commutation limits." One persistent error has been the assumption that the kilowatt output should be given predominating consideration in laying down the lines of the design, and that the required voltage and amperage are of altogether minor importance. Machines of different voltages, but for the same kilowatt output have, however, one set of features in common, namely, the mechanical design in general. He describes a group of machines designed with due regard not only to these features of mechanical similarity, but also to the points where the designs should diverge in order to suitably comply with the requirements of different voltages and current ratings. In these machines the base, stands, bearings and shaft are the same for all voltages, but while in the low voltage design the electromagnetic part of the machine is extremely narrow and the commutator wide, the high voltage machine has precisely the opposite characteristics. Since, however, the diameter of commutator, armature, field bore and magnetic yoke, are the same for all voltages, it is quite practicable to use to a great extent the same drawings and patterns for all voltages, the patterns being extended or not, according as castings for machines of the one or the other voltage are required. It is shown how naturally all this works out, and the opinion is put forth that by the use of these principles the best results for a given outlay may be obtained. Incidentally, the assertion is made that low reactance voltage greatly outweighs in importance low armature strength so far as relates to excellence in commutation, and high commutator peripheral speeds are advocated on account of the very great improvement in commutating constants which are thereby rendered practicable. Careful attention to all these different considerations still permits of a fair degree of interchangeability and uniformity in the designs for different voltages of the same kilowatt output. He discusses in detail his method of estimating the reactance voltage. Incidentally, he remarks that the inductance of a coil laid upon the surface of a smooth core armature is, with customary proportions, rarely much less than one-third and often one-half or more as great as in the case of the same coil laid in slots. He considers the case of large high-speed commutating machines, and states that by the use of high armature reaction—as expressed in armature ampere turns per pole piece, and high commutator peripheral speeds, even 600-volt machines of large capacity may be designed with excellent commutating properties for high speeds.

In the discussion which followed, S. P. Thompson said that the reactance voltage is not really the crucial quantity to be considered in connection with satisfactory commutation. No one has experimentally investigated what goes on in the moment of commutation. The current has to change from a positive to an equal negative value, and it cannot do this instantaneously. He denied the correctness of Hobart's assumption that the connecting curve is a sine curve smoothly joining the two steady currents before and after commutation. In his opinion the real determining factor in commutation is the width and resistance of the brush in contact with the commutator strip. Chamen said that the difficulties with commutating large dynamos are mechanical and not electrical.—Lond. *Elec.*, Sept. 20.

Direct-Current Dynamo Design.—MAVOR.—A long abstract, with diagrams, of his Glasgow Internat. Engin. Congress paper. The essential part of a dynamo is the region occupied by the armature conductors in the magnetic field. This region he calls the "active belt" of the armature. It is bounded by the peripheral surface of the armature, the surface of the core at the bottom of the slots and the ends of the core. An examination of the machine in the terms of the energy generated in this "active belt" leads to the interesting result that machines of very widely varying size, output and speed, give a remarkably constant value in watts generated per cubic centimeter of active belt at unit velocity in unit field. This value he believes to be about 0.0000005, or 5 ergs per second per cubic centimeter at unit velocity in unit field. The greater part of the paper is chiefly mathematical and cannot well be abstracted. Regarding the cost, he finds that in the case of many groups of machines there is no regular ratio between the cost and the output. There ought to be, however, and the following method is suggested for obtaining this result: Plotting watts per revolution as abscissas and costs as ordinates, the position of each machine is marked, and the points representing cost and output for each carcase of a given diameter with varying length are joined by a straight line which is produced to the origin. The point where this line cuts the zero ordinate gives the limit of cost to which this carcase approaches as the core length is reduced to zero, and may be called the base cost of any given carcase. An increase in diameter increases the base cost and reduces the slope of the line passing through the costs of the actual machines, so that, starting from the smallest diameter and passing to the largest, will give a succession of straight lines, each touching its next lower neighbor at one point, and producing a curve made up of segments of the lines representing each machine, each segment showing the economical range of length for the machine which it represents.—Lond. *Elec.*, Sept. 20.

REFERENCES.

Theory of the Short-Circuited Alternator.—HORSCHITZ.—A communication, being a supplement to his article abstracted in the Digest, Aug. 3. He gives the curve of the short circuit current as a function of the frequency at constant exciting current for a three-phase alternator, and develops the numerical formula.—*Elek. Zeit.*, Sept. 12.

Large Direct-Current Generators.—ROTHERT.—A communication referring to the article of Hobart recently abstracted in the Digest. He agrees in general with the principle of Hobart, except that Hobart favors a somewhat higher number of poles. He makes a few critical remarks on details of design of the machines of the Gen. Elec. Co. and of Hobart.—*Elek. Zeit.*, Sept. 5.

Direct-Current Generators.—An illustrated description of large direct-current generators, made by the English Elec. Man. Co. at Preston.—Lond. *Elec. Rev.*, Sept. 20.

LIGHTS AND LIGHTING.

REFERENCE.

Arc Lamp with Three Arcs.—An illustrated description of a 110-volt arc lamp with three arcs, without any resistance in series, so that no energy is wasted. Preliminary photometric measurements show that this lamp gives a better illumination than an arc lamp with a single arc or with two arcs; but the consumption of carbons is slightly greater.—*Elek. Anz.*, Aug. 25.

POWER

REFERENCES.

Water Power Plant in Bosnia.—J. B. C. KERSHAW.—An illustrated description of the electric power plant at Jajce, a small town in Bosnia. The power house contains 10 turbines, eight of 1000 horse-power each, two of 632 horse-power each. The larger ones drive

three-phase generators, the smaller ones direct-current machines. The power from the plant is used in the manufacture of calcium carbide, alkalies and chlorine in neighboring works. Each of the alternators delivers 3000 amperes at 350 volts, and this current is used to operate three carbide furnaces. The two direct-current machines deliver together 7200 amperes at 120 volts. This current is used in the adjoining works for the production of alkalies and chlorine. The current from the alternating generators is carried to the carbide works by 96 bare copper cables, each cable being made up of 19 ¼-inch wires, and the total sectional area of each cable is thus 0.93 square inch.—*Cassier's Mag.*, Oct.

Electric Hoists.—Hall.—An illustrated article on the successful operation of electric hoists on the Comstock. A continuous rope electric hoist is used, driven by means of a variable speed, three-phase induction motor. The variations of the motor are secured by non-inductive resistances inserted in both primary and secondary. —*Jour. of Elec.*, Aug.

Electric Traction Battery Tests.—R. Kennedy.—An article in which he says that long-run trials of automobiles do not prove anything concerning the value of the batteries, except the durability of the cells if the runs are repeated often enough. Such runs are really tests of the car as a whole. How much or how little of the success is due to the battery cannot be known. Batteries for automobiles can be well tested only on the road, but the same car on the same road must be run under the same conditions with several different sets of cells. He proposes that a test should be made of batteries, open to all makers, the car battery to be made up of so many cells of each manufacture, coupled up to form one battery on one car, say, 10 competitors each to put in four cells to make a battery of 40, and no series parallel battery coupling to be allowed. From the tests the watt-hours are ascertained per pound of cell of each make. The car run is to be stopped when the cells of any make drop to 1.7 volts, with the normal current flowing, and the remaining cells are discharged at normal rate until down to 1.7 volts. The last cell to drop to this p. d. is to be adjudged the best.—Lond. *Elec. Rev.*, Sept. 13.

REFERENCE.

Automobiles.—Mueller.—The first parts of a serial on "The solution of the problem of the electric automobiles." He deals with details of mechanical construction and thinks that the greatest improvement can be expected from an increase of the wheel diameters. He discusses at great length the mathematical theory of the effect of such an increase.—*Centralblatt f. Accum.*, Aug. 15, Sept. 1, 15.

Installations, Systems and Appliances.

Relative Advantages of Three, Two and Single-Phase Systems.—Field.—A very brief abstract of his Glasgow Internat. Eng. Congress paper on "The relative advantages of the three, two and single-phase systems for feeding low-tension networks." He advocates the use of three-phase currents for feeding low-tension networks in all cases except exclusively for electric lighting. With mixed systems, i. e., those for both lighting and power, he inclines towards the use of a three-phase network with the motors on all three circuits, the lamps being placed on only one circuit. In this system regulation can be effected by controlling the pressure on the lamp section alone, the motors tending to equilibriate the system as a whole. In the discussion which followed, several speakers expressed the opinion that the three-phase system is the final goal towards which all electrical engineering is rapidly tending. S. P. Thompson considered there was room for several systems. In changing over from single-phase to polyphase working it is often advantageous to use the two-phase system, building up the circuits on the single-phase first and then transferring to the two-phase when all the circuit arrangements are completed. He also recalled that Ferranti is still the apostle of single-phase working, and has never even in spite of all the modern developments of large three-phase plants, changed his opinion that in the end we shall have to get back to single-phase machinery for every branch of electrical engineering.—Lond. *Elc., Eng'ing*, Sept. 20.

Rates of Charging for Electrical Energy.—Kallmann.—A very long article, illustrated by diagrams. In recent years two different systems of charging have been introduced into practice: One the so-called maximum demand system, the other a system in which different tariffs are used for charging for different hours of the day. Both systems are more just and adequate than the older ordinary system of charging. Nevertheless, he thinks that each of them is somewhat one-sided, and does not take into proper consideration all the important points. A strictly just system would consider the whole load diagram, as follows: For each month, or for summer and for winter, any electric station has a characteristic load curve which represents the average value of the load curves of all consumers. The area of this curve can be used as base of the tariff, in such a way that a consumer whose average load curve is equal to the average load curve of the generating station, has to pay the fixed average price per kilowatt-hour, which is calculated from the fixed expenses of the generating plant and the costs of operation. If the average load curve of the consumer is inside the average load curve of the plant, the consumer has to pay more than the average price, because the fixed expenses are then to be distributed on a smaller number of kilowatt-hours. On the other hand the consumer has to pay a lower price, if his load curve extends beyond the load curve of the plant. The price the consumer has to pay varies, of course, between a maximum and a minimum, for instance, between 4 cents and 15 cents per kilowatt-hour. To use a system based upon these principles, in practice, an automatic instrument is required which takes the place of the registering instrument, and which takes into account properly the ordinates as well as the abscissas of the load curve. The area between the load curve and the axis of abscissas represents the total energy. He divides this area into three parts or stages by straight lines parallel to the axis of the ordinates. The first part corresponds to loads below 20 per cent full load, the second to loads between 20 and 50 per cent full load, the third to loads between 50 and 100 per cent full load. The area of each of these three parts can evidently be represented by a rectangle, the base (abscissa) representing the number of hours during which the load was in that certain stage, while the height (ordinate) represents the average value of the load in that certain stage. The area of each rectangle therefore represents the total energy corresponding to the stage of load. When the consumer has used up the amount of energy corresponding to the average load curve of the plant, the fixed expenses are covered, and for the energy above that amount, a lower price is charged. The instrument needed for such a method of charging must therefore register separately the energy of each stage. For small electric plants a time counter with three dials is practical, which consists of a clockwork and a triple relay, one armature of which is attracted at a load of, say, 5 per cent full load, with the result that the time at which the load is above 5 per cent, but below 20 per cent, is counted on the first dial. When the load reaches 20 per cent, a second armature is attracted and the time at which the load is between 20 per cent and 50 per cent is counted on the second dial. In the same way the time at which the load is above 50 per cent is counted on the third dial. For larger electric plants he recommends using two different stages, the lower stage corresponding to loads below 33⅓ per cent, and the higher to loads above that value. He illustrates the method by the following numerical example: An installation has 2 arc lamps and 20 incandescent lamps of together 1.8 kilowatts or 16.3 amperes at 110 volts. The energy consumed for loads at and above $\frac{1}{3} \times 1.8 = 0.6$ kilowatts, and the energy consumed at lower loads is counted separately. For any 20 hours in each stage 1 per cent discount is allowed up to a maximum discount of 50 per cent. An interval of 20 hours of operation corresponds, for the lower stage, to $20 \times \frac{1}{3} \times 1.8 = 12$ kilowatt-hours, and for the higher stage to $20 \times 1.8 = 36$ hours; in other words, for any 12 kilowatt-hours in the lower stage and for any 36 kilowatt-hours in the higher stage a discount of 1 per cent is allowed. Let the energy consumed in the year in the higher stage be, say, 443 kilowatt-hours, and in the lower stage 512 kilowatt-hours, so that the total energy consumed is 955 kilowatt-hours, and let 15 cents be the fundamental price for 1 kilowatt-hour, then the discount is $512 \div 12 = 43$ per cent in the lower stage and $443 \div 36 = 12$ per cent in the higher stage. While the total price, calculated from the fundamental price of the kilowatt-hour, is $143.25, the discount allowed on the lower stage is $33.02 and on the higher stage $7.98, so that the consumer has to pay, on the whole, $102.25, i. e., about 10 cents instead of 15 cents per kilowatt-hour. He pays for the kilowatt-hour in the lower stage about 8.6 cents and in the higher stage about 13.2 cents. A consumer who burns a few lamps for long hours therefore gets the energy at a lower price; on the other hand, the price charged is profitable to the station.—*Elek. Zeit.*, Aug. 22.

British Supply Station.—The conclusion of the illustrated article on the Kensington and Notting Hill companies' joint electric supply works, the first part of which was recently abstracted in the Digest. Some electrical notes are also given on the plant. Simplicity is said to be the keynote of this system, and is obtained in a large measure by the use of synchronous motor generators, and that efficiency has not been ignored is evident from the use of boilers working at 200-lbs.

pressure with triple expansion engines. Owing to the fast-speed engines, the generating sets are exceedingly compact.—Lond. *Elec.*, Sept. 20.

Cedarburg.—An illustrated description of the alternating-current lighting plant at Cedarburg, Wis. There are two 60-kw, 1100-volt single-phase alternators. Arc and incandescent lamp service is supplied from the station. There are two alternating-current series arc lamp circuits each of 25 lamps, the current being supplied from two 15-kw transformers raising the voltage to 2200, which is the voltage of the arc circuits. The incandescent lamp service consists of four two-wire circuits with a total capacity of 1200 lamps of 16 candle-power. The distribution is made at 1100 volts, the current being transformed by transformers "at the points of distribution" to 110 volts.—*West. Elec.*, Sept. 28.

WIRES, WIRING AND CONDUITS.

Disruptive Strength of Insulating Materials.—O'GORMAN.—A communication referring to Baur's paper, recently illustrated in the Digest. He thinks that the evidence, given by Baur, is not sufficient to prove for his general formula that the breakdown voltage is proportional to the two-thirds power of the thickness. A straight-line law should be expected. For a dielectric thickness of more than ½ or 1 cm, the dielectric strength curve is sensibly parallel to the axis of the thickness.—Lond. *Elec.*, Sept. 20.

REFERENCES.

Transmission Line.—DUTCHER.—A paper, read before the convention of the Pac. Coast Elec. Transm. Ass'n on the Bay Counties transmission line, which, for reason of safety against breakdowns, has been made a double line. One line carries No. 00 B. & S. gauge medium hard-drawn copper, and the other No. 0000 seven-strand aluminum—the equivalent of No. 00 copper.—*Jour. of Elec.*, Aug.

Pole Line Construction.—POOLE.—A profusely illustrated paper, read before the convention of the Pac. Coast Elec. Transm. Ass'n on "Some details of high-tension pole line construction," used by the Standard Elec. Co., of California. The problems of pole-line construction are also discussed editorially.—*Jour. of Elec.*, Aug.

ELECTRO-PHYSICS AND MAGNETISM.

Atoms and Electrons.—SUTHERLAND.—A study of "The cause of the structure of spectra," bringing out the result that the atoms of the different elements are all equipped with the same, or nearly the same, electrical apparatus, whereby the mechanical energy of the atom is made communicable to the ether for radiation. The atom with the kinetic energy assigned to it in the kinetic theory of matter, exercises no direct mechanical effect on the ether, but is like a flywheel driving the dynamo to which we may liken the electrical equipment of the atom, i. e., the arrangement of electrons. He gives an extended analysis of Balmer's and Rydberg's laws for the wave lengths of spectrum lines, and traces the structure of spectra to two facts, first, that atoms vibrate as deformable but practically incompressible bodies of finite calculable rigidity, so that their surfaces have stationary waves corresponding to the fundamental mode of vibration and its harmonics, and, second, that electrons in describing nearly circular orbits round an atom, out of an infinity of such orbits possible, have orbits of certain frequencies made predominant by resonance. The orbits for a positive electron are different from those for a negative, and therefore a relative motion between positive and negative electrons is set up. This is the direct cause of the vibrations of light. This relative motion can be represented by giving the positive and negative electron different angular velocities round the circumference of a circle. By such motions, Balmer's and Rydberg's formulæ can be explained, and Rydberg's laws lead to the conclusion that the fundamental angular velocity of all electrons associated with all atoms is a constant representing a frequency of 33 times the 14th power of 10 per second. The spectra of different elements appear to be caused by practically one and the same form of electrical appliance—pair of electrons—which is supplied with energy by the atom at various internodes. One spectrum is only a slight kinematical variation of the other.—*Phil. Mag.*, Sept.

Reality of Atoms.—RUECKER.—The first part of his highly interesting presidential address to the British Assn. for the Adv. of Science. He speaks of the hypotheses and assumptions on which the fabric of modern theoretical science has been built, and inquires whether the foundations have been so "well and truly" laid that they may be trusted to sustain the mighty superstructure. The three chief conceptions are the existence of atoms, of the mechanical nature of heat, and of the existence of the ether. It is well-known that of late doubts have arisen as to whether the atomic theory, with which the mechanical theory of heat is closely bound up, and the theory of the existence of an ether, have not served their purpose, and whether the time has not come to reconsider them. The fundamental question is whether these theories are to be regarded as accurate descriptions of the constitution of the universe or merely as convenient fictions, as diagrams or models. If the laws of the working of the model could be expressed by abstractions, as, for example, by mathematical formulas, then when these formulas are obtained, the model might be discarded as probably unlike that which it was made to imitate. The model would therefore be not an essential part of science, but only an aid of thinking. He agrees that great progress in physical science has been made without the aid of the theory of atoms. "A great school of chemists, building upon the thermo-dynamics of Willards Gibbs and the intuition of Van't Hoff, has shown with wonderful skill that, if a sufficient number of the data of experiment are assumed, it is possible, by the aid of thermo-dynamics to trace the form of the relations between many physical and chemical phenomena without the help of the atomic theory." But this method deals only with matter as our coarse senses know it. It does not pretend to penetrate beneath the surface. He strongly asserts that the exposition of such a system of tactics cannot be regarded as the last word of science in the struggle for the truth. He asserts that atoms are real. He refers to the rings of Saturn which appear to be continuous masses separated by circular rifts; but from Maxwell's mathematical calculations and Huggins' spectroscopic observations we know that the rings are not continuous masses, but minute moonlets, closely packed, but separate from one another. "A physicist who believes in the reality of atoms thinks that he has a good reason for dividing an apparently continuous gas into molecules as he has for dividing the apparently continuous Saturnian rings into satellites." He inquires first whether there is valid ground for believing that all matter is made up of discrete parts, and, secondly, whether we can have any knowledge of the constitution or properties which those parts possess. He discusses the "coarse-grainedness of matter," and refers to the phenomena of diffusion and expansion of gases, liquids and even solid bodies. Austen has placed pieces of gold and lead in contact at a temperature of 18 degs. C. After four years the two metals were united and appreciable quantities of gold were detected even at a distance of more than 5 mm. from the surface. These phenomena can only be explained by the hypothesis that matter consists of discrete parts in a state of motion. The phenomena of heat can only be explained by the supposition that heat is a mode of motion; and if that is so, it is the fundamental particles of matter which are moving. These and other considerations are the fundamental proofs of the atomic theory; but they give no evidence as to the nature of the particles or granules into which matter must be divided. The paper is to be concluded.—Lond. *Elec.*, *Elec. Eng.*, Sept. 13.

Graphical Combination of Vectors.—EMDE.—A communication on the principles underlying the graphical combination of fluxes and m. m. f.'s. The parallelogram of forces and Fresnel's theorem must be distinguished. While magnetic fluxes and m. m. f.'s are no vectors, they can be graphically combined as if they were vectors.—*Elek. Zeit.*, Sept. 22.

Effects of Magnetization Upon the Electrical Conductivity.—BARLOW.—A brief abstract of a Brit. Ass'n Adv. Sc. paper on the effects of magnetization upon the electrical conductivity of iron and nickel. He found that the effect is very marked, being greater than can be accounted for by change of length and diameter of the magnetized wire. The increase in the electrical resistance is found to vary approximately as the square of the magnetic induction, there being a second term varying as the fourth power, and a third term varying as the sixth power of the induction.—Lond. *Elec.*, Sept. 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Caustic Alkali and Chlorine.—COHN and GEISENBERGER.—The production of caustic alkali and chlorine by the electrolysis of solutions of chloride of the alkalies, has the disadvantage that a diaphragm is required and that the caustic alkali produced must be separated from the chloride of the alkali with which it is mixed. To overcome these disadvantages, the authors carry out the process in the cold, with the result that the caustic alkali produced is deposited in solid form so that it cannot mix with

the alkaline chloride or with the chlorine. An apparatus for this purpose is described and illustrated.—*Elektrochem. Zeit.*, Sept.

Determining the Constitution of Complex Salts from Electrolytic Transport Numbers.—Rieger.—The conclusion of his article. He found that in potassium copper sulphate, potassium silver iodide, potassium mercury iodide, potassium zinc cyanide, potassium cadmium cyanide, potassium ferro-oxalate and potassium ferri-oxalate, the nobler metal goes to the anode, and is therefore in all these salts to be considered as a portion of a complex union.—*Zeit. f. Elektrochemie*, Sept. 5.

REFERENCES.

Discharge of Storage Batteries.—Montel.—An article in which he tries to develop mathematical formulæ for the process of the stopping up of the pores of the lead peroxide plate, when it is changed into lead sulphate. He arrives finally at Liebenow's empirical formula for the capacity of the lead storage battery as a function of the discharge current. The capacity is inversely proportional to the sum of unity and the product of a constant times the discharge current. This formula is valid for not too high a current density.—*Centralblatt f. Accum.*, Sept. 1.

Automobile Storage Battery.—A description of the "Progress accumulator," with accounts of the results of tests. The figures given do not seem to agree with each other.—*Elektrochem. Zeit.*, Sept.

Units, Measurements and Instruments.

Measuring Permeability.—Baily.—An abstract of a Brit Ass'n Adv. Sc. paper on a new method for measuring the permeability of iron and steel and other high permeability samples. The apparatus depends on the measurement of the ratio of B to H in the sample. A complete magnetic circuit is formed by two lengths of the sample joined by short iron blocks at the ends. Magnetizing coils are placed round the samples. In one of the blocks is a narrow gap perpendicular to the direction of the lines of force. Above this is pivoted a pair of astatic magnets. The lower magnet is influenced by the difference of magnetic potential between the two sides of the gap, the force being proportional to B. Round the upper magnet is placed a small coil in series with the main magnetizing coils, which acts on the magnet with a force proportional to H. Using the principle of the sine galvanometer, the coil is rotated until the two forces are balanced, the position of the magnet system being along the line of the gap. The coil is shaped to give an almost uniform scale through some 80 degs. of arc, and the permeability is read directly on the scale. The scale is calibrated for a standard size of specimen, and the value for any other size is obtained by multiplying by the ratio. A wide range is obtained by using only a part of the magnetizing coils when the permeability is high. The magnetizing force is read on a separate instrument, such as a suitable ammeter.—Lond. *Elec.*, Sept. 20.

Electricity Supply Meters of the Electrolytic Type.—Dick.—A long abstract of a Glasgow Internat. Eng. Congress paper in which he dealt with shunted electrolytic meters, and especially with such in which mercury is deposited from a mercurous salt. When a shunt is used in connection with an electrolytic meter which has a back e. m. f., some compensating e. m. f. has to be inserted in the cell circuit in order to obtain a constant linear ratio between the main and shunt currents. Wright does this in several ways. "The most practical method is to place a shunt R across the mains and to interpose a portion r of this resistance R in the cell circuit, such that with a back e. m. f. in the voltameter of 1.5 volts, the ratio $r:R$ is the same as 1.5 to the supply pressure. The resistance r will then counterbalance the e. m. f. of the cell, and no current will flow through the cell when there is no current in the mains." It would be preferable, however, to use an electrolytic cell without any back e. m. f. Mercury salt cells, generally mercurous nitrate, which is very soluble, offer the great advantages that their e. m. f. is very low, and that the mercury liberated need not be weighed by taking the apparatus to pieces, but can be collected and measured in graduated vessels. The chief defect of former meters of this kind was that crystals would deposit at the anode surface and that the consequent increase in the resistance could not be prevented by agitation. One of Wright's meters is claimed to be free from these defects. The anode is placed above the cathode. The anode mercury is contained in a circular trough, which is of such a height that the concentrated solution formed by the electrolytic action falls off the curved surface of the mercury by gravity and mixes the liquid. This diffusion by gravity would become ineffective if the mercury in the anode were to sink below the level of the lip of the trough, but this is prevented by adding an anode feeder which resembles a "bird fountain." As the lever of the anode mercury is lowered by electrolysis, the flow from the anode feeder restores the mercury level in the trough while a corresponding amount of solution replaces the mercury thus withdrawn from the trough. The cathode is a hollow cone of platinum or carbon concentric to the anode trough. The mercury deposited falls into a glass funnel and a siphon V-tube. When this siphon tube has received mercury equivalent to 100 units, the siphon will come into play and the whole mercury be drawn into a graduated receptacle. The temperature coefficient of the electrolyte is negative, that of the resistance in series with it positive, thus a constant total resistance can be secured. To avoid the necessity of using two meters in a three-wire system, he splits the neutral wire into two equal low resistances, and connects the meter across the ends of these resistances. The current through the cell will then always be proportional to the sum of the currents in the two halves of the installation. After eight months of working these meters under conditions equivalent to five years of ordinary installation practice, the proportion of mercurous nitrate in the solution was found unaltered, and only traces of mercury nitrate could be detected. "The lingering objections to electrolytic meters should therefore vanish."—*Eng'ing*, Sept. 13.

Telegraphy, Telephony and Signals.

Telephone Lines on Power Transmission Pole Lines.—Some editorial remarks on the experiment successfully tried and adopted by the Bay Counties Power Company, in which the telephone line between the Colgate power house and the Oakland sub-station is run on one of the pole lines carrying the 40,000-volt, 132-mile power circuit straight, i. e., without transposition in the telephone circuit. Reference is made to a statement of an Italian engineer, Semenza, in a report on the Paderno-Milan transmission line, in which he says that "the noises disturbing the telephone are caused by electrostatic induction; in our case, at least, electromagnetic induction gives no trouble. Our telephone circuits are not transposed or spirallel. Nothing has been done to counteract electromagnetic induction. Nevertheless, the noise has been almost entirely suppressed by very carefully insulating all parts of the telephone circuit from the ground." This agrees perfectly with the opinion expressed by Theberath that non-transposed and adequately insulated telephone circuits will give the nearest approach to perfect telephone service over circuits run on long-distance high-tension pole lines.—*Jour. of Elec.*, Aug.

Brussels.—An illustrated description of the new telephone exchange of Brussels. The central battery system of the Western Elec. Co., of this country, is used.—*Elek. Zeit.*, Sept. 12.

Miscellaneous.

Comparison of American and British Methods.—An article by a British electrical engineer who attended the recent Am. Int. E. E. annual meeting. The causes of difference in the practice of the two countries are said to be first that in America engineers have been given a practically free hand, while the British engineers were restricted by governmental regulations which have caused the advance in England, although slower, to be on firmer lines; second, the relation between labor and fuel, which has necessitated that extreme attention is paid to lavor-saving machinery in the United States, has in Great Britain rather caused the absolute efficiency of the plant to be the first consideration; third, England has a freer trade, and thereby the advantage of being able to buy all that is best abroad. He admires the beautiful systems of control and labor-saving schemes in American supply stations. He wonders that the supply voltage in lighting installations has not been raised in the United States, while it has been generally doubled in England. He doubts whether on the whole English engineers need consider themselves behind their American confreres. Where the American gains in unrestricted advance, the Englishman possibly has an advance in thoroughness of work. The extended use of movable tools is commended, as are the forming machines for armature windings. A feature of great interest is said to be at the General Electric Company's works, the motor-driven 10,000-volt oil switch, giving a remarkably quick and accurate break. "Traction, in practice, is scarcely in such a superior state as one would have expected." The conduit system in New York is said to be virtually the same system as that laid down at Blackpool some 15 years ago, while the control is up to date, the track is nearly identical. "Certainly the road surrounding the track, and often the track itself, in the heart of New York City, is in such a marvelous state of disrepair that it is a source of constant won-

derment that the accident wards are ever with a vacant bed."—Lond. *Elec.*, Sept. 20.

Engineering.—CROMPTON.—His presidential address to the engineering section of the Brit. Ass'n Adv. Sc. He dealt with three different subjects: Modern development of passenger and goods traffic as affecting carriage on railways, tramways and ordinary roads; standardization and interchangeability in all kinds of modern machinery, and the object of the Brit. National Standardizing Laboratory.—Lond. *Elec., Elec. Rev., Eng'ing*, Sept. 20.

Metric System.—GREENWOOD.—An abstract of a Glasgow Eng. Congress paper on "The adoption of the metric system in our workshops." The principal point is that its adoption is necessary to push the export trade to countries of Europe and elsewhere where the metric system is universal. The one serious objection is the cost and trouble of making the change.—*Am. Mach.*, Sept. 26.

Making Glass Electrically.—BERMBACH.—An article which deals in general with the same subjects as that author's paper which was recently abstracted in the Digest, but the present article is more complete. Several arc furnaces for making glass are illustrated by diagrams.—*Elektrochem. Zeit.*, Sept.

German Manufacturing Plant.—In the continuation of the serial on the recent visit of the Brit. Inst. of Elec. Eng. to Germany, an illustrated description of the works of Schuckert & Co. is given.—Lond. *Elec.*, Sept. 20.

Berlin Exposition.—WILKING.—An illustrated review of the electrical exhibits at the present Berlin Exposition of materials for fighting fires, automatic fire alarms, fire engines with electric pumps, automobiles, etc.—*Elek. Zeit.*, Sept. 19.

New Books.

HIGH TEMPERATURE MEASUREMENTS. By H. Le Chatelier and O. Boudouard. Translated by George K. Burgess. New York: John Wiley & Sons. 230 pages, 52 figures. Price, $3.

This is a very thorough and complete text-book upon the measurement of high temperatures. It is written by an author well known to be familiar with this subject. The work is divided into thirteen chapters, with a preface to the American edition and an excellent index. The subject is dealt with both in a scientific and a practical manner, and the results of the latest methods in use in pyrometry are sketched clearly.

The following data are given as the most reliable melting and fusing points at present known:

Ebullition temperatures.—	Water	100	degs. C.
	Naphthelene	218	"
	Sulphur	445	"
	Zinc	930	"
Fusion temperatures.—	Silver	962	"
	Gold	1065	"
	Platinum	1780	"
	The sun, about	8000	"

It is stated that, whereas the boiling point of sulphur and other substances below its ebullition temperature may be known to 1 deg. C., the uncertainty as to the fusing point of silver and temperatures beyond may be 10 degs. C.

It is shown that high temperatures are measured (1) by gas pyrometers, which are mainly used in laboratories; (2) by calorimeters, which are simple, cheap and are used for occasional measurements in industries; (3) by electrical resistance pyrometers, originated by Dr. Siemens, which seem to have the most promising future if the determination of the law of resistance of platinum can be carried out with greater precision; (4) the thermo-electrical pyrometer employing a metallic couple, and which is much used commercially, but is not reliable for the best high-temperature laboratory work; (5) by the heat-radiation pyrometer, which is not used at present, but which offers a wide field for further advance; (6) the luminous-radiation pyrometer which gives only rough determinations; (7) the contraction pyrometer and fusible cones, much used in practice, and giving reliable comparative observations, but not the most reliable scientific determinations.

The work deserves the appreciation of all those who are interested in practical pyrometry, or high temperature measurements.

ENGINEERING EDUCATION. Proceedings of the Society for the Promotion of Engineering Education. New York Meeting, 1900. Vol. VIII. Edited by Professors John B. Johnson, Albert Kingsbury and Henry S. Jacoby, Committee. New York: Engineering News Publishing Company. 377 pages. Price, $2.50.

This society had 266 members at the date of publication, almost all holding professorships in engineering colleges. It has a council of seven members and meets annually in connection with the meeting of the American Association for the Advancement of Science. It publishes its papers and discussions in a well-bound blue book with large type.

The condition of professional education is undergoing a distinct change, as shown by the fact that during the past 20 years the students in engineering have increased 500 per cent, those in law 300 per cent., those in medicine 140 per cent, and those in theology 87 per cent. In an average college curriculum for the education of American youth there is a distinct tendency to reduce the classics and increase the technics, for which we are all devoutly thankful.

The great purpose of educational institutions is to meet and occupy the resources of each individual applicant. There are some who can afford to devote themselves entirely during a four-year course to a technical college training, and for them a particular line of appropriate study is prepared in these institutions. There are others who can devote night work to classes, being occupied in supporting themselves during the day, and for these a correspondingly modified curriculum is adopted and prepared. A third number of students are so occupied in places remote from educational centers that while having spare time for study they have no schools available for their spare time, and for them again correspondence schools are particularly adapted. It is very interesting to observe in a perusal the views of the various writers and speakers on this topic of engineering education, and how to provide for it. The participants in the discussion are all highly trained men and specialists, and consequently what they write is well worth reading. The differences of opinion are, of course, numerous, but they tend to vanish if the division of engineering education among the various classes above mentioned is kept in mind. The book is of importance to educators and of interest to workers in engineering.

Flexible Pole Brackets.

The accompanying cuts illustrate two styles of flexible pole brackets manufactured by the Ohio Brass Company, of Mansfield, Ohio. In the first of these (Fig. 1) is shown the type for wood poles, in which a peculiar form of pole socket and hook casting is employed by means of which the bracket is attached to the pole. The construction of these castings is well illustrated in the enlarged view of these parts. The castings in conjunction with the brace arm, admit of a vertical adjustment of the horizontal arm and give the additional

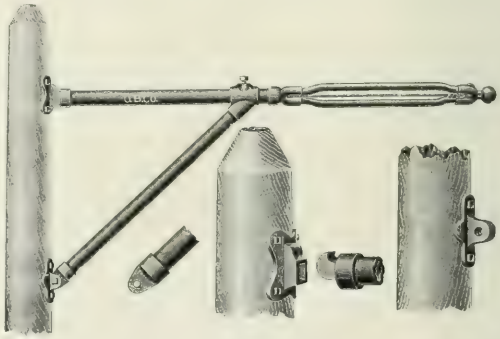


FIG. 1.—FLEXIBLE POLE BRACKET.

feature also of allowing the bracket to be easily swung into position on the pole, the pole castings having been previously put up. The flexible end at the outer extremity of the bracket forms a yielding and flexible support for the wire, allowing the car to be operated at a high rate of speed without the evil results heretofore experienced. The trolley wire hanger is suspended on a steel strand cable between the curved arms which extend on either side of it in substantially the same plane, so that it is impossible for the trolley wheel, should it

accidentally leave the wire, to strike it or become entangled in the suspension cable.

Another style for wood poles is shown in Fig. 2, which possesses

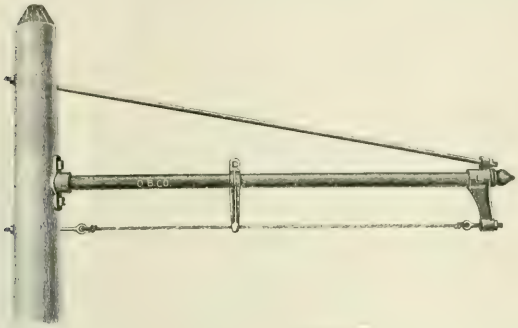


FIG. 2.—FLEXIBLE POLE BRACKET.

several features of merit, where a substantially constructed bracket of this form is preferred.

Band Polishing Wheel.

The accompanying illustration shows a band-polishing wheel, designed to hold one or two emery wheels. The wheels are made of cast iron, an elastic surface being produced by a felt covering. The emery, or other abrasive material, is a piece of emery cloth which is tightened firmly around the wheel. This machine is suitable for shops where skilled polishers are not employed, as well as in those employing skilled labor.

The one-wheel machines are mounted on one end of the spindle, the

BAND POLISHING WHEEL.

other end being suitable for buffing, and are provided with cushioned or hard surface. These polishers are made by Charles H. Besly & Co., 10 North Canal Street, Chicago, Ill.

Telephone System for the Manhattan Railway.

An interesting feature in the development of the telephone is shown in the contract just placed by the Manhattan Elevated Railway Company, of New York, with the Lambert Schmidt Telephone Manufacturing Company, New York, for a complete exchange telephone system to be used on the elevated road in New York City. The instruments will be located at the stations and in the offices of the railway company, and replace the former telegraph equipment, which has proved itself too antiquated to meet the needs of rapid service. The entire equipment will consist of a 500-line multiple switchboard and telephones, this system being arranged on the common battery plan with lamp signals. The conditions of the specifications were necessarily severe, on account of the great number of calls required between the different points for train signaling and otherwise, it being estimated that many of these telephones will be used on an average of 2000 times a day—practically continuous service. A telephone man can readily appreciate the severe strain such an enormous traffic would have on a common battery system, and the Lambert Schmidt Telephone Manufacturing Company is to be congratulated on satisfying the authorities of the road that its system fully covers the conditions necessary.

The equipment will present many new features and will, it is said, be a long stride ahead in the telephone art as applied to common battery multiple switchboard systems. An important point in connection with this system is the fact that many of the telephones are located fully 10 miles from the exchange center. There was considerable competition on this contract. The engineers of the road made thorough investigation, and the Lambert Schmidt Telephone Manufacturing Company is exceptionally pleased at securing this contract on merit alone.

A Carborundum Exhibit.

An exhibit of unusual attractiveness is that of the Carborundum Company, Niagara Falls, N. Y., which has its product tastefully arranged in glass cases finished in mahogany. In the center and to the front of the space is a high, square glass case, in which is built up a pyramid of the beautiful carborundum crystals, as taken from the electric furnaces. This pyramid is surrounded by inverted bottles containing the various sized grains. On one side of this case is a pyramid of wheels, built up from the largest, 36 inches diameter, to the smallest dental point, and on the other side is a pyramid built of rolls of paper and cloth and the various forms of these used in polishing and grinding. Along the entire length of this space, at the

CARBORUNDUM EXHIBIT.

back, is a large glass case containing a great variety of wheels of peculiar or special shapes, used for special grinding. Here are also shown sharpening stones, files, rub stones, etc., so tastefully arranged as to make a beautiful display. In a glass case at the end of the space are various specimens of work intended to show some of the uses of carborundum, among which are specimens of granite from all parts of the world, cut glass, porcelain, petrified wood, etc., all polished by carborundum. In front of this case are two beautiful spheres, one of Barre granite and one of Quincy granite, both polished by this substance.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 3 per cent; time money was easier during the week, closing at 4¼ per cent for high grade loans, 4½@4¾ per cent for good mixed, and 5 for the more indifferent sort. The stock market was dull, which condition was accompanied by lower quotations for railway shares and by general declines in industrials. Amalgamated Copper and other industrials took a downward turn on liquidation and lack of support, due to an anti-trust decision by New York courts, poor earnings and the absence of information relative to their financial position. Steel stocks were the most active of the industrials, common advancing in anticipation of the favorable statement and declaration of the dividend. After the statement and the announcement of the dividend, quotations receded in sympathy with the break in other industrials. In the traction list, Brooklyn Rapid Transit showed weakness on anticipations of an unfavorable annual report, and closed the week with a decline in price of 6¾ points net. Metropolitan Street Railway also showed weakness, closing at 160¼—a net loss of 4¾ points. General Electric suffered a net loss of 8 points on the week's trading, closing at 250, ex dividend. Western Union held its own pretty well, closing with a net loss of only ¾ of a point. Other electric stocks which showed net losses were American District Telegraph, 1 point, closing at 32, and American Telephone & Telegraph, 2 points, closing at 159, ex dividend. Following are the closing quotations of Tuesday, Oct. 8:

NEW YORK.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
American Tel. & Cable..	—	—	General Carriage.....	1	1
American Dist. Tel.....	—	—	Hudson River Tel.....	114	112
Brooklyn Rapid Transit..	64⅛	57⅝	Illinois Elec. Veh. Trans.	.	.
Commercial Cable.....		—	Metropolitan Street Ry..	162½	158
Electric Boat.....	16	16	N. E. Elec. Veh. Tran..		—
Electric Boat pfd.....	40	40	N. Y. Elec. Veh. Tran...	10	8½
Electric Lead Reduc'n...	2	1⅞	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	1	1½	Tel. & Tel. Co. of Am...	5	5
Electric Vehicle pfd.....	4	3	Western Union Tel.....	91	90⅞
General Electric.....	257½	250			

BOSTON.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
Am. Tel. & Tel.....	159	157	Mexican Telephone.....	2	2
Cumberland Telephone...		—	New England Telephone.		
Boston Electric Light...		—	Westinghouse Elec.....		—
Erie Telephone.....	39	39	Westinghouse Elec. pfd .		—
General Electric pfd....					

PHILADELPHIA.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
American Railways.....	41	40½	Phila. Traction.....	95¾	95¾
Electric Storage Battery.	60	63	Philadelphia Electric....	5½	5¼
Elec. Storage Batt'y pfd	60	63	Pa. Electric Vehicle....	½	½
Elec. Co. of America...	7	7	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
Central Union Telephone			National Carbon pfd....	83	83
Chicago Edison.....	168	160	Northwest Elev. com....	37	38
Chicago City Ry.....	202	202	Union Traction.....	17½	17
Chicago Telep. Co.....	255	254*	Union Traction pfd....	58	58
National Carbon.....	18	18⅛			

*Asked

MR. MORSE IN INDEPENDENT TELEPHONY.—A Boston dispatch referring to the decision of Mr. C. W. Morse, of the American Ice Company, to exercise his option on the stock of the Telephone, Telegraph & Cable Company, states that this decision is taken to mean that the independent telephone interests have decided to make a vigorous fight. Whether or not the new owners will find it desirable to retain control of the Erie Company is still a question. The fact that the Telephone, Telegraph & Cable Company still has in its treasury 23,000 shares of Erie Telephone stock brings a solution of the problem down to one or two methods. Either the former control of the Erie is to be regained or a market will be found for the stock now held. In order to secure control approximately 30,000 shares of stock must be secured. This can be accomplished by paying off the loans to the Old Colony Trust Company syndicate or buying them outright. As long as the loan remains unpaid, that course is naturally impossible, and it would therefore seem that he future control and operation of the Erie Company is included in the deal involving the purchase of the Telephone, Telegraph & Cable Company.

STREET RAILWAY TAXES.—Mayor Tom Johnson, of Cleveland, who has been prominent in street railway management, and who is also an advocate of many changes in existing tax systems, does not favor the mulcting of street railways by exacting percentages of profits, or other considerations, as a way to raise city revenue. In his view, the railroads give much in return for their right of way in the streets. "First," he says, "they lower materially—from a half to a third—previously established passenger and freight rates. Second, they afford people not only their own extra facilities for travel and shipping, but also bring better steam railway facilities with lower rates. Take these two more obvious results, and they alone will more than repay any city for the use of its streets. In a nutshell, every additional facility a city gives people and freights for reaching it, and reaching it cheaper, benefits that city just that much. My advice to all cities is—throw open wide the gates for every urban electric line that she can even encourage into life, that will reach out 20, 30, 40, 50, 60 or more miles into the country."

BROOKLYN RAPID TRANSIT REPORT.—The report of the Brooklyn Rapid Transit Company for the year ended June 30 last was made public on Oct. 8. It shows an increase in the net earnings of the Rapid Transit Company and its constituent companies, as compared with the year previous, of $257,374, but the yield of surplus after charges shows an increase of only $51,081. Following is a summary of the statement:

	1901.	1900.	Changes.
Total receipts	$12,135,559	$11,768,550	Inc. $367,009
Op. ex. and taxes....	7,216,008	7,106,373	Inc. 109,635
Net earnings	$4,919,551	$4,662,177	Inc. $257,374
Charges*	4,341,748	4,135,405	Inc. 206,343
Surplus	$577,803	$526,772	Inc. $51,031

*Included in charges are allowances for damage claims, legal expenses, etc., which in 1901 were $1,157,593, against $913,292 in 1900, an increase of $244,301.

The surplus account as of July 1 stands as follows:

Surplus for year ended June 30, 1901.....	$577,803
Previous surplus	623,426
Total	$1,201,229
Allowance for depreciation, betterments, etc.....	228,678
Balance surplus July 1, 1901	$972,551

THE INTER-STATE TELEPHONE COMPANY, which has acquired by purchase many local telephone companies in Pennsylvania and New Jersey, and which a few days ago bought the Elizabeth Mutual Telephone Company for $30,000, met in Elizabeth, N. J., on Oct. 8, and organized. W. H. Rankin, president of the old company, resigned, and Hugh Hammell, of Trenton, was elected president, and Barker Gummere, Jr., also of Trenton, was elected treasurer. The following were elected directors: Hamilton F. Kean, Barker Gummere, Jr., Henry Loudenslager, William S. Hancock, P. H. Gilhooley, John W. Whalen and Lawrence O'Donnell. The company has decided to spend $100,000 in improving the system.

DIVIDENDS.—The Standard Underground Cable Company, of Pittsburg, has declared a quarterly dividend of 2 per cent. The U. S. Steel Corporation has declared dividends of 1¾ per cent on the preferred and 1 per cent on common.

MINNEAPOLIS GENERAL ELECTRIC.—The Minneapolis General Electric Company reports for the year ending July 31, 1901: Gross earnings, $358,413; operating expenses, $174,288; net earnings, $184,125; fixed charges, $106,135; surplus, $77,989.

Commercial Intelligence.

THE WEEK IN TRADE.—The state of trade throughout the country continues in a very satisfactory condition. While speculative markets showed reactionary tendencies, general distributive trade was active and a heavy volume of business transacted. The best reports of the year come from the iron trade. Bessemer pig iron is 25 cents higher at Pittsburg, at which point the September sales of pig iron were the largest since January. Finished and structural mills are two or three months behind on orders, and rail orders already booked ensure activity far into next year. The leading tube works mills will be run on Sundays hereafter in order to catch up with current work. The business failures for the week, as reported by *Bradstreet's*, aggregate 175 as against 197 the previous week, and 177 the corresponding week last year. The September failures and liabilities were the smallest of any month this year, and the failures for the third quarter of the year are also smaller than in the first or second quarter, as regards numbers. For the nine months period failures and liabilities are larger than one or two years ago, but smaller than in any previous year since 1892. In the metal market,

copper has recovered from its depression and more confidence is shown generally. There has been no change in prices, however, and there does not seem to be any likelihood that there will be in the near future. Manufacturers at home and abroad are utterly bare of stocks, and since there is no prospect of the price breaking, there is more and more buying. Quotations are: Lake, 16½ cents; electrolytic in cakes, wire bars and ingots, 16¼ cents; in cathodes, 16 cents, and casting stock, 15⅞ cents.

WATER SUPPLY FOR CITY OF MEXICO.—The City of Mexico is to have a new water system, which will entail the expenditure of some millions of dollars in the United States for the purchase of electrical machinery, waterwheel equipment, pumping outfits, etc. A syndicate of New York capitalists has acquired the concession granted some years ago by the Mexican authorities to Mr. Wm. MacKenzie, formerly traffic manager of the Mexican Gulf & Monterey Railway, and the contracting firm of Mr. Warren A. Loss, 52 Broadway, New York City, has been allotted the important contract for the construction of the system, which will, it is estimated, cost nearly $6,000,000 American currency, and will mean the purchase of some 35,000 tons of material in the United States. Though the actual details have not yet been settled, it may be stated that the General Electric Company and the Stanley Electric Manufacturing Company will undertake the contract for the supply of the requisite electrical equipment. The former concern's portion of the contract will, it is said, reach a value of nearly $1,000,000. The Pelton Waterwheel Company is to be assigned the contract for waterwheels, and the Worthington branch of the International Pump Company will supply all the pumps. Mr. Loss, accompanied by Mr. John M. Brill, of Chicago, who will act as chief engineer of the work; Mr. E. Abs Hagen, consulting engineer of the Havana sewerage system and chief engineer of the San Antonio, Texas, works, who has been appointed consulting engineer to the syndicate; Mr. A. M. Pierce, the well-known hydraulic engineer; Mr. W. L. Farr, representing the Stanley Electric Manufacturing Company; Mr. O. M. Ticer, on behalf of the Pelton Waterwheel Company, and a representative of the General Electric Company, are now in Mexico making a tour of inspection over the entire line, prior to commencing actual work. The water it is sought to utilize is to be derived from the Almoloya springs, which are located some 40 miles southwest of the Mexican capital and about six miles southeast of Toluca. From those springs a supply equal to 2000 liters of water per second will be drawn and transported by means of canals, pumps and pipe lines over the intervening mountain ridges to the City of Mexico. The magnitude of the undertaking can be more readily appreciated from the following interesting construction data furnished a representative of Electrical World and Engineer by a member of the contracting firm: The work embraces the construction of a total of 36.6 miles of canals, or 6.4 miles of steel pipe lines (the pipe varying from 10 inches to 48 inches in diameter), the installation of pumping machinery necessitating nearly 27,000 horse-power in order to elevate the needed water to a height of 1456 ft. for the purpose of obtaining a gravity fall to the City of Mexico. Electric energy to operate the pumps will partly be obtained from the Falls of the Malinaltenaco River, some 24 miles southwest of the Almoloya springs. The water in its descent from the plains of Salazar near La Cima, dropping gradually from a height of 2214 ft. on its way to the capital, will furnish 17,500 electrical horse-power, a part of which will be requisite for the operation of the pumps. Of the remainder about 8000 horse-power will be transmitted to the City of Mexico for street lighting, railway and other power purposes, while the rest of the power will be made use of in adjoining towns, mines, and so forth. In the construction of the transmission line no less than 1,400,000 lbs. of copper will be utilized. On completion of the system, which will take two years, the Mexican capital will be furnished with nearly 40,000,000 gallons of pure spring water every 24 hours.

ELECTRICAL ENGINEERING IN BRITAIN.—At the recent International Engineering Congress at Glasgow, the presiding officer was Mr. James Mansergh, president of the British Institution of Civil Engineers. In the course of his opening address, he referred to foreign, and especially American, competition. He said that an alarm had been sounded in their ears of late, warning them that the United Kingdom had touched the high-water mark of the prosperity derivable from manufacturing industries, based upon engineering, or served by it with the means of transport and communication. This might be so. The nation had no royal secret for arresting the revolution of fortune's wheel. The question was whether Britishers could maintain their ground, to say nothing of increasing their lead. Would the engineer in future flourish best in Britain or abroad? One heard much talk nowadays about the British need for more technical education for workers, and of better instruction in the art of living for the people generally, and he was not disposed to disparage this desire for more light. He feared that only too good a case could be made out for the allegation that a mistaken statutory system had discouraged in Great Britain—for the time being, at least—the naturalization and development of electrical engineering on the largest scale. Instead of the electrical and mechanical development of lighting and power plant being undertaken upon a scale proportional to its early promise, the work had to be done by "sample"—every small specimen differing from the others. Long years passed before any English engineer was in a position to give out an electrical power contract amounting to $500,000. Meanwhile competitors in America and on the Continent of Europe had been forging fast ahead. So Englishmen had lost their chance, and would probably have to take other people's electrical plant for some time, instead of striking out their own leading line, as their forefathers did in railway work and shipbuilding years ago.

ELECTRICAL APPARATUS FOR NEW YORK RAPID TRANSIT SUBWAY.—The Rapid Transit Subway Construction Company, of New York, which is to operate the Rapid Transit tunnel when completetd, as already noted in these columns, has let contracts for the steam equipment of its power house. The contract for the electric generating apparatus, it is now announced, has been let to the Westinghouse Electric & Manufacturing Company. This contract includes six 5000-kw, 11,000-volt, three-phase generators of the revolving field type running at 75 r. p. m. at a frequency of 25 cycles. They are rated at 263 amperes per terminal, non-inductive load. The exciters for these machines are of 250 kilowatts, three in number. They will operate at 240 r. p. m. with a voltage of 250. For the substations 26 rotary converters of 1500 kilowatt capacity each are contracted for. These are to give a voltage on the direct-current side of 625 and will run at 250 r. p. m. For starting these rotary converters in the various sub-stations there are to be eight motor-generator sets consisting of induction motors coupled to direct-current generators. The contract also includes 78 step-down transformers of 550-kilowatt capacity each, arranged for giving 390 volts on the secondary terminals, with primary voltages of 9500, 9750, 10,000, 10,250 and 10,500. The alternating generators mentioned will have 40 poles; the frame will be built in seven sections. The fields will constitute the flywheel of the engine. These alternators will be of exactly the same capacity as the generators being built for the Manhattan Railway, New York.

NEW TELEPHONE APPARATUS FOR TOLEDO, OHIO.—The Sterling Electric Company, of Lafayette, Ind., has secured the complete contract for the central office apparatus of the new Home Telephone Company, Toledo, Ohio, consisting of a common battery, lamp signal, multiple switchboard, and comprising also a chief operator's desk, monitor's desk, wire chief's desk, trouble clerk's desk, and information desk. The board will be equipped at each position with the Sterling selective signal four-party line ringing keys. The company will supply also the main distributing board, with its combined "strong" and "sneak" current protective system; and the power board and storage batteries. In this system there is but one battery for talking and signaling and but one relay in the circuit, with consequent advantages. A similar installation is now being put in by the Sterling Company at Houston, Tex., and it is now building equipments for Galesburg and Rockford, Ill., and Peru, Ind.

ELECTRICAL STEERING GEAR.—That the advantages of steering vessels by electricity are receiving a great amount of attention is evinced by the fact that although the "Pfatischer system" has been before the public only a little over a year, the Electro-Dynamic Company, of Philadelphia, reports having orders to equip with it 11 vessels of an aggregate of 110,000 tons displacement. The Eastern Shipbuilding Company, after a careful investigation, has adopted the system for the two mammoth vessels it is now building for the Great Northern Steamship Company. The Electro-Dynamic Company has prepared for general circulation a pamphlet describing the method.

WESTINGHOUSE INTERESTS.—The announcement was made in these columns lately that the Westinghouse interests had purchased 650 acres of land near Stewart station, 20 miles from Pittsburg, on the Pennsylvania Railroad. The Westinghouse companies will, it is now stated, build a town at that point and concentrate there the foundries now operating in Pittsburg, Allegheny and Cleveland. The new plant will employ 2000 men, and will involve an outlay of about $5,000,000. The new town will be called Trafford Park.

THE PHILADELPHIA COMPANY.—A special meeting of the stockholders of the Philadelphia Company will be held on Dec. 4 to vote upon propositions to absorb the Consolidated and Southern Traction companies, the Pittsburg Express Company, and probably the Mellon lines and the Suburban Traction Company. At the same time the capital and bonded indebtedness of the Philadelphia Company will be increased. The exact necessities in this direction will not be known until the various deals pending are consummated.

THE GARTON-DANIELS COMPANY, Keokuk, Iowa, is doing a very handsome business in its kicking coils. One of its latest orders is from the Anglo-American Provision Company at Chicago, a new plant, for 10 coils of 1500 amperes each, with a maximum capacity of 2000 amperes.

ONONDAGA DYNAMO COMPANY, of Syracuse, N. Y., reports its excellent Pan-American exhibit unit as sold, and that inquiries are now in hand for several more.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material from the port of New York for the week ended Oct. 3: Antwerp—7 packages electrical machinery, $205; 21 packages, $1,900. Aden—1 package, $81. Argentine Republic—70 packages, $3,986. British Possessions in Africa—134 packages electrical machinery, $15,430; 93 packages, $4,085. Bristol—16 cases electrical machinery, $2,500. Bradford—35 packages copper wire, $270; 1 case electrical machinery, $145. Bremen—4 cases, $494. Berlin—1 case, $560. British East Indies—37 packages, $1,506; 22 packages electrical machinery, $1,160. British Guiana—43 packages, $746. British Australia—10 packages, $154. Brazil—106 cases, $9,318. British West Indies—21 cases, $623. Central America—17 cases, $549. Chili—1 case, $52. Cuba—1 case electrical machinery, $186; 603 cases, $1,942. Copenhagen—3 cases, $87. Cardiff—1 case, $80. Dutch West Indies—2 packages electrical machinery, $90; 3 packages, $21. Glasgow—38 cases electrical machinery, $2,416; 8 packages, $322. Genoa—2 packages, $467. Hamburg—1 case electrical machinery, $35; 55 packages, $6,738. Japan—251 cases, $26,503; 55 cases electrical machinery, $13,754. Havre—5 cases electrical machinery, $870; 23 cases, $1,759. Korea—8 cases electrical machinery, $145. Leeds—1 case, $85. Lisbon—8 packages, $995. Liverpool—15 packages electrical machinery, $961; 33 packages, $1,649; 275 packages copper wire, $11,060. London—203 packages electrical machinery, $20,673; 125 packages, $3,531. Manchester—1 package, $57; 43 packages electrical machinery, $2,709. Marseilles—2 cases, $260. Milan—1 case, $50. Mexico—231 cases, $19,771; 6 cases electrical machinery, $486. New Zealand—7 packages, $105. Newcastle—4 cases, $200. Philippines—21 cases, $390; 44 cases electrical machinery, $918. Peru—28 cases, $682. Paraguay—68 cases, $687. Riga—8 cases, $1,150. San Domingo—2 packages, $41. St. Petersburg—4 cases, $200. Southampton—42 packages, $5,265; 3 packages, $24. Siam—28 cases, $1,400. U. S. Colombia—2 cases, $41. Venezuela—52 cases, $702.

U. S. FOREIGN COMMERCE.—The record of the foreign commerce of the United States during the eight months ending with August, 1901, shows an increase in imports of $14,000,000, and in increase in exports of $23,000,000, comparing the 8 months of the calendar year 1901 with the corresponding 8 months of 1900. The increase in imports is chiefly in coffee and diamonds. For manufacturers' materials and manufactures ready for consumption the figures of 1901 are strikingly similar to those of 1900. Articles in a crude condition for use in manufacturing were in the 8 months of 1901, $198,702,596, against $198,961,392 in the same months of 1900; articles wholly or partially manufactured, for use in manufacturing, were in the 8 months of 1901, $54,795,758, against $55,994,569 in the same months of 1900; and manufactures ready for consumption were in the 8 months of 1901, $89,850,126, against $89,815,604 in the corresponding months of last year. On the export side the growth is chiefly in agricultural products, which increased $60,000,000, comparing the 8 months of 1901 with those of 1900. Products of the mine show a slight increase, those of the forest and fisheries a slight decrease. Manufactures show a decrease of over $36,000,000 for the 8 months, the figures for 8 months of 1900 being $304,087,505 and those of the 8 months of 1901 $267,853,957, a decrease of $36,233,548. An examination of the detailed statement of exports shows that this reduction is chiefly in copper, iron and steel, and mineral oil. The reduction in exports of copper alone is $18,649,227. The reduction in iron and steel exports is $17,827,830. The reduction in exports of mineral oil is $4,418,625. These three items, it will be observed, show a total reduction of $40,895,672, or about $4,000,000 greater than the net decrease in all manufactures exported, thus indicating that in other lines of manufactures than these three items there has been an increase.

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone & Telegraph for the month ended Sept. 30 shows:

	1901.	1900.	Changes.	
Gross output	75,578	44,190	Inc.	31,388
Returned	33,482	30,942	Inc.	2,540
Net output	42,096	13,248	Inc.	28,848
Since Dec. 20:				
Gross output	683,171	501,354	Inc.	181,817
Returned	301,289	220,903	Inc.	80,386
Net output	381,882	280,451	Inc.	101,431
Total outstanding.....	2,334,698	1,860,956	Inc.	473,742

PIPE CUTTING PLANT IN NEW YORK.—Crane Company, New York, a branch of Crane Company, Chicago, manufacturers of valves, fittings, pipe, etc., has added to its already large quarters a plant for the cutting, threading and flanging of large and small pipe and for pipe bending at 497 to 505 Cherry Street, connecting in the rear with the pipe storage warehouse at 742 and 744 Water Street, and being opposite the main warehouse at 490 and 502 Cherry Street. Being directly on the East River, and very easily accessible to lighters it is in an exceptionally convenient location for handling heavy work. The building is 125 ft. by 100 ft., the main shop being 110 ft. by 63 ft., and devoted to the cutting, threading and flanging of large pipe. The rear shop is devoted to the handling of small pipe and to pipe bending.

CONTRACTS IN PENNSYLVANIA.—The Iron City Engineering Company, 410 Penn Avenue, Pittsburg, reports having closed two sizable contracts, one at Uniontown, Pa., and the other at College Hill, Beaver Falls, Pa. The latter plant consists of a 50-hp Walrath gas engine, a 30-hp Warren inductor alternator, a switchboard made by the Crouse-Hinds Electric Company, 20 Manhattan enclosed arcs and pole line covering the entire town. The Uniontown contract consists of four 150-hp tandem compound direct-connected Ball engines, four 100-kw Crocker-Wheeler generators, one 6-panel switchboard made by the Crouse-Hinds Company, and conduit and wiring for the 12 floors of the building into which the plant goes. This contract was closed through the office of D. H. Burnham & Co., of Chicago.

TROLLEYS AND COTTON MILLS.—A recent special dispatch from Hartford, Conn., says: A force of 300 workmen is employed on the western section of the interstate trolley line between Danielson, Conn., and Providence, R. I. In a few months the entire line, of about 30 miles, will be completed. The section running from Providence to Foster, R. I., was finished in June. The construction of the road will bring the people of eastern Connecticut into closer touch with Providence than they have ever been before. One result of the building of the road has been the sale to Providence capitalists of three cotton mills at East Killingly, Conn., which were owned by W. R. Klein, of Pennsylvania. The factories have been idle about six years, but they will be started again as soon as needed repairs can be made.

RAILWAY CAR LIGHTING.—It is said that the Atchison, Topeka & Santa Fe Railway Company has adopted the system of the Consolidated Lighting Company and will pay for the 117 cars which are now in operation on the road. Mr. John N. Abott, vice-preisdent of the Consolidated Company, is now in Chicago. Mr. Isaac L. Rice, who is now in Europe, has made a contract with the Great Northern Railroad Company of England for 27 cars. This order has been secured through Vickers, Maxim Sons & Co., fiscal agents for the American Company.

NEW NIAGARA POWER TUNNEL.—The Canadian Niagara Falls Power Company has awarded the contract for the construction of the power tunnel to A. C. Douglass, the cost to be over $500,000. It is to be completed by Jan. 1, 1903, and will be over 2200 ft. long, extending from a point near the head of Cedar Island to the Gorge, a short distance below the Horseshoe Falls. The tunnel will be slightly larger than the tunnel on this side, but it will be of the same form.

BALL ENGINE CONTRACTS.—The Hocking Valley Railway Company, shops at Columbus, have recently placed in operation a 135-hp engine, built by the Ball Engine Company, Erie, Pa., and arranged for direct connection with the generator. The Ball Engine Company has also recently shipped engines for electric lighting to beet sugar factories at Loveland, Colo.; Saginaw, Mich., and Bay City, Mich.

NEW YORK FIRE SUPPLIES.—Bids were opened last week for certain supplies for the New York Fire Department. For furnishing the Boroughs of Manhattan and the Bronx 22,000 ft. of underground cable, the Safety Insulated Wire & Cable Company bid $3,490 and got the contract. The Standard Underground Cable Company bid $4,464, the James Reilly Repair & Supply Company $6,355, and the Manhattan Electric Supply Company, $6,420.

APPARATUS WANTED FOR CINCINNATI.—The C. H. & D. Railway is in the market for an auto car or any device that will give an independent movement of a passenger car for suburban travel. Mr. D. G. Edwards, C. H. & D. Traction Company, Cincinnati, Ohio, will be glad to hear from any of our readers who can furnish or suggest such apparatus.

ELECTRIC DRILLS.—The Marvin Electric Drill Company, whose plant is located in Canastota, N. Y., has increased its capital stock from $300,000 to $500,000. The company will increase the output of its factory.

SUPPLIES WANTED FOR COLORADO.—The electrical department of the steel works of the Colorado Fuel & Iron Company, Pueblo, Colo., is being greatly enlarged. Catalogues and bulletins of electrical apparatus and supplies for mill work are requested.

THE FEDERAL ELECTRIC COMPANY, 141 Broadway, New York City, is now placing orders for large quantities of line construction material for the Chinese market.

General News.

THE TELEPHONE.

OZARK, ARK.—The Home Telephone Company, recently organized here, purchased the interests of the Ozark Telephone Company. It has a switchboard capacity of 100 drops, and 70 subscribers. It has 30 miles of toll lines, and its charges are $1.50 per month for residences and $2 for business.

VICTORIA, B. C.—According to advices just received here from Japan, France is about to construct a telegraph from Tonquin to Amoy, and thence to Port Arthur, giving France direct communication to the Far East independent of British lines.

LOS ANGELES, CALIF.—The Telephone Hygienic Company has been incorporated; capital stock, $500,000. The incorporators are H. L. Cutter, E. H. Cutter, J. S. Osborn, W. R. Fales and G. J. Leovy.

WASHINGTON, D. C.—Proceedings in equity have been instituted in the Supreme Court of the District of Columbia against the Chesapeake & Potomac Telephone Company by Thomas T. Keane and Nicholas Auth, partners. The court is asked to restrain the telephone company from carrying into effect a threatened refusal to supply the complainants with telephone service, upon payment by the latter of the rental fixed by act of Congress approved June 30, 1898. The action is similar to the hundred or more cases heretofore brought against the same company. Chief Justice Bingham issued an order restraining the defendant pending the disposition of the test case now before the Supreme Court of the United States.

ATLANTA, GA.—The Federal Wireless Telephone & Telegraph Company is making efforts to obtain franchises to operate its system in Georgia. It proposes to establish offices at Atlanta, Augusta and the principal cities and larger towns in the State. It is stated that the Federal Company proposes to compete with the two principal telegraph companies and "flash messages through the air at one cent a word."

COVINGTON, GA.—An independent telephone system was put in operation here during September. This is a competitor of the Bell Company previously established.

STERLING, ILL.—The Whiteside County Telephone Company will make extensive improvements in Morrison as well as Sterling.

HARVARD, ILL.—A. B. Wager, of Woodstock, has sold out his telephone exchange to a syndicate composed of Judge C. H. Donnelly, Geo. W. Field and F. D. Joslyn.

CHICAGO, ILL.—The Lewistown Automatic Telephone Company, of Lewistown, has been granted a charter. Its capital stock is $2,000. Geo. F. Loar, Ralph Hanson and Lucien Gray are the incorporators.

ROCHELLE, ILL.—The stockholders of the Ogle County Telephone Company will vote upon the proposition of increasing the capital stock and also consider the advisability of consolidating with the Independent County Telephone Company of Polo.

CHICAGO, ILL.—About 500 linemen in the service of the Chicago Telephone Company struck on Oct. 1. Among the towns affected are Elgin, Aurora, Joliet, Rockford, Evanston, La Grange, Plainsfield, Lake Forest, Highland Park and Waukegan.

CHICAGO, ILL.—A formal demand has been made on the Chicago Telephone Company by the Illinois Manufacturers' Association that the company shall not charge more than $125 per annum for its service, under the so-called special service contract. This action is preliminary to the litigation which the association will institute against the telephone company to test its right to charge $175 per annum for the service in question.

INDIANAPOLIS, IND.—The Bell Telephone Company has a line from Columbus to North Vernon almost completed.

ORLEANS, IND.—The Georgia Telephone Company has been granted a franchise to build and maintain a telephone system in the town of Mitchell.

MORGANTOWN, IND.—The Morgantown Telephone Company has been incorporated; capital stock, $10,000. The directors are A. M. Fleener, E. M. Woods and H. J. Griffith.

UNION CITY, IND.—Another telephone line has been proposed here. Captain J. B. Ross presented an ordinance for the American Telephone & Telegraph Company, of Indiana, asking the Council for a franchise.

INDIANAPOLIS, IND.—The following-named companies have been incorporated: The Jackson County Telephone Company, capital $5,000; the Logansport Home Telephone Company, capital $150,000; the Cass County Telephone Company, capital $60,000.

LA PORTE CITY, IA.—Otto Wettsteit has been granted the right to erect a telephone exchange in La Porte.

SLOAN, IA.—The Odebolt (Iowa) Telephone Company is engaged in building a line from Mapleton to Smithland.

MONTOUR, IA.—A farmers' telephone line is to be built from Montour to Potter by J. Mages and Levi and James Arment.

TURNER, MAINE.—The New England Telephone Company has purchased the right to erect poles and string wires between Turner and Buckfield.

BOSTON, MASS.—The directors of the Erie Telegraph & Telephone Company are now understood to be planning, in connection with the proposed reorganization of their operating department, for the appointment of a general manager for their entire Southwestern property, who will have charge of their plants in Texas and Arkansas, with the territory divided into divisions practically as at present.

HOWELL, MICH.—The Livingston Home Telephone Company has been incorporated, with a capital stock of $100,000.

WEST LIBERTY, MICH.—A new telephone line, known as the Liberty and Hanover town line route, has been established.

GRAND RAPIDS, MICH.—The Michigan Telephone Company reports a large gain in subscribers during the month of August.

YPSILANTI, MICH.—An independent telephone company has applied for a franchise, and the council is said to look with favor on the matter.

GRAND RAPIDS, MICH.—At a regular meeting of the Citizen's Telephone Company it was reported that the affairs of the company were in excellent shape. A large quantity of materials was requisitioned for and new construction work will be begun on its arrival.

MENOMINEE, MICH.—The City Council has made formal demand on the Green Bay & Lake Michigan Telephone Company to file a bond to insure its good faith in respect to the building of a system in this city. The bond will be promptly furnished by the corporation. Mr. Edw. Munger is meeting with much encouragement in soliciting subscribers. Over a hundred have been secured.

JACKSON, MICH.—The People's Telephone Company of Jackson, recently incorporated with an authorized capital stock of $200,000, is now building its system. The plant will have an ultimate capacity of 2500 subscribers, 1500 drops having already been installed. The lines will connect with those of the United States Telephone Company. The plant includes 80,000 feet of Camp underground conduit, already laid down. Kellogg apparatus is used by the company. Extensions to all outlying towns and throughout the farming districts are contemplated.

ST. PAUL, MINN.—Judge Bunn has filed an order prohibiting the authorities from interfering with the poles and wires of the Northwestern Telephone Exchange Company during the trial of the case of the telephone company vs. the city of St. Paul.

CLINTON, MO.—The Mutual United Telephone Company has been incorporated, with a capital stock of $15,000. The incorporators are S. T. Neill, W. F. Hall and G. R. Lingle.

ST. LOUIS, MO.—The Police Telephone & Signal Company, of St. Louis, capital stock $50,000, has been incorporated by Henry A. Baker, Elisha Morgan, Eugene Buder and others.

TRENTON, N. J.—The Wireless Telegraph Company of America has been incorporated; capital stock, $3,000.

FULTON, MO.—The Missouri & Kansas Telephone Company has ordered materials and latest improved equipment for the reconstruction of its Fulton exchange. This company has also ordered material for the construction of a new toll line north via Mexico. These improvements will be completed early in November.

TRENTON, N. J.—The Bismarck Telephone & Electric Company, of Bismarck, N. D., has been incorporated in New Jersey; capital, $100,000. Incorporators: James Serne, Edmund Mancusi, Benjamin J. Flenchaus.

TRENTON, N. J.—A building which will rank among the best equipped telephone plants in America will shortly be erected by the Interstate Telephone Company in Trenton. The plans, prepared by Architects Brouse & Arend, have been accepted by the board of directors, and bids for the contract will probably be submitted next week.

WATKINS, N. Y.—The Watkins Telephone Company has been formed at this place.

ALBANY, N. Y.—The Oulcout Valley Telephone Company has been incorporated to operate a telephone system in the county of Delaware, N. Y. Capital, $3,000.

WAVERLY, N. Y.—The Waverly telephone system of this place has just finished laying about 1500 feet of underground conduits. New switchboards are being put in which will accommodate about 400 patrons, and other improvements are being made.

ITHACA, N. Y.—The construction of the Century telephone system which is to take the place of the present automatic plant will be begun immediately. The independent company is now rapidly building plants in various cities in this section of the State and will soon be able to make extensive long-distance connections.

ALBANY, N. Y.—The Seneca Falls Home Telephone Company, with a capital of $100,000, has been incorporated to operate in Seneca Falls, Tyre and Junius, Seneca County. The directors are Howard Hendrickson, of Albany; A. G. Lord, J. A. Drake, S. B. R. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin and J. H. Griswold, of Elyria, Ohio.

BELMONT, N. Y.—The telephone situation in this city continues decidedly warm. The Bell and independent interests are bitterly fighting each other, and the townspeople have divided their sentiment between the two companies. The outcome appears to be in favor of the anti-monopoly interests. The Belmont independent company is putting up a spirited fight, and results thus far are extremely satisfactory.

WELLSVILLE, N. Y.—The independent telephone company at Wellsville, under the management of H. W. Savidge, is steadily increasing its business, and the outlook is very satisfactory. The farmers in the neighborhood of Wellsville are rapidly becoming educated to the value of the telephone, and it is expected that within a short time the territory in this neighborhood will be covered with farm lines. The line of the Inter-Ocean Telephone & Telegraph Company is now being rapidly extended west from Wellsville. It will connect with Wellsville, Belmont, Friendship, Cuba, Olean, Salamanca, Little Valley, Cattaraugus, Randolph and Jamestown and all intermediate points, with a view to giving a complete long-distance service for the western part of the State, particularly on points on the Erie Railroad.

MAUMEE, OHIO.—The Bell Telephone Company has opened a fine new exchange building at Maumee.

OXFORD, OHIO.—The Lewisbury Telephone Company, of Preble County, has increased its capital stock from $1,500 to $10,000.

BATAVIA, OHIO.—The Citizen's Telephone Company, of Batavia, has been incorporated, with $50,000 to build a local exchange.

LEWISBURG, OHIO.—The Lewisburg Telephone Company, of Preble County, has increased its capital stock from $1,500 to $10,000, to provide for improvements.

AKRON, OHIO.—Electrical workers employed by the telephone companies at Akron are on strike, demanding 9 hours' work with 10 hours' pay, and recognition of the union.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company, one of the new properties of the Federal Telephone Company, has increased its capital stock from $200,000 to $250,000.

CIRCLEVILLE, OHIO.—The new exchange of the Circleville Citizens' Telephone Company is being connected up. Branch exchanges at Williamsport and Ashville will be connected up after Oct. 1.

PORT CLINTON, OHIO.—The submarine cable from Put-in-Bay and Middle Bass Islands to Port Clinton is giving excellent satisfaction. The cable is of an especially constructed type made by the Roebling Company.

CINCINNATI, OHIO.—The Hamilton County Commissioners have voted to install a branch telephone exchange in the county buildings in Cincinnati. The cost of switchboard, six trunk lines and 26 telephones will be $1,060.

BROOKVILLE, OHIO.—The Brookville Telephone Company, of Montgomery County, has been incorporated by O. E. Baker, Enos Shellabarger, J. C. Snyder, W. Z. Miller and N. W. Rinehart; capital stock, $6,000.

WARREN, OHIO.—The Lane Construction Company, of Warren, Ohio, has been formed to build telephone systems. Those interested are W. Hyde, W. T. Griswold, Thaddeus S. Lane, A. I. Powers and W. A. Smith. Capital, $5,000.

TOLEDO, OHIO.—The Toledo Home Telephone Company now has over 5000 contracts for the new service. Construction work is being pushed rapidly in all directions, and it is expected that the system will be completed by June 1, 1902.

CLEVELAND, OHIO.—The Findlay Home Telephone Company, one of the Federal properties, has about 1000 telephones in operation, and it is expected the list will be brought up to 1500 ultimately. About 300 farmers' lines are being connected up.

HAMILTON, OHIO.—The United States Telephone Company will open its long-distance toll stations in Hamilton within a few days. The independent lines have been kept out of this city for a long time through the opposition of the Bell Company.

TOLEDO, OHIO.—The Toledo Home Telephone Company has closed a contract with the Sterling Electric Company for a multiple common battery system switchboard, with 12,000 capacity for its new exchange now under construction. Work is being pushed on the underground district.

MANSFIELD, OHIO.—The independent telephone company at Mansfield will be in full operation about Dec. 1. About 500 houses have been connected up and about the same number are still to be wired. The system will reach a number of small towns in Richland County. This is one of the properties recently acquired by the Federal Telephone Company.

CINCINNATI, OHIO.—The Board of Public Service is in receipt of a request from the Fitzsimmons Telephone Company for permission to string wires. Electrician Weissleder returned the application to the Board without recommendation. This is the independent company which has tried at various times to get a foothold in Cincinnati without success.

COLUMBUS, OHIO.—According to the statement of State Auditor Guilbert, the growth of the telephone business in Ohio the past year has been most wonderful and an immense amount of money has been invested in new companies. The aggregate increase in the valuation of the telephone properties of the State would, he said, be very close to the $2,000,000 mark.

HAMILTON, OHIO.—Within the past few days citizens of Hamilton have cut down over 100 poles erected by the City & Suburban Telegraph & Telephone Association. In response to a general demand, the city Board of Control has revoked the permit granted to the company and ordered all poles removed. The telephone company refuses to do so, claiming that the permit was a contract. The matter will be fought in the courts.

CADIZ, OHIO.—The Harrison County Telephone Company has recently installed an exchange at Jewitt, Harrison County. It has also connected the towns of Jewitt, Short Creek, Adena, and Harrisville with the Cadiz exchange, making in all about 25 miles of toll lines just completed. The Farmers' Telephone Company, and the Harrison County Company are building a joint line to Hopedale which will give them connections through to Steubenville, St. Clairsville and Wheeling, W. Va. The United States Telephone Company (long distance) will build a line from Uhrichsville to Cadiz, which when completed will connect a number of Ohio River towns with the lake cities.

CLEVELAND, OHIO.—F. A. W. Lewin, for the past two years superintendent of construction for the United States Telephone Company, has tendered his resignation, to take effect Oct. 1. He will become general manager of the Peninsula Telephone Company, of Tampa, Fla. Mr. Lewin will be succeeded by W. C. Prickett, at present superintendent of construction for the Dayton Home Telephone Company, Dayton. The new company with which Mr. Lewin will be associated proposes to build an extensive system of independent exchanges and long-distance lines in Florida. It was promoted by Ohio people. The company has incorporated with $300,000 capital stock and the headquarters will be at Tampa. A large exchange will be installed there and auxiliary exchanges will be built in seven towns in the vicinity. These will be connected by toll lines, and a long-distance line will be built on right of way already secured along a railroad, to Jacksonville. Here connection will be made with lines to be built by the independent company in Georgia, giving connection with the Northern States. Small exchanges at Palmetto and Bradentown have been bought up and will be enlarged. The exchange at Tampa will have a switchboard of 1000 drops, with an ultimate capacity of 2500. Poles have been purchased and work has started on the underground lines. Specifications for the equipment of the Tampa exchange are being prepared and bids will be received in the near future.

CLEVELAND, OHIO.—There is considerable speculation among local telephone people as to the exact status of the Frontier Telephone Company, of Buffalo, which has just been incorporated in Albany to build long-distance lines connecting Buffalo, Rochester, Syracuse, Utica, Albany, Poughkeepsie, New York City, Tonawanda, Niagara Falls, Lockport, Dunkirk, Erie, Pa.; Cleveland, Ohio; Jamestown, Elmira, Binghamton, and Hornellsville, N. Y. Judge J. M. Thomas, of the Telephone, Telegraph & Cable Company of America, is mentioned as one of the directors. Mr. H. A. Everett, of the United States Telephone Company, says he has no knowledge of the company, and says he does not see how it can run into Cleveland, in view of the fact that the United States Company has wires extending east to Erie, which take care of all independent business in that section. Mr. B. G. Hubbell, president of the Consolidated Telephone Company, the parent organization of the Interstate Company, which is building long-distance lines in New York State, says that the new company has nothing to do with his companies, despite the fact that Judge Thomas is a director of both companies. The Inter-State lines touch Jamestown, Elmira, Binghamton and Hornellsville, and Mr. Hubbell says he does not see how it will be possible for the new company to build to these points in view of the fact that the Consolidated Company controls the exchanges and gives long-distance connection. It seems quite probable that, unknown to the Cleveland people, Judge Thomas has organized a new company for the purpose of building exchanges at Buffalo and other cities in the Northwestern section of New York State, and the Frontier company is to provide the long-distance connections for such exchanges. It is understood that in the near future an attempt will be made to build an independent exchange at Buffalo.

GUTHRIE, OKLA.—The North American Telephone Company purposes building a line from Texas through Indian Territory and Oklahoma to Kansas City and St. Louis.

RIDLEY PARK, PA.—Council has granted a franchise to the Keystone Telephone Company of Philadelphia.

ALBION, PA.—The Albion Telephone Company, Albion, Erie County, has been incorporated, with a capital of $5,500.

PHILADELPHIA, PA.—The Interstate Telephone Company has been granted a franchise to string wires through Woolwich township, Gloucester County.

HAZLETON, PA.—The Anthracite Telephone Company, a local concern, has voted to merge the line with the Consolidated Telephone Company of Pennsylvania, which will enter into active competition next year with the Bell Company.

PITTSBURG, PA.—Twenty new wires between New York and Chicago, to accommodate increasing telephone business over the Bell long-distance system, have been almost completed between New York and Pittsburg. The American Telephone and Telegraph Company aims to have the new line complete to Chicago by the first of the year. The lines reach Pittsburg by a new route through York, Latrobe, Ligonier and Somerset counties. The cost of the line from New York to Pittsburg will be over $800,000.

HARRISBURG, PA.—A charter has been issued by the State Department to the Cambria County Telephone Company, Cresson township, Cambria county, to operate in Cambria, Clearfield, Center, Blair, Bedford, Somerset, Fayette, Westmoreland, Allegheny, Armstrong, Beaver, Washington, Huntingdon, Mifflin, Juniata, Perry, Cumberland, Dauphin, Lebanon, Lancaster, Chester, Berks, Montgomery, Delaware, Butler and Philadelphia counties; capital, $50,000. Directors: G. S. Mitchell, John Pfeister, F. J. Burgoon, P. C. Hill, Gallitzin; L. T. Sanker, Loretto.

HARRISBURG, PA.—The consolidation of the Pennsylvania Telephone Company and the Central Pennsylvania Telephone & Supply Company went into effect on Oct. 1. The Pennsylvania Telephone Company has its headquarters at Harrisburg, and serves a territory extending from Hazleton to the Maryland line and from Lancaster to Bedford Springs. The Central Pennsylvania Telephone & Supply Company, whose headquarters are at Williamsport, serves a territory embracing fifteen counties, and extending from Forest City to Johnstown. The consolidated company will be known as the Pennsylvania Telephone Company. The headquarters will be at Harrisburg, and the general manager will be M. H. Buehler, at present general manager of the Pennsylvania Company. The Williamsport headquarters of the Central Company will be discontinued.

ALLENTOWN, PA.—The seven independent telephone companies of Eastern Pennsylvania have been merged into one general system, under the name of the Consolidated Telephone Companies of Pennsylvania, operating under the charter of the Schuylkill Valley Telephone & Telegraph Company, of Reading. These independent companies included the Interstate Telephone & Telegraph Company, having lines in operation from Scranton, through Pittston, Carbondale, Wilkesbarre, Hazleton, Mauch Chunk, Leighton, Allentown, Norristown to Philadelphia, where it connects with the Keystone, with which it has a traffic agreement, and a branch line to Trenton, connecting with the independent system of New Jersey and New York. The capital stock is $4,000,000. The present indebtedness is $2,500,000, which will be increased to purchase additional plants and to extend the system. These officers were elected: President, Robert E. Wright, Allentown; secretary, Dr. T. H. Leidy, Reading, and treasurer, C. M. W. Krell, Allentown.

SPARTANSBURG, S. C.—The American Bell Telephone Company is now completing its long-distance line to Asheville, N. C.

EUREKA, S. D.—The Eureka Telephone Company has purchased the Eureka and Mound City telephone system, and will at once extend its lines to Ashley and all the new towns on the Soo line.

NASHVILLE, TENN.—It is reported that the Cumberland Telephone Company may expend several thousand dollars on a proposed building for its executive headquarters.

MEMPHIS, TENN.—Jas. S. Warren, general manager of the Memphis Telephone Exchange (independent system) denies the truth in the rumor that his company will be absorbed by the Cumberland Company.

CANADIAN, TEX.—The Watonga Electric & Manufacturing Company has taken a charter to operate an ice plant, electric plant and telephone lines.

BEAUMONT, TEX.—The Beaumont Telephone Company has begun excavating for the underground conduit on Crocket Street for the new telephone system. The underground conduits will be used throughout the business section, covering a distance of about one mile in the central portion of the city.

NORFOLK, VA.—There is quite a hot telephone fight going on here between the Raleigh, the entirely local company, and the Inter-State. The Bell Company

does not appear to be drawn into the fight. The Raleigh Company says it proposes to have the local business and that this is its field. It offered to buy the local business of the Inter-State, but the latter asked a fancy figure.

RICHMOND, VA.—The Virginia Long-Distance Telephone Company and the consolidated local lines throughout the State, with James R. Kemper at Staunton as president, have sold out to the Bell Company. Many of the smaller companies were induced to consolidate to resist the Bell Company. The Richmond Telephone Company was allied with the Virginia Long-Distance in fighting the Bell Company here and was taken by surprise.

MADISON, WIS.—The Interurban Telephone Company of this city, with a capital of $200,000, has filed articles of incorporation. The company will construct and maintain a system of telephone lines and systems in this State which may later be extended outside of the State. The incorporators are A. L. Hutchinson, H. E. Kelper and Charles Schernecker.

CHEYENNE, WYO.—Work on the telephone line between Cheyenne, Casper and Douglas is progressing rapidly, and the Bell Company hopes to have the line in operation from Casper to Cheyenne before winter sets in.

Electric Light and Power.

SAN FRANCISCO, CALIF.—A project is being considered for the establishment of a jute bag factory in Colusa, with a capacity sufficient to supply all the grain growing territory tributary to that town. It is proposed to organize a joint stock company, with a capital of $100,000. The plant will be operated by electric power.

SAN FRANCISCO, CALIF.—The Quilty water-power, with headwaters in the Mt. Hamilton range of mountains beyond San Jose, Calif., has again come to the surface. It is reported that an engineering party is in the field to make preliminary surveys for an impounding dam, etc. It is claimed that quite an amount of power can be generated at a point 45 miles from San Francisco, and that an Eastern purchaser now holds the water rights formerly held by C. W. Quilty, of San Jose.

COVINGTON, GA.—The city has just completed an electric light plant and lights have been turned on. The system is valued at $15,000.

CHICAGO, ILL.—E. A. Cummings, Charles E. Bolles, Willis S. Herrick, and other citizens of Oak Park, who obtained a franchise last March to furnish heat, light, and power in that suburb under a new system, have taken out articles of incorporation at Springfield. The company is formed with a capital stock of $300,000, under the name of the Oak Park Yaryan Company, and a plant similar to those now in successful operation in several other cities will be built, in which the Yaryan system will be installed.

INDIANAPOLIS, IND.—A manufacturing suburb has been laid out south of this city and incorporated as South Indianapolis. Ten new factories are already secured. The promoters are building a large central electric power-house and electric light plant.

NEW ORLEANS, LA.—The Comptroller will advertise for bids for electric street lighting in this city after the expiration of the present contract, on Dec. 31, 1902. The specifications call for 301 series alternating enclosed arc lamps in the underground district and 2299 lamps of similar construction in the overhead district, a total of 2600 lamps, against 3027 open arc lights now used by the city. The contractor must also furnish 150,000 kilowatt hours' service per annum for incandescent lights, motors, fans, etc., in the public buildings.

WINNIPEG, MAN.—The Winnipeg Street Railway Company and the Ogilvie Milling Company have formulated a co-operative plan whereby they will jointly construct an immense power plant for the transmission of electric power from the Winnipeg River to this city. By this means their own establishments will be furnished and enough surplus electric power generated for the whole city. The plant will cost in the neighborhood of $1,000,000.

BIG RAPIDS, MICH.—The Ferris Industrial School has awarded the contract for a complete electrical equipment for its buildings.

GRAND RAPIDS, MICH.—The Gunn Furniture Company has bought a 50-kw dynamo and other equipment for lighting its factory.

VASSAR, MICH.—Hereafter this town will own the lighting plant, having bought out the private concern operating the lights heretofore.

GRAND RAPIDS, MICH.—The Oriel Cabinet Company, a large manufacturing concern, has just installed a modern 175-kw lighting dynamo to replace the antiquated machine formerly used. The contract was let to a local firm.

BIG RAPIDS, MICH.—A new dynamo has been installed in the lighting plant here and the city is again lighted electrically after a darkness of six weeks. Enclosed arc lamps of the latest type have been put up and better service than heretofore is expected.

ST. LOUIS, MO.—The price paid for a water franchise in St. Louis County at an auction sale before the St. Louis County Court, Sept. 30, was $32,000, and was bid by the Ariel Electric & Manufacturing Company. With the franchise for the water privileges goes the permission for the distribution of gas and electricity for heating, lighting and power purposes.

ST. LOUIS, MO.—Mr. E. G. Bruckman, president of the Imperial Electric Light, Heat & Power Company, received the money a few days ago for the sale of the company's plant and interests to the North American Company. The deal was arranged some time ago and all the details settled. But the final transfer was not made until last week. Mr. Bruckman will act as the representative of the company in this city, and will, it is said, endeavor to bring to a consummation the plans to continue all the lighting, heat and power companies in the city.

HAMLET, N. C.—G. O. Saunders has gone North to buy machinery for the new electric light plant which he will operate here.

FAYETTEVILLE, N. C.—The proposed contract between the city and the Cape Fear Electric Power Company calls for 100-horse-power for street lighting at $2,000 per year, to be furnished on or before Jan. 1, the city retaining an exclusive franchise for all arc and incandescent lights.

WADESBORO, N. C.—Samuel T. Stowe, of Charlotte, N. C., and Mr. Thurston, of Maine, are engaged in surveying the water power at Bluitt Falls on the Pee Dee River, some distance from Wadesboro. It is said that a charter will soon be obtained. The company will then be ready to let contracts for the construction of a dam, and for machinery for transmitting power.

MASSENA, N. Y.—Water was turned into the wheels of the St. Lawrence Power Company's plant at this place on Oct. 1.

PORT JERVIS, N. Y.—A meeting of the Deerpark Electric Light Company, the Port Jervis Gas Light Company, and the Port Jervis Electric Light & Power Company, was held, and a resolution was adopted to consolidate these three companies under the name of the Port Jervis Electric Light, Power & Gas Company. The following directors were then chosen: R. H. Beach, C. R. Horn, R. S. Weaver, Benjamin Ryall and W. A. Parshall. The new board then organized and chose the following officers: President, R. H. Beach; Secretary and Treasurer, C. R. Horn; Manager, R. S. Weaver.

COLUMBUS, OHIO.—Bids have been opened for street lighting. The Columbus Electric Light Company was the only bidder and offered to furnish 600 lights for dark hours only at $74.50 per lamp per year. The city will furnish 400 lights from the municipal lighting plant.

AKRON, OHIO.—The officials of the Canton & Akron Railway Company have applied to the Akron Council for a franchise to operate an electric lighting system in the streets of the city. If the franchise is secured it is the intention to build the power plant for the road near the city and to make a bid for the city's lighting which is now done by the Northern Ohio Traction Company.

SHAWNEE, OKLA.—The Shawnee Electric Light Company will install additional machinery to double its capacity.

OGDEN CITY, ORE.—Council has ordered the Mayor to enter into an agreement with the Portland General Electric Company for a term of six years to furnish arc lights for $7.00 and incandescents for $1.25 per month.

PITTSBURG, PA.—The Burnham Electric Light, Heat & Power Company has been incorporated at Lewistown; capital, $1,000.

HARRISBURG, PA.—Charters have been issued by the State Department to the following corporations: Suburban Electric Company, of Derry Township, Lewistown; capital, $1,000. Granville Electric Light Company, Lewistown; capital, $1,000. Reedsville Electric Light Company, Reedsville capital, $1,000.

CHATTANOOGA, TENN.—The People's Electric Light & Power Company has been organized in this city and a charter will be applied for at once. The incorporators are D. P. Montague, J. H. Warner, Edwin Warner, of Nashville; Frank Spurlock, and W. A. Sadd. The capital stock of the company is to be $200,000. J. H. Warner will be the general manager.

TULLAHOMA, TENN.—The Electric Light and Water Works Commissioners has awarded the contracts for the erection and construction of the water and electric light plants. The General Electric Supply Company, of Atlanta, got the contract for the dynamos and electrical apparatus. The entire contract amounts to $37,500.

ALVIN, TEX.—A move is on foot here to establish an electric light plant for this city. Some of the machinery is already on hand for the plant and if a sufficient number of subscribers can be secured the balance of the machinery will be ordered at once and work of erecting suitable buildings and poles begun.

SALT LAKE CITY, UTAH.—Clements Herschel, the hydraulic authority engaged by the Utah Light & Power Company to report on the feasibility of the proposed dam and reservoir in Ogden Canyon, has completed his labors, and submitted a report favorable to the project. An earthen dam with concrete core was suggested, sixty to seventy feet high, capable of impounding two billion cubic feet of water. The cost is estimated at $250,000.

SALT LAKE CITY, UTAH.—Believing that there is a field in Salt Lake for a new electric light and power company, H. F. Baker, on behalf of himself and a number of Eastern capitalists, is quietly canvassing the situation here with the view of ascertaining the probability of making such an enterprise a paying one. The promoters of the company are confident that they can furnish power and light at a less rate than that charged by the Utah Light & Power Company.

GREEN BAY, WIS.—Arrangements have been completed between the Green Bay and Depere Electric Light & Power companies, whereby the power which has been furnished from Depere from the water power there, will hereafter be generated in this city.

The Electric Railway.

LITTLE ROCK, ARK.—The City Council has granted the Little Rock Traction & Electric Company a 50-year street railway franchise.

ANNISTON, ALA.—The Woodstock Iron Company contemplates building an electric railway from its ore mines, at Rocky Hollow, to the Louisville & Nashville Railroad tracks. Residents on the proposed route are opposing the movement.

FRESNO, CALIF.—The Fresno City Railway Company was recently incorporated, with Fresno as the principal place of business. Electric railway lines aggregating 43 miles in length will be constructed. The directors are S. N. Griffith, W. H. McKenzie, F. M. Helm, W. M. Wyatt and W. T. Porter, all of Fresno; H. A. Voorman, H. C. Tilden and A. C. Jewett, of San Francisco, and Claus Kroeger, of Oakland. Capital stock, $500,000; subscribed, $43,000.

PENSACOLA, FLA.—All the motormen and conductors of the Pensacola Electric Terminal Railway went out on a strike on Sept. 29, because the company put a non-union man on one of the cars and instructed a motorman to break him in. The motorman refused and the company discharged him. The union demanded he be reinstated. The company refused to comply with the demand, hence the strike.

JACKSON, GA.—The proposed electric railway has advanced to the point of the granting of a franchise by the city to the Jackson Street Railway & Electric Light Company. The cost of the power plant at Ocmulgee River, equipment and lights is estimated at $100,000.

ATLANTA, GA.—President Jerome Simmons, of the Atlanta Rapid Transit Company, says that his company will build to Marietta, Stone Mountain, Buckhead and Manchester. This will mean the construction of thirty-three more miles of street railway for Atlanta. The two companies already have 142 miles, and this addition would give Atlanta 175 miles of electric railways.

ATLANTA, GA.—The sale of the Atlanta Railway & Power Company, reported recently has been ratified. The purchasers are a syndicate composed of the Old Colony Trust Company of New York, the New York Security Company, and the Mercantile Trust & Deposit Company of Baltimore. The purchase price has not been divulged. The Atlanta Rapid Transit Company is also owned by the above-mentioned syndicate, and Mr. H. M. Atkinson is now practically head of the combined properties worth according to estimate over $12,000,000, the Georgia Electric Light Company being included.

AUGUSTA, GA.—The Augusta Railway & Electric Company has secured the funds to make improvements and to wipe out all its previous liens by the sale of $1,000,000 of 5 per cent first mortgage bonds to the Mercantile Trust & Deposit Company of this city. These improvements have been in progress for some time, and it will take several months more to complete them. They will then represent an outlay of about $4,000,000. New and heavier machinery has been installed by the company, including two 1000-horse-power generators, which are directly connected to the turbine water wheels. Generators for the electric-light station, new boilers and engines and labor-saving machinery are also included. What is said to be the finest switchboard in the South is being installed. The machine shops are fitted up with an electric forge, an electric hammer, wire-insulating machinery, electric drills, electric saws and the usual complement of hydraulic presses, shearing machines, punchers, planers, lathes, emery wheels, etc.

WINCHESTER, IND.—The Eastern Indiana Traction Company has been granted a franchise to run tracks and operate cars through this city. The company is headed by Peter Schwab, of Hamilton, Ohio.

COLUMBUS, IND.—The Pennsylvania Company has begun the wiring of its line between this city and Indianapolis, for the purpose of running electric cars in competition with the Indianapolis, Greenwood & Franklin road. It is claimed that the railroad people find this necessary, as the electric line has taken a great part of the passenger and local freight traffic between Indianapolis and this city.

SHELBYVILLE, IND.—The Shelbyville & Southeastern Traction Company has been organized here and incorporated with a capital stock of $600,000 to build a line from this city to Indianapolis. The incorporators are Cleveland, Ohio, capitalists, headed by Ed. K. Adams. The franchises have been secured from both Shelby and Marion counties and private rights of way secured where necessary. The company has also let the contract to construct the line to a Chicago construction company, and work is to be commenced at once.

MILLBURY, MASS.—The promoters of the proposed trolley line from Worcester to Providence have petitioned for a charter in this State. A charter will be asked for the passage of the road in Rhode Island. The company will be capitalized for $200,000.

HOLLAND, MICH.—There is now quite a dispute here between the Mayor and the street railway company concerning the latter's attempt to put up new feed wires through the main thoroughfares. It looks as if the company would come out on top because it threatens to tie up the entire line if the Mayor's orders are enforced.

RALEIGH, N. C.—It is reported that the Raleigh electric street car line will be extended the entire length of Fayetteville Street.

UTICA, N. Y.—The Utica Belt Line and Suburn, Utica & Mohawk; Utica & Deerfield; Oneida Street Railway, and the Herkimer, Mohawk, Ilion & Frankfort Railway have been consolidated. The name of the consolidated company will be the Utica & Mohawk Valley Railway and the capitalization will be $3,000,000. All the stock has been taken by the incorporators.

ALBANY, N. Y.—The Westchester Traction Company has been incorporated, with a capital stock of $200,000, to operate a street surface electric road from Ossining to Pleasantville, Westchester County, a distance of five miles. The directors are Thomas F. Barrett, Harry M. Shaw, H. C. Willes, C. J. Harrington, D. E. Shaw, and P. C. Ackerman, of New York City, and R. E. Farley, G. N. Bissell, and J. M. Farley, of White Plains.

NEW YORK, N. Y.—The Edison Electric Illuminating Company has completed the work of laying a three-inch lead pipe, containing three conductors across the Bridge in order to connect with the feed wires of the Brooklyn Rapid Transit Company. The railroad company has been unable to secure sufficient power to operate its cars to the suburbs since the destruction of the Kent Avenue power-house. The current will be furnished by the Edison Company from its power-house in Manhattan. The cables will carry an alternating current of 6600 volts.

NEW YORK, N. Y.—Hearings took place last week before the State Railroad Commission on the application of the New York & Portchester Railroad Company to be allowed to build a four-track electric railway from 132d Street and the East River to Portchester. William C. Gottshall, president and engineer of the road, said that the road would be operated on the third-rail system. William Barclay Parsons, chief engineer of the Rapid Transit Commission, said he considered the proposed speed of twenty-one miles with ten stops in thirty-one minutes practicable. The cost of right of way for the road is estimated at $1,600,000, and that of construction and equipment $7,000,000. This road is intended to be operated in connection with the New York Rapid Transit Subway system.

CANTON, OHIO.—After a long fight the City Council of Canton has agreed to grant a franchise into town to the Northern Ohio Traction Company for its Akron, Massillon and Canton line, now under construction.

WARREN, OHIO.—The Mahoning Valley Railway Company is planning to establish a summer resort at Leavittsburg on the line being built from Warren. This will be on the through line from Cleveland to Warren.

HAMILTON, OHIO.—Five injunctions have been issued against the Millcreek Valley Railway in Hamilton and the road is effectively barred from building its line in Hamilton until the disputes are settled by the courts.

COLUMBUS, OHIO.—The Akron & Barberton Belt Line Railway Company and the Akron South Side Belt Line Company, Akron, have consolidated under the name of the Akron Belt Line Railway Company. The capital stock is fixed at $25,000.

XENIA, OHIO.—Officials of the Springfield-Xenia division of the Pennsylvania Railway announce that the branch will be equipped and operated by electricity within two months. Wire and heavy rails have been ordered. The road will be operated on the third rail system.

NEWCOMERSTOWN, OHIO.—The power for the operation of the Newcomerstown, White City and Uhrichsville electric railway will be obtained from a pair of horizontal turbines of 125 horse-power. A duplicate plant, of the same power, will be installed to be run by a gas engine. The company was recently incorporated by C. W. Walker, G. W. Reed, W. P. Sherron, Fred Elbery, J. L. Hillyer, Albert Elbery, W. J. Anderson and G. A. Parr. The capital stock is $10,000.

CLEVELAND, OHIO.—It is promised by Christmas sleeping cars will be run on a trolley line between Cleveland and Detroit on the line of the Lake Shore Electric Company. This is part of the system developed by the Mandelbaum-Pomeroy syndicate, which is ultimately to run from Detroit to Pittsburg.

CLEVELAND, OHIO.—New negotiations are in progress for the consolidation of the Columbus, Delaware & Marion Railway promoted by E. J. Lattimer and J. W. Holcomb, of Cleveland, and the Columbus, Delaware & Northern Traction Company, which is promoted by the Appleyard syndicate of Columbus.

CINCINNATI, OHIO.—Connection is expected to be made with some of the various suburban lines radiating from this city with the newly incorporated Indianapolis, Shelbyville & Southwestern. The construction of the road will be begun at once and it is expected that it will be finished by June 1. The line will be 26 miles long and will extend from Indianapolis to Shelbyville.

CLEVELAND, OHIO.—E. P. Roberts & Company have the contract for building the Muncie, Hartford & Ft. Wayne Traction Company's line in Indiana, which for the present will be about 30 miles in length. S. M. Hexter, of Cleveland, is president of the company and Messrs. J. G. Gilchrist and S. Osborn, of this city, directors. E. P. Roberts & Company are at present getting out specifications and contracts for grading, and line work will be let during the next two weeks.

SCRANTON, PA.—The employes of the Scranton Railway Company struck on Oct. 1 because two of their number were recently discharged for alleged dishonesty. The Union demanded their reinstatement, and the refusal of the company to do so resulted in the strike. Later reports state that the strike is a practical fizzle, and that it is not receiving favorable public sentiment. The company, it is stated, is running cars with fair regularity.

READING, PA.—The employes of the Union Traction Company in this city were called out on strike on the evening of Oct. 5. The trouble is the result of the discharge of two men and the inability of the four arbitrators to select the fifth. The company claims to be prepared to meet the trouble, and asserts that it has plenty of new men to take the places of the strikers. Only a few of the men obeyed the call, and these were promptly discharged. A majority of employes, it is stated, have renounced the union, and the road will be non-union hereafter.

BLOOMSBURG, PA.—A charter has been granted to the Shickshinny & Huntingdon Valley Electric Railway Company, and the Borough Council, at its last meeting, granted the company right of way through the streets of the borough. The road will connect Shickshinny, Harveyville and Huntingdon Mills, and will open up a rich farming district through which there is at present no railroad. It is understood that eventually the lower end of the county will be thus connected. The officers of the company are: President, R. M. Robinson; Secretary, R. M. Tubbs; Treasurer, E. W. Garrison; Directors, N. B. Rutter, E. S Stackhouse, J. D. Woodworth, C. B. Harned, Dr. J. B. Hess, J. C. Harvey, Captain John Robinson, all of Shickshinny.

NASHVILLE, TENN.—The Nashville Railway Company refused to employ the 150 motormen and conductors who joined the union recently and quit work pending a settlement of the question as to signing a surety bond which the men say is intended to hold them responsible for accidents occurring while on duty. The service is badly crippled.

CHATTANOOGA, TENN.—Major J. H. Warner and others interested in the Chattanooga Electric Railway Company, have applied for a charter for an electric company which will furnish power for manufacturing purposes and to the street railway company. This plan was adopted instead of enlarging the present power-house of the railway company, which would otherwise be required because of the extension of the road into various suburbs hitherto not reached by the line, and which are now being built.

PARIS, TEX.—The Paris Transit Company, of Paris, has been incorporated; capital stock, $100,000. The incorporators are: John A. Porter, F. N. Stormont, S. B. M. Long, R. W. Wortham, of Paris, and W. F. Little, of St. Louis.

SALT LAKE CITY, UTAH.—One of the final steps in the merging of the properties of the Salt Lake Railway Company, the Rapid Transit Company and the Utah Power Company into the Consolidated Railway Company, was taken on Sept. 27, in the filing of a first mortgage for $3,000,000. The bonds run for twenty years, drawing interest at 5 per cent.

RICHMOND, VA.—The Richmond & Petersburg Electric Railway Company expects to begin operating its line about the middle of November. All grading has been practically completed. Work is proceeding from the Richmond terminus.

NEW INDUSTRIAL COMPANIES.

THE P. T. MOTOR COMPANY, of East Orange, N. J., has been incorporated to manufacture motors; capital, $100,000. Incorporators: Albert R. Palmer, Edward T. Magoffin, John R. Turner.

THE ELECTRICAL INVESTMENT COMPANY, of Fort Wayne, Ind., has been incorporated with $100,000 capital stock. The company will buy bonds and stock of electric companies. All of the incorporators are Ft. Wayne men.

THE EMPIRE MOTOR CARRIAGE COMPANY, of New York City, has been incorporated at Albany, with a capital of $250,000. The directors are Bradley S. Teale, of Oneida; George B. Gurley, Henry T. Clinton, Thomas P. Payne and William A. Fitzpatrick, of New York City.

LEGAL.

FIGHTING OVER A SIGN.—The closing days of the Pan-American Exposition have been enlivened by a brisk fight in the courts at Buffalo between the Crocker-Wheeler and Westinghouse companies over a large lamp sign which the latter concern had put up in Electricity Building, and which was alleged by the Crocker-Wheeler Company to infringe on its territory. The Westinghouse people held that their sign was in place before the space below had been occupied, but the Crocker-Wheeler Company obtained a peremptory order for the sign's removal. The Westinghouse Company have complied with the mandate of the court, but in cutting off part of the sign have done a very clever piece of advertising, as whoever visits the building makes inquiries as to the missing letters and carefully spells them out for himself. Everybody seems happy over the result.

IMPORTANT BOOSTER LITIGATION.—Three bills were filed in Cleveland on October 7 in the United States Circuit Court for the Northern District of Ohio by the Electric Storage Battery Company, of Philadelphia, through its counsel, Mr. John R. Bennett, of New York City, against Sipe & Sigler, the Cleveland Electric Railway Company and the Cleveland & Chagrin Falls Railway Company, for infringement of the H. Ward Leonard so-called "Booster" patent, owned by the Battery Company. The outcome of these cases will be watched with keen interest by electric railway owners and builders throughout the United States, as they involve broadly the right to use what is known as the "booster" system, which is now regarded as so necessary in the application of storage batteries to electric railways. It is understood that these three suits in the Ohio District are preliminary to others to be brought in other jurisdictions.

OBITUARY.

THE LATE E. P. GLEASON.

ELLIOTT PERRY GLEASON. Last week we noted the death of Mr. E. P. Gleason, president and founder of the well-known concern in this city bearing his name, and are now able to present a recent portrait. Not only was he one of the pioneer inventors in the field of gas illumination, but in that of glass manufacture for lighting purposes. When electric illumination developed his company was again one of the first to make fittings and appliances solely intended for that new branch of industry, and to his long list of inventions he added globe holders, insulating joints and many fittings now standard. This again required new developments in glassware, and the Greenpoint factory started in 1883, one of the largest in the East, is far too small for the redoubled demands upon it. Mr. Gleason was what could be called a "business philanthropist." He disliked to see idle factories, and where a business appealed to him as one affording plenty of work, even if not very profitable to himself, he was prepared to finance it and "start the wheels." He had a faculty of choosing the right sort of lieutenants to aid him in his many ventures, which, being widely separated, could not all receive his personal attention. He was always easy to approach and took delight in going around among his men. Employing at least 1,000 hands, he knew the names of most of them, and could greet them intimately on the chance meeting of the moment. Though employing both union and non-union help—according to the location and conditions—Mr. Gleason never had a strike or any falling out with any of his working men, and any complaint, minor or otherwise, received his immediate attention, and if well founded was promptly remedied. Mr. Gleason was called "the workingman's friend"—a title given him by a newspaper twenty years ago. This title has stuck to him, and no action of his ever caused him to forfeit it. His life well typified the restless, acute, indefatigable, successful New England inventor, whose genius lies at the base of so much that is finest and best in American achievement in the arts and sciences. Without such men, no art can advance; with their aid any art will make giant strides to perfection. A number of nephews who were associated with Mr. Gleason in business will conduct the various branches as heretofore.

PERSONAL.

MR. JOHN A. GRIER has an interesting article in the Chicago *Daily News* on the respective electrical features, etc., of the Chicago World's Fair and the Buffalo Pan-American.

MR. LUTHER STIERINGER read a paper before the American Institute of Architects at Buffalo, during their convention last week, on "Electrical and Decorative Work in Connection with Exposition Buildings," in which a number of interesting and suggestive features were brought out.

MR. ROBERT HAMMOND, the veteran English electric lighting advocate, whose activity in the field of electrical engineering has continued with incessant vigor for the last twenty years, has been a visitor to this country to study electrical railway development, and returned to England by the "Majestic" on Wednesday, after a rapid participation in the American Street Railway Convention by way of bonne bouche. He met a number of old friends and made many new acquaintances during his all too brief stay in America.

EDUCATIONAL.

LECTURES ON ELECTRICITY.—Special attention is paid to electricity, in the course of free lectures announced by the New York Board of Education. Following is the programme: Principles and Practice in Electrical Engineering, by W. W. Ker, illustrated by stereopticon views and experiments. At the Young Men's Institute, No. 222 Bowery—Oct. 9, Magnetism; Oct, 16, Generation of Electricity; Oct. 23, The Electric Motor and Its Application; Oct. 30, Electric Arc Lighting; Nov. 6, Incandescent Electric Lighting; Nov. 13, Electro Plating and Electrotyping; Nov. 20, Wireless Telegraphy; Nov. 27, Electric Bells, Batteries and Alarms; Dec. 4, Electric Heating and Its Application; Dec. 11, Alternating Currents; Dec. 18, The Electric Storage Battery and Its Application. At the West Side Auditorium, No. 318 West 57th Street—Oct, 18, How Buildings Are Wired for Electricity; Oct. 25, Electrical Units and Measurements; Nov. 1, Thermo Electric Generators; Nov. 8, Recent Development in Wireless Telegraphy (Marconi's syntonic system); Nov. 22, Application of Electricity in Mining; Nov. 29, Electric Railways (Third Rail and Sectional System); Dec. 6, Application of Electric Signals; Dec. 13, The Modern Steam Engine.

Trade Notes.

ASSIGNMENT.—The Scott Automobile Company, of St. Louis, Mo., has made an assignment. The company was organized about a year ago to manufacture electric motors and automobiles.

SWEDEN.—The sun never sets on Cross oil filters. The Burt Manufacturing Company, of Akron, Ohio, the manufacturer reports them in use in 28 different countries. A shipment of them was recently made to Stockholm, Sweden.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising a receptacle which it claims is the only article which will make a wet job dry. It is the Newgard combined waterproof globe and receptacle, for which this company is general agent.

PAN-AMERICAN MAP.—The American District Steam Company, of Lockport, N. Y., is distributing, with its compliments, a pocket folding map of the Pan-American Exposition and the city of Buffalo. These maps will be found very serviceable to visitors to the Exposition.

PRESSES.—The E. W. Bliss Company, Brooklyn Borough, New York City, illustrates its complete line of drawing presses and spinning lathes in a neat 48-page pamphlet, just issued. The principal features of construction of many of the machines are briefly described.

REMOVAL NOTICE.—The Chicago office of the Cutler-Hammer Manufacturing Company, formerly at No. 403 Fisher Building, has been moved to Rooms 1232 and 1233 Monadnock Block, in order to facilitate its increased business in rheostats and devices for motor control. The office will be in charge of Mr. C. H. Norwood.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently got out a novelty in the medical battery line. It is complete, with all attachments, and is contained in an aluminum case seven inches long and two inches in diameter. It is most compact, and the latest thing of its kind on the market. It can be easily carried in the pocket.

FALCON SPECIALTIES.—The October bulletin (No. 8) of the Falcon Electric Manufacturing Company, New York, is devoted to that company's specialties, which include panel boards of all sizes, fuse blocks, lugs for knife switches, attaching plugs and flush receptacles, "Falcon" desk and bracket fans, "Falcon" motors and "Falcon" arc lamps. The pamphlet includes price lists and illustrations of these goods.

RUBEROID ROOFING.—This article has been in the market for many years, and is very well known to manufacturers and others as a reliable and serviceable roof covering. It is manufactured by the Standard Paint Company, 100 William Street, New York, and is one of the well known P. & B. products. The company has just brought out a neat leaflet in which it gives all the facts about Ruberoid roofing that any interested person cares to know, besides copies of many testimonial letters.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, which makes series and multiple clusters and electrical specialties, has had unusual success in its sales for September, its expectations having been more than realized. As a result, its factory facilities have had to be increased in order that it may keep up with the orders. Very many people who have used its clusters have expressed themselves as highly pleased with them and have evinced their sincerity by forwarding duplicate orders.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 1, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

683,235. MOTOR GENERATOR; René Thury, of Geneva, Switzerland. App. filed Jan. 11, 1900. The apparatus consists of a stationary armature and a hollow vertical shaft carrying differentially-wound revolving field coils; a centrifugal governor on the shaft cuts out the differential coils of the field for the purpose of controlling the speed of the apparatus; the commutator is stationery and the brushes are secured to the revolving shaft. (Issued Sept. 24.)

683,432. APPARATUS FOR LIGHTING VEHICLES BY ELECTRICITY; B. Bernstein, New York, N. Y. App. filed Nov. 28, 1900. The rotation of the axle of the vehicle operates the dynamo shaft through the medium of reciprocating friction clutches, so devised that constant rotation is imparted to the dynamo in one and the same direction whichever way the axle is running.

683,444. CIRCUIT CONTROLLER; W. W. Cower, New York, N. Y. App. filed Jan. 8, 1901. Details.

683,451. ELECTROMAGNET; E. B. Ellicott, Chicago, Ill. App. filed May 26, 1900. Consists in mounting the pole pieces fixedly upon the base-plate of the relay or other instrument and winding the coil upon a separate detachable core. The pole pieces are made the terminals of a circuit and the two ends of the detachable core are electrically insulated from one another and form the terminals of the helix. This facilitates replacement of a burnt-out coil.

683,460. SYSTEM OF DISTRIBUTION; W. S. Gould, New York, N. Y. App. filed Jan. 31, 1901. A main generator and storage battery and work-

683,843.—Railway Signal.

circuit connected thereto, an independent generator and switching means for transferring cells of the storage battery from the circuit of the main generator to the circuit of the independent generator while maintaining the said two circuits in disconnected relation.

683,480. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Evanston, Ill., and J. L. McQuarrie, Chicago, Ill. App. filed Aug. 19, 1898. (See page 597.)

683,494. BATTERY PLATE SEPARATOR; Henry C. Porter, Chicago, Ill. App. filed Feb. 5, 1900. A flat perforated sheet of insulating material with vertical strips of insulating material secured on both sides of the plate at the edges and to the middle of the plate.

683,505. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed Jan. [illegible] 1900. (See page [illegible])

683,521. ANCHOR FOR PIPES OF CONDUITS IN ELECTRICAL OR OTHER SYSTEMS; L. Teuscher, Laporte, Ind. App. filed May 16, 1901. The pipes inside of the conduit engage with the conduit at intervals so that end thrust on the pipe will be transmitted to the conduit.

683,534. TROLLEY; E. A. Wakefield, Pelham, Mass. App. filed May 31, 1901. Details.

683,558. MANUFACTURE AND REPAIR OF INCANDESCENT ELECTRIC LAMPS; F. Fanta, London, Eng. App. filed May 26, 1900. The filament of an old lamp is regenerated by opening the globe and circulating a current of hydro-carbon vapor through the globe simultaneously with the passage of current through the filament.

683,564. ELECTRIC APPLIANCE FOR TREATMENT OF DEFECTIVE HEARING; W. H. Loop, Cohoes, N. Y. App. filed Sept. 29, 1900. Copper and zinc wire are coiled together in the form of a tube for inserting into the ear.

683,569. AUTOMATIC SIGNALING SYSTEM FOR TELEPHONE EXCHANGES; J. L. McQuarrie, Chicago, Ill. App. filed Jan. 26, 1901. [illegible]

683,579. CUT-OUT BLOCK; H. O. Swoboda, New York, N. Y. App. filed Jan. 18, 1901. Details.

683,601. ELECTRIC BRAKE; E. A. Henry, Cresline, Kan. App. filed Sept. 17, 1900. A series of magnets are mounted to move on a rod or shaft, the latter being provided with shoulders to limit the movement of each magnet. The movements of the magnets apply or release the brake.

683,616. ELECTRICAL AUTOMATIC SAFETY HAND CONTACT FIRING KEY; T. J. Moriarty, Newport, R. I. App. filed Jan. 17, 1901. A spring separated split handle which when squeezed will close a circuit.

683,621. RAILWAY SIGNALING; W. G. Roome, Jersey City, N. J. App. filed Feb. 25, 1901. Storage batteries along the roadway for operating the signals are charged by dynamos operated by the moving train through circuits made up in part of the track rails.

683,622. ELECTRICAL MEASURING INSTRUMENT; H. O. Rugh, Sandwich, Ill. App. filed July 24, 1901. A Wheatstone bridge apparatus wherein by a peculiar arrangement of circuits the indicator in the bridge wire is dispensed and an indicator in one of the legs takes its place.

683,631. TELEPHONE RECEIVER; Hubert Lawrence White, Utica, N. Y. App. filed March 22, 1900. The improvement consists in attaching the permanent and electro-magnets to an inner shell or cup which is screwed down into the outer case, the cap clamping the diaphragm to the edge of the inner cup, and abutting against the shoulder of the outer case.

683,639. PROTECTIVE APPLIANCE; W. P. Crockett, Chicago, Ill. App. filed June 12, 1901. One end of a fuse is attached to a spring so that when the fuse is weakened, the spring will break and separate the parts.

683,657. ELECTRIC BURGLAR ALARM; A. J. Noreen, Chicago, Ill. App. filed March 9, 1901. Details.

683,663. DEVICE FOR TAKING OFF CURRENT FOR ELECTRIC TRAMWAYS; A. Reinecke, Neviges, Germany. App. filed April 12, 1901. The trolley wheel is supplanted by two balls between which the wire rests, flanges being used to prevent the wire from becoming displaced.

683,668. ELECTRICAL MEASURING INSTRUMENT; N. H. Suren, Needham, Mass. App. filed Feb. 16, 1901. Means for regulating the magnetic field containing the magnetized needle.

683,680. ELECTROMASSAGE DEVICE; L. J. Chapman, Columbus, Ohio. App. filed July 31, 1901. Details.

683,689. ELECTRIC OPERATION OF ELEVATORS; J. D. Hilder, Yonkers, N. Y. App. filed April 26, 1901. In a system where the elevator is controlled by means of push buttons, at each floor, means are provided for allowing the passenger to safely make his exit from the car before the latter can be moved by the operation of a push button at another floor.

683,690. APPARATUS FOR STERILIZING DISEASE GERMS; C. M. Johnson, New York, N. Y. App. June filed 13, 1900. A source of current and a pair of divided electrodes constructed and arranged to project the violet rays through diseased portions of the body.

683,692. PUSH BUTTON; C. J. Landin, Boston, Mass. App. filed Feb. 9, 1901. Details.

683,709. CONTROLLER FOR ELECTRICAL APPARATUS; G. W. Schilling, Philadelphia, Pa. App. filed May 16, 1901. To prevent the current from being thrown on too rapidly, the handle of the controller is caused to rise and fall over obstructions fixed in its path.

683,759. ELECTRIC SIGNALING APPARATUS; F. B. Herzog and S. K. Wheeler, New York, N. Y. App. filed Jan. 29, 1886. The first claim describes the invention as follows: In a signaling system, circuit controllers at two or more sub-stations, and at a central station, receiving mechanisms, each controlled by a magnet, each normally controllable from either sub-station, together with a circuit to each sub-station; the magnets which control the receiving mechanism being fewer in number than the number of these circuits; and automatically operated devices common to the circuits connecting with the receiving station, and acting, when one distant apparatus has secured control, to prevent interference from another station.

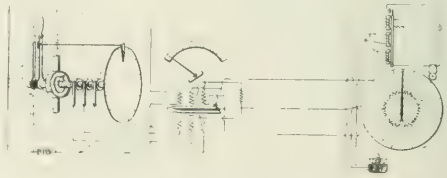
683,783. CROSSING SIGNAL FOR RAILWAYS; F. McBrien, Newark, N. J. App. filed April 19, 1901. An auxiliary circuit in connection with the other circuits, keeps the signal in operation, if a second train happens to be in the protected region before the first train leaves it.

683,831. ELECTRIC METER; V. Arcioni, Spoleto, Italy. App. filed June 5, 1901. Means for actuating a signal device simultaneously with the decrease of the current through the instrument.

683,836. PROCESS OF MAKING PAPER PULP; T. C. X. A. Berget, Paris, France. App. filed Dec. 5, 1900. (See page 591.)

683,839. CONTACT SHOE CARRIER; J. F. Bjurlund, Richmond Hill, N. Y. App. filed Dec. 5, 1900. An elliptical spring of peculiar construction is inserted between the bracket and the shoe.

683,843. RAILWAY SIGNAL; F. E. Button, New York, N. Y. App. filed Aug. 9, 1900. The circuits operating the signals are such that trains enter-



683,872.—Electrical Signaling Apparatus.

ing opposite ends of a block at the same instant will be apprised of the fact, notwithstanding that each train is capable of setting the signals at both ends of the block on its entry thereto.

683,845. APPARATUS FOR THREADING CONDUITS; T. A. Callahan, St. Louis, Mo. App. filed Jan. 17, 1901. A threading device which can be moved through the conduit in either direction at will.

683,849. INDICATING MECHANISM; J. P. Coleman, Edgewood Park, Pa. App. filed Nov. 14, 1900. Details.

683,872. ELECTRICAL SIGNALING APPARATUS; A. U. Alcock, London, Eng. App. filed Jan. 21, 1901. This invention consists of various improvements in signaling apparatus of the kind in which the transmitting and receiving instrument are connected by three wires, and the indicator of the receiving instrument is caused to move synchronously with a movable part of the transmitting instrument.

683,876. GAS LIGHTER; S. Boronow, New York, N. Y. App. filed July 5, 1901. A portable device consisting of a handle containing a battery, and an incandescing wire to be heated upon the closing of the circuit by a push button attached to the handle.

A Great Trolley and Elevated Railway Center, City Hall Park, Borough of Brooklyn.

Twentieth Annual Meeting of the American Street Railway Association

In accordance with the arrangements and programme, the twentieth annual meeting of the American Street Railway Association began on October 9 at Madison Square Garden, New York, in the large concert hall, the amphitheatre and the large restaurant adjoining being filled to overflowing with exhibits.

President W. H. Holmes, of Kansas City, called the convention to order at 10.45 a. m., and introduced Mr. Randolph Guggenheimer, president of the Municipal Council of New York City, who delivered a brief address of welcome.

President Holmes, in responding to the address of welcome, said he felt that he but feebly voiced the sentiment of every member of the association when he said that not the slightest doubt was ever entertained that the meeting in New York would prove to be the most enjoyable and profitable in its history. After referring in feeling terms to the untimely taking off of the late President, and expressing a profound hope that red-handed anarchy would never be seen in our midst again, he pointed out the great good likely to flow from the appointment at the last meeting of a commitee on the standardization of street railway equipment. Referring to the enormous development in street railway transportation he said that the street railway manager is now nothing more nor less than a merchant selling rides on a large scale. The profit of each ride is so small that money is to be made only by doing a large business. This fact every competent manager fully realizes, and hence it is that he is ever willing to introduce improvements everywhere, even to the casting aside and discarding of substantial and valuable equipment when it can be shown that such action would bring anything like an adequate return in the way of increased patronage. The value to the members of the exhibits of manufacturers and supply men was dwelt upon, and he believed that a careful and discriminating study of them would be almost an education in itself. Attention was directed to the important work of the Accountants' Association, which is accomplishing much of value in its special department and greatly facilitating the interchange of desirable information and promoting the safe and economical administration of the affairs of the street railway companies.

Secretary Penington presented his report as secretary and treasurer, which showed the association to be in a good financial condition. The receipts for the year were $14,753, which included a balance of $7,000 from the previous year. The expenditures were $4,624, leaving a balance of $10,128. During the year the membership was increased by 24, and subtracting 6 withdrawn on account of consolidations, the total membership is now 181.

STREET RAILWAYS.—A REVIEW OF THE PAST AND A FORECAST OF THE FUTURE.

In a paper with the above title, Mr. Robert McCullough sketched the situation which existed with respect to transportation in cities previous to the advent of the "bob-tailed car," and dwelt on the relatively primitive condition of the street railway up to the introduction of electric traction. Now the street car has ceased to be the "poor man's carriage," and is everybody's carriage. It has ceased to be purely a necessity, a large proportion of its revenue coming from travel induced by pleasure alone. It has exercised a great effect in expanding and beautifying cities and has led to a revolution in retail mercantile business. It has also exercised a great social effect. The former occupant of the tenement house no longer lives at the threshold of the factory or shop, the street railway having extended the time limit to the cottage in the suburbs.

Referring to the subject of municipal ownership, Mr. McCullough says that looking back over the rapid and costly changes of the last few years, it is questionable if municipalities would have been strong enough and bold enough to have discarded the old and grasped the new, owing to the lack of the stimulating expectancy of success and

reward that have nerved the individual to determination and risk and resulted in existing conditions. No city of this country could have attained its present development had its transportation facilities been as limited as the best given by municipalities now in control of that important service. That the ownership and control by the city of water and light supply have been found of advantage does not warrant the assumption that the same result would follow the municipal operation of street railways. The former services may exist under the baneful political influences and incumbrances with which they are embarrassed, but it is questionable if the daily transportation of the people of a city would be in safe or capable hands when intrusted to those whose terms of office and position rest on influences in which merit is not a consideration.

THE ADOPTION OF ELECTRIC SIGNALS ON SUBURBAN AND INTERURBAN RAILWAYS OF SINGLE OR DOUBLE-TRACK AND THEIR ECONOMY OF OPERATION.

Mr. William Pestell, in a paper, treated the subject of signals for electric railways, which, he said, is receiving a great deal of attention in all sections of the country at the present time. The delays and inconvenience in the operation of single-track interurban roads without a properly designed signal system are very apparent. Signaling on steam railroads has for some years been in satisfactory and general use, but apparatus used on steam roads would be of no use in electric railway service. On steam railroads where a temporary increase in traffic demands a greater carrying capacity, more cars are added to the train. In electric railway service several cars are sent out instead of a train. This complicates the work to be done by signals, because the various cars operating on the same schedule cannot keep very close together, and there is danger that the crews of the preceding cars will not notify cars going in the opposite direction of cars that are to follow. Where no signal system is in use, some roads attach signs to the dash of a car when another car is to follow. On steam railroads stopping places are fixed, and there are always employes at every stopping place.

The telephone is rapidly being introduced on the lines of electric railways for the purpose of dispatching cars. This has the disadvantage that some time is lost by train crews in communicating with the dispatcher's office. The telephone, however, is considered desirable as an aid in operating street railway systems. The object of a signal system for interurban railways should be to indicate a safe passing point for cars going in opposite directions, giving single track roads with fairly frequent passing points nearly the same operating conditions as those of double-track roads, thus avoiding delays in maintaining schedule time. All signals will add certain elements of danger due to chances of failure inherent in every piece of mechanism. It is therefore important to select a signal with the chances of failure so slight that only the added safety resulting from its use may be considered. The use of block signals on steam roads has reduced the liability of rear-end collisions, and yet were the signals of such construction as to be unreliable the danger would be greater than without the signals.

Among the various types of signals in use are those depending solely on incandescent lamps, those depending solely on semaphores, or disks, illuminated at night, and those on disks, or semaphores, visible in the daytime. Another type of signal cuts the current from the trolley wire on the entering side of a turnout head, and the leaving side of the turnout behind, thus preventing a car from either end of the block entering until the block is clear. There are various devices for operating the above signals, first, the manually operated switch; second, the rail contact device; third, the switches operated automatically for the passing of the trolley. The recommendations of the commitee of the Massachusetts Street Railway Association on signals are the use of a telephone and some kind of block signals suited to the conditions. Letters sent out to all the electric railway companies in the United States indicated that the prevalent idea is that signals are very desirable for single-track lines, but that those in use are not absolutely reliable and are generally affected by lightning, and that they do not indicate more than one car on a block at a time. No definite conclusions are reached in the paper other than those outlined.

STORAGE BATTERY LOCATED IN POWER HOUSE.

Mr. W. E. Harrington, in his paper with the above title, besides treating the subject in a general way, gave detailed information concerning the operation of a storage battery in the Camden, N. J., power house. A point, he said, which is usually lost sight of in connection with the use of storage batteries, is that they reduce the rate of depreciation of the machinery in the power house and may more than pay by reduction in the expenditures for repairs and by prolonging the life of generating apparatus, the expense charged against storage battery depreciation. An incidental advantage of a storage battery installation is the protection which it affords from lightning. The plates offer, through the electrolyte, such an excellent path to current, as well as acting as a large condenser, as to give the best protection that can be obtained against the serious effects of lightning discharges.

Data was given of the test of the plant of the Camden power house. The storage battery consists of 265 chloride cells installed in lead-lined tanks and having a capacity of 300 amperes for a one-hour discharge. All the fluctuations in the load were taken care of by the storage battery, the average charge of which was 59 amperes and the average discharge 57 amperes, though it frequently reached 200 amperes and at times even 300 amperes and over. On the charging side the current frequently reached 180 amperes; the maximum fluctuation, therefore, ranged about 450 amperes.

The Camden & Suburban Railway Company has a line running 7½ miles from the power house to a town called Haddonfield, equipped with 40 double-truck cars running on a headway of 10 minutes. The voltage at Haddonfield varied from 350 to 500 volts, the power station voltage being maintained at 550 volts. A calculation showed that the installation of sufficient copper to bring the lowest voltage above 450 volts would require an investment of $16,416 in copper. It was found, however, that a storage battery, ground and building for the same, the battery to have a one-hour discharge rate of 160 amperes, would cost but $9,000. A battery was, therefore, installed consisting of 240 chloride cells, the cost of the maintenance of which has not been over $100 per year. The attention required is only nominal, the battery being tested by a man sent from the power house once a week. The night car on this line is run from the battery an average of four hours each night. Taking into consideration the saving from this and other sources, including motor depreciation, the investment was an excellent one. The paper gives a plan for the installation of a storage battery sub-station.

THE PUBLIC, THE OPERATOR AND THE COMPANY.

Mr. Charles H. Sargeant devoted a considerable portion of a paper with the above title to a consideration of the taxation of electric railways. He believes it will generally be admitted that the burden of the taxes levied upon the railways falls upon the public who use the cars. It must follow then that such burdens tend either to increase the fares or maintain them at a high level, or diminish the facilities afforded the public in the quality of cars and track, frequency of service and its general maintenance. Any tax on the street railway company is a restraint of transportation facilities. Erroneous ideas prevail in the public mind relative to the profits to be derived from street railway enterprises. Those who are engaged in the business realize that the utmost endeavor and watchfulness are necessary to secure a fair return upon the investment when there are added burdens in the way of excessive taxation or otherwise. The operator is then in need of all the experience and skill to save a proper dividend from the net earnings. In conclusion, Mr. Sargeant said that it would seem to be in the power of the association and within the scope of its duties to take some action looking toward unity of legislation relative to street railway companies and to lend aid by disseminating information upon many points as to which the general public is entirely ignorant.

THE BEST MANNER AND MODE OF CONDUCTING THE RETURN CIRCUIT TO THE POWER HOUSE.

In a paper with this title Mr. E. G. Connette advocated an independent return circuit. With bonded rails, even when the greatest care is observed and the best material is used, the deflection of the joints in the course of time from various causes will impair the efficiency of the ground return.

A few years ago when electricity as a motive force had been perfected to such a degree as induced the street surface railroads to transform their motive power from horse power to electric power, there were two electric companies in the field offering apparatus for street car propulsion, viz.: The Sprague Electric Company and the Thomson-Houston Electric Company. In 1890, the writer assumed the management of a street railway company, a part of which was being equipped by the Sprague Electric Company and the other by the Thomson-Houston Electric Company. The Sprague Electric

Company used the rails of the track exclusively for conveying the return circuit and used a No. 6 galvanized iron bond, riveted to the rails. After reviewing the subject of rail bonding as practiced since the first electric railway to date, he concludes that the best manner and mode of conducting the return circuit to the power house is by using practically a jointless and independent metallic return, connected to each rail, and the connection made with ample surface contact and absolutely water tight. On account of the chemical action, which is likely to take place between the copper rivet and the steel rail, the rivet should be covered with a thick coating of lead, solder or tin. The best connection which can be used, if the facilities are available, is to electrically weld the connection from the auxiliary ground wire to the center of each rail, and that even with the extra initial cost of an independent ground wire, it will result economically in the long run.

Mr. Connette considers that if an independent metallic return circuit was the custom now, there would be no more need of discussing the subject of rail bonding, or of electrolysis, or of the best method for discovering bad connections in the return circuit, and the expenditure of a large amount of money for expert investigation and advice to cure the bad results of the present imperfect system of conducting the return circuit to the power house; and that the amount saved by loss of power, cost of rail bonds and labor of renewals, tests and investigations, as well as the trouble and expense incident to electrolytic action will be more than ample to pay a large interest upon the cost of installing an independent ground return.

Cast iron joints and electrically welded plates on the joints makes the rails of the track practically a jointless metallic circuit as a conveyance for the electric current, but the very large number of joints in the rails of the track makes the certainty of an unbroken and continuous metallic circuit a doubtful proposition, as the wear and tear of heavy traffic, and the expansion and contraction of the metal will, in the course of time, produce results, which may very materially impair the efficiency of the joints as a perfect conductor. It is just as essential to have a conductor as perfect and asefficient in carrying capacity, to convey the current back to the power house, as is used to convey the current from the power house to the car, and if this were the case, there would be no more troubles with the return circuit. An independent metallic return used in connection with the single trolley system is not as expensive to install as the double trolley system, and practically obviates all the troubles incident to the ground return where the rails with bonded joints are used for the return circuit.

In a short paper Mr. J .W. Baumhoff said the subject assigned to him—The American Street Railway Association; the Purposes of Its Organization and the Benefit Accruing to Investors in and Operators of Street Railway Properties by Membership Therein—justifies a paper in keeping with the title, but that he shall merely endeavor to enumerate some of the more important of the many advantages of membership in the association. He pointed out the benefit that had been derived from membership in the days of the horse railway, and during the period leading to the present state of the art, and said that the users of electrical power are now looking forward with eager eyes to still greater achievements in the improvement of street railways. He paid a tribute to Littell, Longstreet and Lowry for their notable part in bringing to the present stage of efficiency the street railway system of this country, which system the entire world has adopted as its standard.

The association, he said, doubtless represents through its membership a greater combined capital than any organization or association in the world. It has been the means of saving millions of dollars to investors in street railway properties, by information imparted through papers and discussions at its annual meetings, particularly during the period of transition from animal to mechanical traction. He referred to the appointment by the association of a committee on standardizing street railway equipment as another step in the right direction, which would doubtless prove of inestimable value to the investor and manager. Another auxiliary having its origin in the association, the importance of which cannot be overlooked, is the electric railway press, through whose untiring efforts the industry is constantly advised of improved methods.

ALTERNATING AND DIRECT-CURRENT TRANSMISSION ON CITY LINES.

Mr. M. S. Hopkins introduces a paper having the above title with the statement that he is not an electrical engineer, and has had no experience with alternating currents. He considers, however, that the growth of city street railway systems and the increased suburban traffic which comes with that growth severely tax the direct-current distribution systems at present in use in many cities. Five different plans have been used to meet these increased demands on the feeder system: First, the addition of copper to the feeder system, which has already reached enormous proportions; second, increasing the voltage on certain feeders by means of boosters; third, the installation of storage batteries at the ends of lines; fourth, the supply of an additional power station located with reference to economy of copper; fifth, the installation of an alternating-current system in the main power station and rotary converter sub-stations at convenient points. The first four plans mentioned lack flexibility, and when extensions are made a large outlay for copper is required. The author then takes up the advantages of polyphase alternating-current transmission for city service.

For long-distribution distances alternating-current transmission is now almost universally adopted where an entirely new plant is installed. The many weak points which are always present in any new system have all been worked out and remedied. Railway plants now in operation can with advantage make future additions of alternating-current machinery and still use the direct-current system within an economical range, leaving the alternating-current distribution to take care of the outlying districts. Alternating current machinery, consisting of generators, step-up and step-down transformers and rotary converters, as now built, are simple in operation and should require but very little more attention than direct-current machinery. The generators should require even less attention than a direct-current unit of the same size. The step-up and step-down transformers require practically no attention. The rotary converters can be located at convenient points along the line, as at car houses or other places where an attendant is necessarily on duty at all times.

In installing an alternating-current system in connection with direct-current systems, it would seem wise to use a number of small rotary converters located at load centers over the line. These machines can be worked in parallel with the existing direct-current feeders. The rotary converters will then take the average load and the direct-current feeders will help take sudden fluctuations. A temporary sub-station mounted on a flat car which can be easily moved from point to point will be found very convenient for the extreme, unusual loads which occur in most cities at certain points on special occasions. Where the transmission voltage does not exceed 6600 volts, it is possible to avoid step-down transformers, and for temporary sub-stations of this kind an induction motor driving a generator is recommended instead of rotaries, as the induction motor can be supplied directly from the 6600-volt line without step-down transformers. The three-phase system and 25-cycle apparatus have demonstrated themselves to be the best for railway service.

Mr. Hopkins stated that the Columbus Railway Company, with which he has been connected, operates two steam power plants. The stations are directly connected by a heavy feeder system, but part of the year one station can handle the entire load. These are direct-current stations. Tests were made to determine the loss in two direct-current feeders running north and east to the suburbs, wattmeters being put at the power house and at the end of the feeder. The loss in these feeders averaged from 31 to 23 per cent for 18 hours of the day. On another line the loss varied from 40 per cent during the winter months to from 60 to 75 per cent during the summer months. It is proposed to install an alternating-current generator for supplying the three longest feeder lines, and put in three sub-stations at car houses and other convenient points on these lines. In addition to this a portable sub-station will be used where it is needed. With these sub-stations installed $27,547 worth of direct-current feeder wire would be replaced by the use of a sub-station. The copper required for the alternating-current high-tension lines cost $10,000, leaving $17,547 to help pay the cost of the sub-stations. The sub-stations are estimated to cost $47,000, leaving $29,453 as the investment required for the alternating-current distribution. The interest on this investment should be taken care of by the saving in transmission losses over the old direct-current system. Assuming the cost of producing a kilowatt-hour of energy to be .6 cent, exclusive of fixed charges, the loss shown by the wattmeter readings on the sections to be fed by the sub-stations would amount to $5,363 yearly for the direct-current distribution. It is finally calculated that the net saving in cost of power to operate the cars due to the installation of alternating current transmission would be equivalent to 12.8 per cent on the investment required to put in the alternating-current apparatus.

THE MODERN POWER HOUSE AND THE USE OF COOLING TOWERS FOR CONDENSING PURPOSES.

In a paper with this title, Mr. J. H. Vail, after sketching the position of the steam engine at the end of the nineteenth century, and touching on the use of pulverized fuel and superheated steam, considered at length the subject of cooling towers and condensing systems.

As a practical illustration of the value of the cooling tower in condensation, Mr. Vail referred to the Twenty-sixth Street station of the New York Edison Company, which he designed in 1887, and which was started in 1888. The maximum equipment was limited to 2600 horse-power, with the best selection of apparatus then obtainable, but with the original designed boiler capacity, through improvements in engines and dynamos, and the application of a cooling tower and condenser system, the maximum capacity is increased to 6000 horse-power. At present there are in this country upward of 500 cooling tower installations that range in capacity from 250 to 1200 horse-power.

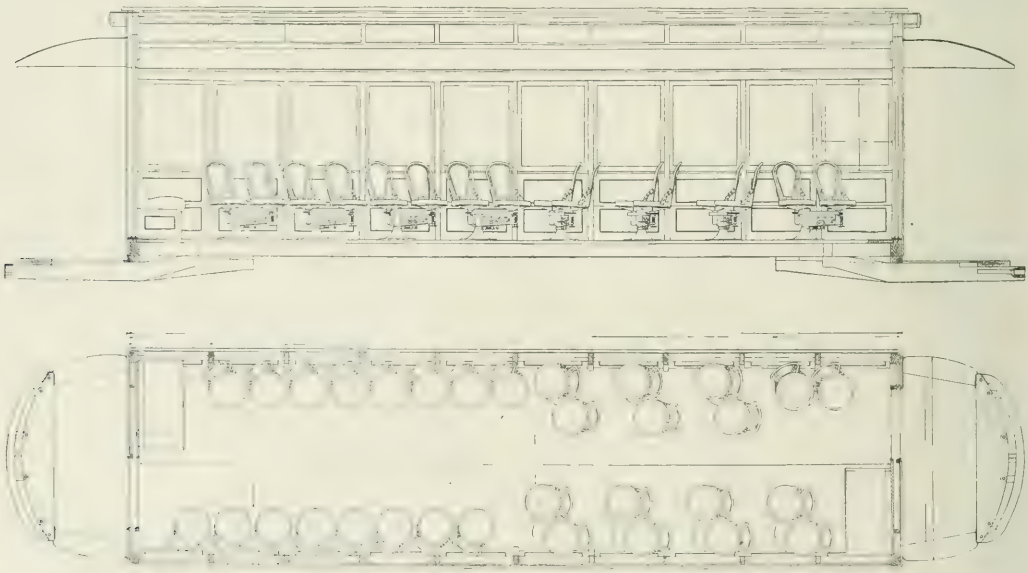
The cooling water should be estimated at not less than 30 times the steam consumption of the engine, and 2000 times more air than water will be required. Actual results with cooling towers show a range of from 30 to 50 degs. reduction of temperature of circulating water, and a vacuum of 23 to 27 inches is readily obtained. The loss of circulating water due to evaporation in passing through the tower is from 1 to 3 per cent. The forced draught or fan type of tower possesses a wide range of flexibility in manipulation, and where the amount of heat to be removed is great and the duty is severe in the hot summer months, more work can be done with it than with the fanless type. The fans should be capable of being driven at variable speed, and this flexibility is better obtained by having a small engine direct connected to the shaft of each pair of fans, than by a motor drive. In winter there are many times when the low temperature of the air circulating through the tower will cool the water without running the fans. A jet condenser may be used where the cooling tower is located at the ground level, but where it is set on a roof or much elevated above the pumps, it is preferable to use the surface condenser, as there will be a balance water column and the work on the pump is simply against the head of water due to the height of the tower.

FIGS. 1, 2 AND 3.—INTERIOR VIEWS OF CAR, SHOWING DIFFERENT ARRANGEMENTS OF SEATS.

Motor-driven pumps are suggested as preferable to steam pumps on the score of economy. In an instance given, with an atmospheric temperature of 96 degs. and a temperature of condenser discharge of 130 degs., the temperature of the circulating water was lowered 37 degs. by passing through towers, and a vacuum of 24½ inches was obtained. In a given case where the total of horse-power was 643, a gain of 157 horse-power was made by the introduction of a condenser and cooling tower. The tower was located on the roof and water was elevated 58 ft., a jet condenser being used; had a surface condenser been used the result would have been still better.

THE BEST FORM OF CAR FOR STREET SERVICE.

The greater portion of a paper with the above title, read by Mr. Eugene Chamberlin, is devoted to the description of a type of car shown in the accompanying illustrations. In this car the window sashes are movable, being held in position by three set-screws passing through each side and tapping into bosses cast on metal strips in position on the outside face of the posts. It is stated that a



FIGS. 4 AND 5.—SECTION AND PLAN OF CAR.

change from the closed to the open car may be effected by the removal of the sash in about 40 minutes. At the window openings grooves are cut diagonally from top to bottom on the side of the posts to take cable curtain fixtures, so that when the sashes are removed and the curtains are drawn down, they incline outward, thus forming a satisfactory watershed during storms.

The seats are of the individual revolving type and rest upon a movable arm, the arm being in turn pivoted out of center upon a fixed base secured to the car floor. This device allows the seats to shift in pairs from across a car to lengthwise a car. In the first case there is an aisle 22 inches in width, and the second case, one 44 inches in width, the car then being prepared for a standing load. In either position there are seats for 36 passengers. Electric heaters are arranged along the wall of the car at convenient points, and when the seats are in longitudinal position the heaters are entirely out of contact with women's dresses. It is proposed to install electric heaters in the arm supporting the chairs as a more desirable location to bring the heat near the central axis of the car. Among the advantages given for this kind of car when used as an open car is the less liability to accidents to passengers than with the open car with side steps or running boards.

THE RELATION OF INTERURBAN ROADS TO CITY ROADS

Mr. Ira A. McCormack in a paper with the above title introduced the subject with the statement that the relations between a city road and an interurban entering over the tracks of the city road should very closely resemble the relations existing between the members of a partnership firm. Each should miss no opportunity of developing their mutual interests even though controlled by different owners. In the Eastern part of the United States the majority of the suburban roads are simply extensions of the lines of the city companies; in the West, however, the interurban lines are in many cases built by independent companies. There in the early days it was often the case that the interurban cars only extended to the city limits and the passengers transferred to the city cars because no satisfactory traffic agreements had been made between the two companies. This system is not conducive to the full development of the interurban business. The public do not like to change cars and run the risk of poor connections at transfer points. The presence of the interurban cars on the city streets is also an advertisement for the interurban line.

So many points must be covered by traffic agreements between the city and interurban roads that they are becoming more and more difficult to draw up. The questions of weight, wheels, voltage, type of car, freight and express service, and many other matters must be decided. The interurban cars being much heavier than city cars, the city tracks are often not suited for the former. The wheels used on interurban cars also have wider treads and deeper flanges than those on city cars, and provision must be made in the switches and crossings for these larger flanges. The Master Car Builders' standard form of wheel as used by American steam roads is recommended for interurban cars, and it is suggested that all special track work laid in cities be designed with a view to admitting this size of wheel flange. Some city companies are now doing this. In others the traffic agreements specify that the interurban company must make all changes in special track work made necessary by the use of unusually heavy cars or extra large flanges. The use of T-rail is advocated for city streets for a number of reasons. It can be so paved as to be perfectly satisfactory and there is less tendency for teams to drive on the tracks than with a girder rail. The distance apart of tracks and width of cars is another question that must be considered. In some cities the distance apart of tracks is regulated by law, and the interurban cars which enter on such tracks cannot exceed certain widths.

Freight handling by interurban lines is discussed, and the opinion expressed that care should be taken that the interurban lines do not interfere with the city lines in unloading and loading freight or express. The freight business is stated to be too important a branch of interurban railway service to be neglected. The traffic agreements made between city and interurban companies in a number of cities are reviewed at some length in this paper, but a full reading of the paper is necessary to an understanding of the points brought out. The carrying of local city passengers by interurban cars is then taken up and the opinion expressed that as far as possible the interurban cars should not carry city passengers, as it tends to delay the interurban service and to crowd the cars to the discomfort of long-distance passengers. Interurban lines are improving the speed and quality of service to such an extent that it is a question whether some of these roads will be able satisfactorily to serve their patrons by entering over the lines of city railway companies with the necessarily slow schedules involved therein.

In the discussion, Mr. McCormack referred to the difficulty in obtaining information from different companies in relation to traffic agreements. He was surprised to find that it is in the Western cities where traffic agreements are made between interurban and city roads, and that very few of these agreements exist in the East. Mr. Albion Lang, of Toledo, said that the contracts made in Cleveland, Cincinnati and Detroit were on the basis of the interurban cars doing city work, the interurban company being paid a certain mileage for the use of its cars in the city. In Toledo the interurban roads run their cars into the city and out again and assume all liability of accident. This, however, is not desirable unless the contract contains some provision which gives the city road practically the control of the interurban road employes. In Toledo an arrangement is projected whereby, upon giving notice to the interurban company that an employe refuses to recognize the authority of the city superintendent, the man shall be immediately discharged. Mr. Lang considers that the rapid transit feature of interurban roads is a factor of value to the city companies, and hence in contracts which his company has made it is provided that the city company shall pay to the interurban company a proportion of the fares collected, ranging from 3 to 4 cents per passenger. As to freight business, a temporary contract has been made whereby the city company receives from the interurban company a proportion of the freight receipts based on the mileage over the city lines. He is not satisfied, however, that this is a good provision to make or that it is fair to either side.

In Toledo and also in Cleveland there is a central station for handling freight, located in the heart of the city, to which the freight cars of the interurban roads run. The plan is to charge the suburban companies a rental for the use of the building based on the cost of the land and building, taxes, depreciation, etc. It is expected that later on a company will be formed for doing the express and freight business of the city, to solicit business and exchange it between the roads. He referred to the difficulties that arise from interurban roads having adopted different wheels than those used on city cars. The Toledo interurban roads have built cars designed especially for freight business, which are run at given hours during the day. It has been arranged that these freight cars shall not trail through the central part of the city. Mr. Lang said that the favor with which this freight traffic is received is astonishing, and the butchers, grocers and others patronize it very generally. He referred to the use of the "Bonnar Rail Truck" in one or two cities in Michigan. This consists of a wagon built with a wide tread wheel that is mounted on a truck, which makes trips about a farm and is then put on a truck and carried on the street railway into the city, where it is taken off the truck to make delivery in the city.

Mr. O. T. Crosby said that while he thinks that present arrangements between city and suburban roads are based upon conditions as they now exist, yet he believes that these conditions are going to change and much of present practice must change with the conditions. In addition to a determination of the question whether ownership shall be vested in the town, city or country road, there are other questions to consider of a mechanical and electrical character. The tendency is toward a divergence of mechanical operation in the case of the city and suburban road. The former has practically reached its limit with respect to the size and speed of car, while the interurban road has not yet reached such a limit. It is probable that we must approximate our interurban service more to that of steam roads. It would appear that a special track would be needed for handling large high-speed suburban cars. The ultimate relation between the two classes of service depends upon the solution of the problem as to the fair and proper limit of the size, weight and speed of interurban cars that may be handled in a typical city service. Mr. Willis E. Gray approved the considerations brought forward by Mr. Crosby. The suburban service being in its infancy a great many problems will come up for solution which will require mechanical changes in equipment.

Mr. L. E. Meyers, who said that he represented a joint steam and electric railway road, said that his company operates steam locomotives and electric passenger cars over the same tracks. Through business is handled with steam locomotives and there are two local freight trains each way daily for the transportaion of such bulky packages as cannot be carried on the passenger cars. He considers that the interurban electric railway will be developed substantially along the lines of steam railway evolution. He disagreed with an

opinion expressed that the relations of the steam railroad and the interurban electric railroad are going to be closer, his experience leading him to believe that instead of the relations becoming closer they will become more antagonistic as the success of the interurban railway becomes more clearly defined. His idea of the solution of the problem of the relations between interurban and city roads, is for an independent entrance station owned by the city company, the city business to belong to the city company and the interurban company should not expect to participate in that busines under any circumstances.

Mr. Nicholls said that he is operating a road from the center of the city of Rochester, 41 miles to Sodus Bay, and also some 100 miles of track in the city. About two-thirds of the interurban lines is on a highway and one-third on private right of way. The satisfactory rail for interurban tracks is a T-rail with a wide tread and deep flange about the same as that used for steam railroads. As the cars have to run in the city, the maximum length was fixed at 45 ft. in order to go around corners of the streets, and the width was limited to 7 ft. 9 inches by the track gauge. If this company were to build the line again they would provide for a private right of way as near to the lines of the highway travel as possible, in order to obviate numerous stops. This company is going on the principle that the city road is entitled to very nearly all the income from the interurban cars over city tracks, and contracts have been made on the basis of the earnings per mile or per car-hour of city lines. If an interurban car runs over a line which gives a revenue of 20 cents per car-mile this amount is charged and divided up between power and operation, the city line furnishing the power and men for interurban cars. As soon as the car reaches the city limits it is turned over to the city company, and the crew becomes entirely under its charge. If any of the crew are not satisfactory they are required to be discharged, and if certain repairs are not made within a given time the city company has the power to make them or keep the car off its tracks. The freight business is done in cars which have much the appearance of passenger cars in order to comply with the wishes of the people of the city. These are run to a depot in the central part of the city.

Mr. McCormack said that in Brooklyn both the electric road and the Long Island steam railroad had failed in endeavors to get farmers to take advantage of plans to transport their wagons on trucks into the city. Referring to a statement that interurban roads would necessarily require such large cars as to necessitate a change of passengers at the city limits, he considers that such a change of passengers is impracticable as such a practice would conflict too much with the transportaion of city passengers.

Mr. Davidson, of Pittsburg, said that so far as the conditions are in Pittsburg, the interurban problem will have to be solved by bringing the cars into the city over the city tracks, and that this would necessitate a change in the rails of the city roads to meet the conditions of the interurban roads. Referring to a suit in a case where the question was as to what one company should pay another for the use of tracks in the ctiy, Mr. Davidson said that the court decided in principle that the compensation should be on the basis of the passengers carried as against compensation on the basis of actual investment. The court, however, instead of awarding a price per passenger, figured out a sum on the basis of the average passengers carried by the interurban road the past five or six years.

PRESIDENT H. H. VREELAND.

H. H. VREELAND.

The new president of the American Street Railway Association, Mr. H. H. Vreeland, whose portrait is shown herewith, was born at Glen. N. Y., and is the youngest son of a poor clergyman, with a large family. He thus had virtually to carve his own way in the world, and at the early age of 10 years he was engaged in driving a wagon in Jersey City. When only thirteen years of age he was given a place by a brother as one of a gang of men and boys employed to fill ice carts for city delivery. He went soon after into the service of the Long Island Railroad in 1875, and he remained with the company until 1881. His first position was on one of the company's night construction trains, but later his ability secured for him a position as inspector of ties and roadbed. The sum of $1 a day accompanied this title. In time he became a brakeman. After serving a few months he was appointed a conductor on a regular train, jumping a long "waiting" list. Control of the road passed into other hands shortly after, and under the new management he was given a most important charge by the president of the company. When the control of the Long Island Railroad again changed, and Mr. Vreeland severed his connection with it.

Mr. Vreeland next became connected with the New York & Northern Railroad, a short steam railroad running from 155th Street, New York, to Yonkers, and owned largely by William C. Whitney, Daniel S. Lamont and others. These gentlemen soon recognized his ability, and after having made him general manager of this road elected him president and general manager of the Houston Street, West Street & Pavonia Ferry Railroad, then recently acquired by the same interests. In 1893 he was elected president of its successor, the Metropolitan Street Railway Company. It is largely owing to his ability and experience that the Metropolitan Street Railway has been brought to the state of perfection in which it is to-day. Any one familiar with the system knows how vast and complicated are its problems, and the brilliant success that Mr. Vreeland has made is a matter of world-wide recognition. Probably no road in the universe is visited so much by experts from Europe in search of information and advice, and it has been said that there is not a city in the old world where Mr. Vreeland would not find some one to whom he has thus opened up freely the Metropolitan data and methods.

It is almost needless to add that Mr. Vreeland is active and prominent in social life. His interests center, however, in traction, and he is not only president of the Association, but a member of the board of the New York State Street Railway Association, and president of the New York Railroad Club.

CONVENTION AND EXHIBIT NOTES.

MADISON SQUARE GARDEN never looked better as a display of machinery than it has done this week, and thanks to the energy of Manager Marcus Nathan the exhibition was a pronounced success, the finest thing of the kind by far that has ever been seen at a railway or electrical convention. Not only was every foot of space taken by 120 exhibitors, but many spaces were cut down, and then there were still a good many disappointeed people who came too late. The main floor was filled chock-a-block and all the space was also occupied in the gallery or balcony built around the arena over the first tier of boxes. Then the big restaurant had to be surrendered to exhibits, and every inch was taken there. The Garden was tastefully decorated, and a pleasing effect was obtained by the uniformity of the deep red cloth background of the side walls of the arena and gallery. All the incandescent lighting available was used and was reinforced by many electric signs and space lighting, the New York Edison Company also running in a special service expressly for exhibitors to supply free power. The New York Telephone Company also furnished a free telephone service, with enclosed booths for all and with desk telephones in the leading exhibits. The attendance throughout the week was remarkably good, and of a strikingly high average. In other words, few people were there for curiosity, and, of course, the street railway men and supply men constituted at all times a large proportion of the assemblage. We give herewith a number of notes and a few views of the exhibits, and shall return to the subject next week, the convention being still in full swing as we go to press.

THE ATTENDANCE at the convention was remarkably large; in fact, early on Wednesday morning the supply of badges had given out before noon, and another couple of thousand had been ordered. The crush of delegates, supply men, exhibitors, etc., was so great as to well-nigh paralyze the excellent system of registration. The attendance in the meeting was also very large at all times, and the papers and discussions proved to be far above the usual standard. In short, the New York convention will constitue a record that it will require some pretty tall hustling to beat.

AMONG THE VISITORS at the convention from abroad were Professor G. Gillon, of the University of Louvain, representing the Belgian Government; Mr. A. H. Pott, on behalf of Sir W. H. Preece, and the engineering firm of Preece & Cardew; and the veteran English electrical promoter and parliamentary expert, Mr. Robert Hammond.

CLUB LIFE cut quite a figure in the week's proceedings, lunch and dinner parties occurring at the Manhattan, Reform, Lotus, Engineers'.

University and New York Athletic clubs, as well as at other leading institutions of the kind.

The Wabash Special.—A large number of street railway officials and supply men left Chicago for New York Monday at 3 p. m. The train consisted of four Pullman car, as dining and baggage car. It was in charge of W. C. Keeran, of the Wabash road, and had the right of way over all other trains. At Syracuse the train took the famous Empire Express engine 999. All day the beautiful scenery of New York State was viewed with delight as the train rolled rapidly over the New York Central and West Shore tracks. The train arrived at Weehawken station at 4.45 p. m. Tuesday. Every one was well pleased with the services of both the Wabash and West Shore roads, and great credit is due Mr. Keeran for his attention to the personal comfort of the passengers. The party numbered 77 persons, many gentlemen being accompanied by their wives.

Consulting and Electrical Engineers were numerous in the crowd, and among them may be mentioned Frank R. Ford, A. B. Herrick, B. J. Arnold, H. G. Stott, E. P. Roberts, R. H. Pierce, F. B Rae, Thorburn Reid, J. H. Vail, H. A. Lardner, W. B. Donaldson, M. Loewenthal, H. D. Black, H. Floy, W. S. Barstow and E. R. Knowles.

The Morris Electric Company, of New York, was spread over the south gallery, and was represented by George C. Ewing, president; E. P. Morris, treasurer; H. S. Sanville, secretary, and Harry Desteese. The Monarch registers made by the Morris Electric Company attracted favorable attention, as well as the Morris rail bonds and overhead material. The lines on exhibition included the apparatus of the Electric Railway Equipment Company, the Garton-Daniels Company, the American Electric Switch Company, the Hunter Illuminated Sign Company, Globe Electric Manufacturing Company, and the Erie Exploration Company, for all of which the company is agent.

The Hunter Illuminated Car Sign Company, Cincinnati, exhibited its illuminated car signs and a special rotary advertising sign constructed to be run by a motor operating on the outside of the sign. This motor revolves curtains on which are displayed advertisements of a general nature, and such as can be placed in the front of business houses of the larger cities. The company was represented by Lytle J. Hunter, E. L. Hawkins and William Willing.

The Bierbaum & Merrick Metal Company, Buffalo, N. Y., represented by William H. Barr and E. P. Sharp, had a neat little display of bearings and steel flange trolley wheels.

The Gould Storage Battery Company, of New York, on the main floor, exhibited samples of both formed and unformed Gould plates, which have thin ribs or laminæ spun on them from the solid lead sheets, varying in thickness from .012 to .024 inch, the grooves between varying from .008 to .012 inch. The chemical process of forming which the plates undergo fills the space between laminæ with active material. A cell was shown with an antimony-lead tank for central station use, with glass plates inside for insulating purposes. This type was installed for the Lansing Street Railway power house. The company exhibited also a couple of 600 ampere-hour cells as installed in the Commercial Building, New York. Mr. W. W. Donaldson, sales engineer, was in charge of the exhibit. Messrs. W. S. Gould, general manager, and A. S. Hubbard, consulting engineer, were also in attendance.

The McGuire Manufacturing Company, of Chicago, represented by B. F. Stewart, sales manager of Chicago, and Mr. Davenport, was unfortunate in the allotment of space, but had a sample of one of 300 trucks built for the Great Northern Railway, of England, on exhibition in the south gallery, and also one of 30 trucks for the Birkenhead Corporation, Birkenhead, England. The shipment of such large orders of trucks from Chicago to England was obviously a source of much favorable comment.

The Albert & J. M. Anderson Company, of Boston, Mass., was represented by Mr. Albert Anderson and Ernst Woltman, the New York manager, and made a typical exhibit of the street railway supplies which have made their name familiar. An Anderson trolley wheel was shown which had done 10,000 miles on the famous Jungfrau mountain railway, and which had at last worn through in several places at the hub. The absolutely even wear shown by this trolley wheel emphasized the excellence of the material. Another curious piece was a trolley car which had been subjected to a short circuit, and had completely fused away at one side of the ear, the iron casing of the insulation being melted. This immense heat had, however, failed to effect the Anderson insulation noticeably. The exhibit included two very large direct-current switches, one of 6000 amperes designed by Mr. T. H. Tapley, chief electrician of the Government Printing Office, in Washington, and the other by the engineers of the New York Edison Company for use here, the latter having a capacity easily of 10,000 amperes, and weighing 2500 lbs. It is practically a switchboard comprising, as it does, seven independent switches between massive bars of copper, and is mounted on a five-inch slate base. In front of the booth were two "Monarc" enclosed arc lamps for use on trolley circuits. At the rear of the space were two boards containing a full line of the Aetna and Heckla specialties in overhead line material, rail insulators, types of standard Anderson switches, etc.; a large 200-ampere switch, and many types of break switches were shown. The exhibit embraced also the special type of switch used under the hoods of the Brooklyn elevated railroad cars and quick-break feeder switches for attaching to trolley poles, as well as the Ajax quick-break feeder switches, model panels for both feeder and generator sections of the street railway switchboard, and other specialties with which the name of Anderson is so favorably associated.

The Simplex Electrical Company, Cambridgeport, Mass., showed its electric car heaters, and in addition made a display of electric heating devices for a variety of purposes. Its exhibit was always surrounded by admirers of this collection of up-to-date heating apparatus.

The Bishop Gutta Percha Company, of New York, had a very neat display in the gallery in charge of Mr. H. D. Reed, superintendent, and Mr. I. W. Smith. A specialty was made of railway cables, this company having been very successful with conductors for car

EXHIBIT OF BISHOP RAILWAY WIRES AND CABLES.

wiring where moisture resisting qualities are essential. Some pieces of raw gutta percha and para rubber were included in the exhibit, which thus included the raw material and the highly finished product.

Merritt & Co., Philadelphia, distributed a handsome booklet, illustrating and describing their system of shop lockers and calling attention to their architectural and ornamental iron and wire work.

The Lorain Steel Company, of Lorain, Ohio, showed a large amount of its special work for street railway service, and a group of its traction motors, including a 37-hp motor complete and open for inspection; 50-hp and 75-hp motors and a 50-hp armature was shown with the casing removed. Beside the railway motors shown in the space there were four 50-hp Lorain motors with gears and case complete in the space occupied by the Sprague Electric Company and operated by the Sprague multiple unit system. A No. 64 controller for four-motor equipments and a No. 38 controller for two-motor equipments were also placed in the Lorain exhibit. Another noteworthy exhibit was the new parallel ground throw switch which has recently been brought out by the company, operating by a cam movement in such a manner as to be practically proof against "freezing" or other ordinary impediments to perfect reliability, and is easily and surely operated at all times. Major H. J. Evans, of the New York office, was in charge of the exhibit.

Consolidated Car Heating Company, of Albany, had a handsome exhibit of car heaters. Mr. C. S. Hawley, of the New York office, was in charge, and drew attention to the special heater which has

been designed for use in the New York elevated cars after the electrical equipment of the road is in.

STUART-HOWLAND COMPANY.—The large exhibit of the Stuart-Howland Company, Boston, in the restaurant annex, was enclosed by a unique railing of cross-arms fitted with braces, pins and glass insulators of various sizes. At the four corners were street railway poles bearing specimens of the bracket arms manufactured by this company. Within, the enclosure was fitted with a comprehensive display of trolley wheels, electric headlights, arc and incandescent lamps, conductor's supplies, gears and pinions, etc. The booth was in charge of Messrs. Herbert W. Smith, manager of the railway department; William Wampler, New York representative, and C. T. White, of St. Louis, factory manager. The souvenir presented was a finely modeled image of a bear in solid bronze, designed for use as a paper weight.

THE AMERICAN CIRCULAR LOOM COMPANY'S space was presided over by Messrs. H. B. Kirkland, general sales agent; R. B. Corey, agent for the Metropolitan District; Thos. G. Grier, Western manager, and J. L. Kirkland, of the New York office. These gentlemen distributed 1500 of the firm's attractive souvenirs—French clay pipes of many designs, each accompanied by a package of tobacco and a box of fusees—and explained the merits of its Circular Loom and "Electroduct."

THE NATIONAL LEAD COMPANY, of New York, etc., exhibited in the balcony a full line of Phœnix metal solder, wire solder bars, perfection anti-friction metal, sterling journal metal, white lead and linseed oil. The company distributed handsome medals in Phœnix metal, showing in high relief President Vreeland, of the Metropolitan Street Railway. Recipients were invited to test the toughness and durability of the metal with a hammer, and then if they desired to obtain another souvenir they could have it by writing to the company. The company is now putting up solder in large pieces, so that a concern can prevent in a simple manner the stealing of solder by its employes. There being so many pieces of solder per pound, it is easy to keep an absolute check upon the work in hand. Messrs. John Haddock, Robert Boyd and R. L. Weithas represented the company.

NATIONAL LEAD COMPANY'S EXHIBIT.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, had an exhibit of carbon brushes of all sizes and for all makes of electric motors and generators, headlight carbons, "Columbia" dry batteries, etc. The company was represented by Mr. R. K. Mickey, of Cleveland; Mr. A. E. Carrier, its New York agent, and Mr. H. J. Davies, its secretary.

THE GARTON-DANIELS COMPANY, Keokuk, Iowa, showed the "automotoneer," which has for its object the regulation of the rate at which current is turned off in accelerating a car. It was invented by G. W. Knox, of the Chicago City Railway, and the Garton-Daniels Company has been perfecting it under Mr. Knox's patents. J. V. E. Titus, general manager of the company, was kept busy explaining it to interested street railway men. The company is now ready to equip controllers with this device in the belief that it will be thoroughly satisfactory. It is hard to see how it could be much simpler, consisting as it does of two gear wheels, a plunger and a wheel with four pins on its periphery.

THE MAYER & ENGLUND COMPANY, Philadelphia, had a very extensive exhibit in the northeast gallery, which was always crowded. C. J. Mayer, A. H. Englund, H. G. Lewis, B. Hayllar, Jr., W. A. Armstrong, Jr., E. B. Ross and H. J. Mayer, of Philadelphia; W. A. Cockley, of New York, and G. W. Provost and J. A. Merrill, of Pittsburg, were on hand. There was a special display of protected rail bonds with hydraulic tools for applying them. In the way of overhead material there was a line of trolley wire cars of the company's own design. Telephone apparatus specially adapted to the needs of street railway service was another interesting feature of the extensive exhibit. Among the concerns which the Mayer & Englund Company represents are the Speer Carbon Company, the Garton-Daniels Company, the Sterling Varnish Company, the Simplex Electrical Company, W. C. McAllen, the Sun Electric Manufacturing Company, and the Protected Rail Bond Company, Conant rail joint bond testing instrument for testing the conductivity of bonds in place in the track, for which Mayer & Englund Company is sole agent, proved very interesting to track workmen.

THE CRANE COMPANY, Chicago and New York, was represented by P. A. Kimburg, who was congratulated upon the largest contract for valves and fittings ever let in New York, which is that for the new Glucose Works being built at Edgewater, N. J. This company is also furnishing valves and fittings for the new 100,000-hp plant of the New York Edison Company at Thirty-sixth Street, and valves of this kind were on exhibition at the company's booth.

NATIONAL BATTERY COMPANY, of Buffalo, a constituent property of the American Bicycle Company, was represented by its expert and electrical engineer, Mr. Elmer A. Sperry, who was also one of the best known street railway pioneers in the big gathering. He reported the company full up for six months on automobile battery orders, and stated that the battery (of which he is the inventor) would soon be largely introduced for stationary and heavy work.

ELECTRICAL WORLD AND ENGINEER occupied a large ornamental booth opposite the main entrance, with regular office accommodations and distributed copies of its recent issues. It was represented by Messrs. T. C. Martin, W. D. Weaver and T. R. Taltavall, of the editorial staff; President J. M. Wakeman and Messrs. Elliott, Boughton, Fellows, E. T. Walker and C. T. Walker.

THE STREET RAILWAY JOURNAL outdid itself with a superb souvenir issue of nearly 500 pages, handsomely printed, in a beautiful cover, showing New York streets in 1841, 1891 and 1901. The reading contents are almost wholly devoted to traction in Greater New York, in all its developments, and constitute a compendium of the art as there exemplified. These articles are profusely illustrated and are the contributions of the presidents of the various systems and their engineers.

BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, was represented by its New York office. Messrs. Lozier, Bolles, Saxelby and others distributed gilt medals bearing the Bullock generator on one side and the Wagner transformers on the reverse. Boxes of pencils were another reminder circulated by the Bullock and Wagner people.

WESTON ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., was represented to Mr. J. P. Brown.

AMERICAN ELECTRICAL WORKS, of Providence, R. I., was represented by Mr. Frank B. Baker.

CHARLES E. DUSTIN COMPANY, the new electrical machinery concern, was represented by President Dustin and Mr. W. S. Barstow, its consulting engineer.

BRYANT ELECTRICAL COMPANY was represented by Mr. E. R. Grier, of Chicago.

ARNOLD ELECTRICAL POWER STATION COMPANY, of Chicago, did not bring along with it one of its plants, but was represented by Messrs. Bion J. Arnold and W. L. Arnold.

McROY CLAY WORKS, of Chicago and New York, were most ably and adequately represented by Mr. E. F. Kirkpatrick, who came on the Wabash special. "Kirk" is not less at home at a street railway convention than among lighting people, and found a host of friends. The McRoy conduits have come into large use for traction work, as well as other electrical purposes.

CHICAGO INSULATED WIRE COMPANY was represented by Mr. W. M. Smith.

BRIDGEPORT BRASS COMPANY, of Bridgeport, Conn., and New York City, had ample space in the restaurant annex and exhibited a large reel of its well-known "Phono-Electric" wire for trolley line wire and other purposes where great tensility with no

loss of conductivity can be secured. An interesting little pamphlet was distributed by Mr. H. Goodwin Madden, the company's representative, showing a number of tests on breaking weights and strains, the weakening of wires by arcing fusing currents, etc., in regard to Phono-Electric wire as compared with the ordinary hard-drawn copper. Data is also given as to corrosion, overloads, etc.

The Speer Carbon Company had an exhibit in the space of Meyer & Englund, of Philadelphia, and were represented by Mr. J. S. Speer himself.

A Concert and Luncheon were given to the ladies at the Murray Hill Hotel on Wednesday morning under the supervision of Mr. H. A. Robinson, of the reception committee, assisted by Messrs. E. H. Mullin, H. Sanderson, J. M. Wakeman, C. W. Price, T. C. Martin and Colonel T. E. Williams. The Kaltenborn Quartette presented an excellent programme of instrumental music, which was followed by an elaborate luncheon in one of the large dining halls.

H. W. Johns Manufacturing Company had a large space near the main floor entrance, exhibiting the Sachs "Noarc" fuses for all voltages. The exhibit consisted particularly of cut-outs for railway service up to 600 amperes. The operation of the fuse was shown by actual test on short circuit and overload, and demonstrations were given showing the arc effect of open fuses as compared with the very silent operation of the Sachs Noarc fuses. A full line of well-known Johns moulded mica trolley line insulating fittings were also shown. The Monarch and Vulcabeston moulded insulating material in all shapes, sizes and forms was exhibited in large variety. The novelty which was introduced to the street railway fraternity was the new insulated crossing for trolley wires, which has just been brought out by the company. There are now 7000 surface cars equipped with the Noarc fuses. Three of the largest elevated roads in the world are using them exclusively. The use of smaller capacity fuses on heater and light circuits is almost universal. The gentlemen in attendance at the exhibit were A. H. Berry, Jos. Sachs, E. B. Hatch, James Perry, D. J. Dickson, James Humphries, S. G. Meek and James Meek.

The Pittsburg Reduction Company, of Pittsburg, had in the gallery an extensive display of aluminum cables, bus-bars and ingots. An interesting feature was the collection of joints and splices used with aluminum cable, some made by the process of compressing an

ALUMINUM EXHIBIT.

aluminum sleeve around the ends of the cable, giving a joint stronger than the cable itself. There was also shown the threaded sleeve, and the plain sleeve twisted. The company was represented by A. V. Davis, general manager; J. A. Rutherford, of Cleveland; Percy Hodges, of Boston; S. K. Colby, of New York; A. K. Lowrie, general sales agent, and William Hoopes, electrical engineer.

The Electric Storage Battery Company, of Philadelphia, had an exhibit at the eastern end of the main floor of "Chloride" accumulators, and was represented by Messrs. Blizard and Reynolds, of Philadelphia, and Taylor and Knudsen, of New York. Col. G. H. Day, president of the company, also participated in the convention. They showed a railway battery switchboard panel with differentially-wound, motor-driven booster and samples of typical railway cells. New features in construction inviting notice were glass sand trays and alloy tanks. Conspicuous in the space was a map of the city showing the locations of "Chloride" accumulator installations, not only very thickly bunched in the shape of isolated plants, but in the systems of the railway and lighting companies.

Westinghouse Electric & Manufacturing Company had a most conspicuous exhibit occupying a very large portion of the central section of the main floor, and embodying, aside from other features, two of the leading novelties, a car equipped with the Newell magnetic track brake and a display of the Nernst lamps. The company had actually built a long run of standard track with a fairly stiff grade at one end, and regularly ballasted with stone like an ordinary railroad. Up and down this section, a full-sized car with Westinghouse motor equipment and Newell brakes was in constant service carrying passengers and illustrating the remarkable ease and cushioning effect with which the car could be stopped by the brake. The Nernst lamp exhibit displayed by Mr. Wurts consisted of a canopy of several strings of the lamp in operation, a cabinet containing all the details, and a color case of silks to show the beauty of the light in giving true values. There was a ceaseless stream of people asking endless questions about both of these striking and very successful exhibits. The company showed in addition a large number of railway motors open for closed and with closed case; Brill and Peckham trucks fully equipped with Westinghouse motors; a Baldwin-Westinghouse electric mining locomotive; a railway power switchboard, a car diverter column partly assembled to show construction; arresters, diverters, fuses, gears, pinions, instruments, etc.; in short, a most representative display of the Westinghouse product in all its wide range, and admirably put together. The company was represented by Messrs. B. H. and A. Warren, Taylor, Wurts, Probasco, Terry, Atkinson, Brady, Brown, Bragg, Townley, Townsend, Ellicott; Duncan, Storer, Kollock, Osburn, Brown, Pendleton, Potter, Gray, Paine and other members of its large executive and factory staff.

The Sprague Electric Company, of New York, exhibited a complete Sprague multiple unit equipment as it would be installed on a three-car train, consisting of two four-motor cars and a trailer. Mr. Frank J. Sprague was himself fortunately in charge of the exhibit, and explained the details of his system to the delegates, many of whom had used the old Sprague trolley system of the early pioneer days. Four Lorain motors in a row represented the motor equipment of one car and four motors placed on Peckham trucks in the Peckham space adjoining, represented the motors of the second car. The trailer was simply indicated by a long, flexible connecting cable. With these three cars Mr. Sprague made at will twenty-one combinations, showing the great flexibility of the system, its adaptability to elevated service, where there is small room for switching, and trains are made up in the shortest time possible. This system is already in use in Boston, Brooklyn, Chicago, Paris, etc., on over 300,000 horse-power of equipment, evidencing an extraordinarily rapid development. The Sprague Company was also represented by Mr. Frank Shepard, of its railway department, and Mr. Alex. Henderson, of its conduit department.

The Okonite Company, of New York, was represented by Messrs. W. L. Candee, G. T. Manson and H. Durant Cheever, who were present throughout the week, Mr. Candee being active on one of the committees.

Dr. W. M. Habirshaw and Mr. J. W. Godfrey were personal reminders of the India Rubber & Gutta Percha Insulating Company.

The Bernstein Electric Company, of Boston, had samples of the "Lowatt" incandescent lamp on exhibition. The lamp contains a silvered mirror reflector inside the bulb, and is suited to all places where a reflector would be used, and for headlights. Edgar S. Gardner, superintendent of the factory, and General B. F. Peach, treasurer, exhibited this lamp in the booth of the Bay State Electric Heat & Light Company.

The Bay State Electric, Heat & Light Company, of Boston, had a small model car fitted with Bay State heaters, and several full-sized heaters. This device is placed under the seat and is supplied with air by a fan motor which forces it through ducts under the seat with the idea of ensuring a proper diffusion of heat without regard to natural draft. The heaters operate on from 5 to 9 amperes. The motors, of 1-6 horse-power, are in series with the heaters, and as the current is varied in the heaters, field coils of the motor are cut in or out to keep the speed constant. Edgar S. Gardner, superintendent of the factory, was in charge, with H. W. Gardner, superintendent of the heater department, and General B. F. Peach, treasurer of the company.

H. B. CAMP COMPANY had an exhibit of conduit samples in charge of Charles C. Baird, of the New York office. Delegates were afforded an opportunity to inspect some of the extensive work which has been done in New York with the Camp conduits.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York, made a display of conduit in single and multiple duct forms. The exhibit was in the care of Mr. B. S. Barnard, general sales agent. The Manhattan Railway is now putting in 2,000,000 ft. of this conduit, and the street railway systems of Greater New York are extensive users. A

VITRIFIED CONDUIT EXHIBIT.

set of placards on the back of the booth gave a list of street railway users, and the array was an imposing one. The American Vitrified Conduit Company also exhibited its third-rail insulator, 50,000 of which are being supplied to the Manhattan Elevated.

GENERAL ELECTRIC COMPANY had a conspicuous space at the main entrance to the Garden, the exhibit covering about 250 square feet. The principal and central feature was the type M control for electric railway motors, of which about 1000 equipments have been sold to the Manhattan Company. This was shown in actual operation; a sign with incandescent lamps being substituted for the motors, by means of which the rise in voltage, comparable with the rise of speed in electric motors, was shown by the varying brilliancy of the filaments of the lamps. Of considerable importance was the electrically operated oil circuit breaker for 11,000 volts, which is also shown in practical operation enclosed in a regular brick pier. This is the type of switch to be used extensively by the Manhattan Company. There were also direct and alternating current switchboard panels similar to those furnished the Manhattan Company for use in New York City. A unique feature was the section of underground conduit showing the construction followed by the Metropolitan Company in this work, the electrical equipment for which is furnished by the General Electric Company. Two of the big 125-hp motors which will be used by the Manhattan Company were also to be seen in the General Electric Company's space, and other railway motors of the various types used in modern railway apparatus. Electric brakes were also shown. Grooved trolley wire and the varied line material required in its installation formed an interesting part of the exhibit. There were also collections of various repair parts and supplies made by this company, in which electric railway men are particularly interested. At the middle part of the company's space a comfortable reception space is arranged. Around the main exhibit of controllers ran a border of third rail, with contact shoes resting on it at regular intervals. The company was represented by Messrs. J. R. Lovejoy, W. B. Potter, R. H. Beach, C. C. Pierce, J. J. Mahoney, E. H. Mullin, T. P. Bailey, J. W. Buell, R. E. Moore, S. W. Trawick, F. H. Strieby, G. D. Rosenthal, F. F. Barbour, J. C. Calisch, H. H. Corson, F. Cutts, J. G. Barry, A. H. Armstrong, T. B. Whitted.

BILLINGS & SPENCER COMPANY, Hartford, Conn., made a neat display of samples of its B. & S. automobile parts and machined steering equipment in spaces 57, 58 and 59, where they were carefully inspected by many delegates already familiar with the concern's drop forgings, etc., for trolley and motor work.

THE GOLD CAR HEATING COMPANY, of New York, had in a handsome space on the main floor against the north wall, an equipment of heaters which represented the full standard elevated railway set of 18 heaters on a long wooden frame. It was mounted for display and current was on. The Gold Company, in its new regulating three-point switch, which was shown, has perfected a device which meets admirably the requirements of such exacting service. It carries in safety 60 amperes, and breaks the circuit at this load on 650 volts without injury. This switch attracted no little attention. Taking one's ease in the space was rendered possible by a group of comfortable seats equipped with the standard types of Gold heaters for this work. President Edward E. Gold, Vice-President J. E. Ward and Messrs. W. E. Banks and F. Cahill received the visitors to the space, and all of the many hundreds received a most timely and very pretty souvenir in the shape of a tiny britannia metal replica of "The Cup" hanging to a green and gold badge. Altogether, the Gold exhibit this year was a great success and an undeniable hit.

J. G. BRILL COMPANY, of Philadelphia, made, as usual, a fine exhibit of specialties in rolling stock, including many new types of cars and trucks. In the Brill exhibit itself no car is shown in its entirety, but an excellent example of Brill construction was given by the large vestibuled car in the Westinghouse space.

UNION STOP SIGNAL COMPANY, of Fall River, Mass., exhibited a signal in charge of Mr. O. W. Hart, general manager to be operated in connection with a telephone dispatching system. There is a machine at the dispatcher's office which automatically records the date, time and number of signal operated, whenever any signal on the line is set by it to stop a car. One of the weak points of the telephone dispatching system as used on electric roads has been that the dispatcher cannot always communicate with the men on the line, because at times when there are delays it is sometimes necessary to stop cars which are on time and running on the regular schedule. Obviously the conductors of such cars could not be expcted to call up the dispatcher at every telephone station on the line. With a signal at each telephone station which can be set to warn conductors that the dispatcher has a message the method is rendered much more valuable and useful. In short, the "Union" stop signal, together with the telephone system, virtually puts electric lines, it is claimed, on the same basis as the steam roads which have telegraph operators at every station.

THE UNITED STATES ELECTRIC SIGNAL COMPANY, of Watertown, Mass., made an exhibit of a pair of signals and trolley wire instruments for operating signals for block signal purposes on single track roads, etc. The car entering the block operates the trolley wire instrument which throws the signal ahead of it at the end of the block to danger, displaying a red light. The signal behind the car is set to caution, displaying a white or other colored light, as the company using it may desire. Two wires are required. Dr. F. E. Withee, secretary; Mr. J. J. Ruddick, superintendent, and Mr. James H. Nickerson were in-charge of the exhibit.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, was represented by Mr. J. F. Stevens. It exhibited a full line of its switchboard and portable instruments in various types and ranges contained in cases showing a number of attractive styles of finish. A feature of the exhibit was its vehicle volt-ammeter. This instrument is the result of much practical and successful experience. The black enamel case adopted as a standard finish is attractive and serviceable. Mr. Stevens is gratified at the manner in which, as evidenced at the Garden, his excellent instruments are becoming as well known in the street railway field as in that of lighting, where they are already standard.

THE STERLING VARNISH COMPANY and the PITTSBURG INSULATING COMPANY, both of Pittsburg, Pa., had a very attracive exhibit in charge of Mr. H. Lee Bragg, general sales agent, and Mr. S. C. Schenk, Eastern representative. They showed samples of their new insulating fabrics made by applying Sterling insulating varnish to various grades of paper and linen. These fabrics have a guaranteed insulation of from 8000 to 15,000 volts puncture test. Sample books containing specimens of the various grades were distributed. A feature of this exhibit was a number of sheets of pure Sterling varnish obtained by applying the varnish to glass, baking and stripping.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., was represented by Charles E. Bibber, manager of the railway and power department, Messrs. Dodd and Jackson, of the engineering department, and Mr. Kelly, chief electrical engineer. The com-

pany has of late found a large outlet in the street railway field for its apparatus.

The Cling Surface Manufacturing Company, Buffalo, N. Y., had a space in the balcony, where Mr. Charles F. Chase, Eastern manager, explained that "the days of tight belts are over," and showed what "Cling surface" will do. He distributed an attractive circular illustrating the use of "Cling surface" treated belts in factories, etc.

The Cling-Surface Manufacturing Company, Buffalo, N. Y., Conn., makers of "Femco" incandescent lamps, was represented by Mr. Jonathan Camp, manager. This company is making a special street railway lamp, and Mr. Camp found many opportunities to present this department of the business to the favorable consideration of large street railway managers.

The Peckham Manufacturing Company, of New York, had a large space in the center of the hall under the supervision of Mr. Edgar Peckham, assisted by Messrs. W. G. Price, A. W. Field, B. R. Stare, G. W. Bowers, W. H. Stare, Warren Boyer and J. A. Hanna, the Western agent of the company. Two maximum traction trucks, two city service trucks with four-motor equipments and 33-inch wheels, one Excelsior single truck, and four high-speed interurban trucks for specially heavy service, were shown in the company's own space, and in the Westinghouse section, near by, was exhibited a Metropolitan special truck, equipped with Westinghouse motors.

Ohio Brass Company.—One of the most conspicuous displays was that of the Ohio Brass Company, of Mansfield, Ohio, which is located in the first balcony above the main floor. It was very attractively arranged, and showed a representative line of overhead material, motor and car supplies and track bonding devices, displayed

EXHIBIT OF OHIO BRASS COMPANY.

on a pyramid of shelves, at the back and either end of which two very attractive "poster girls" were shown. At either corner and at the center of exhibit several styles of flexible pole brackets are shown mounted on iron poles. A very extensive and complete line of overhead materials, such as trolley wire hangers, bars, cross-overs, splicers, strain insulators, etc., were exhibited, including many new types as well as improved forms of existing types of these articles. Among the newer types of trolley wire hangers shown were several forms of twin hangers for both straight line and single and double-curve suspensions. These hangers are designed for supporting two trolley wires on single track electric roads to avoid the necesary complications of overhead switches and frogs where only one trolley wire is used. One of the well-known specialties manufactured by the Ohio Brass Company is the Monarch track cleaner, which was shown mounted on a stand in such a way that its construction and operation may be readily seen. The company was represented by the following from the Mansfield office: Messrs. C. K. King, secretary; G. A. Mead, E. E., G. A. Harwood and A. L. Wilkinson; also by Messrs. R. A. Byrns and A. B. Edes, New York representatives of the company, and Mr. Burt Gellatly, of the Pittsburg office. Messrs. J. W. Porter and Max A. Berg, Chicago representatives, were also in attendance.

The Sterling Electrical Manufacturing Company, of Warren, Ohio, lighted the annex with its special lamps, and samples were shown of the various types in the enclosure of Francis Granger. The company was represented by Mr. William Coale.

Chase-Shawmut Company, of Boston, was represented by Mr. Frank D. Masterson, who had with him samples of its well-known Cartwright enclosed fuses, Shawmut tested fuse wires and links, "Flexible" rail bond, etc.

Mr. Geo. L. R. Eldridge, president of the Acme Switch Company, Hartford, Conn., was in attendance at the convention. Much interest was manifested in the new Acme time switch which, Mr. Eldridge explained, and which is designed to cut in or throw out lights, motors, etc., at given hours.

The New Process Rawhide Company, Syracuse, N. Y., exhibited a case of sample rawhide pinions, complete gears and blanks. A souvenir rawhide covered match case and cigar cutter was distributed by T. G. Meachem and Secretary A. C. Vosburg. A pinion which had been run 105 miles a day for 14 months was shown. Its teeth had worn to a knife edge, without giving away. The space had a sign of rawhide as used in pinions, and equally tough—to the disgust of those who had to nail it up.

The Green Engineering Company, of Chicago, was represented by Mr. P. Albert Poppenhusen, who is now president of the company, Herman A. Oppenhusen being treasurer.

Rossiter, MacGovern & Co., New York, was represented by Frank MacGovern, well-known in electric lighting and street railway circles. This company has recently increased its capital stock, and with Mr. C. L. Rossiter at the head, is entering upon even greater fields of activity and usefulness than ever.

Erie Exploration Company, which had an exhibit of its "rheocrat" in the Morris space, was represented by Mr. W. H. Miller.

Crocker-Wheeler Company made a compact and effective display on the main floor of its generating apparatus, for which it has lately been receiving large orders from the street railway field. The field of one big machine was shown, without the armature, and another, somewhat smaller generator, was set up complete. Above the exhibit was a large illuminated sign, and the company distributed some excellent literature prepared for the convention. It was represented by Dr. S. S. Wheeler, president, and Messrs. Bates, Doremus, Henshaw, etc.

John A. Roebling's Sons Company was represented by Manager H. L. Shippy and Messrs. Bailey, Cockey and Harrington.

Partridge Carbon Works were represented by Mr. James Partridge from Sandusky.

Monarch Fire Appliance Company made a neat display of its Kilfyre tubes, already extensively in use on street railways. Its space was in the annexed restaurant, and was in charge of General C. H. Barney and P. L. Wilbur.

Harold P. Brown made an excellent exhibit on the ground floor of his "plastic" bond specialties for ensuring the more complete conductivity of the return circuit.

Standard Paint Company.—One of the most interesting and attractive exhibits was that of the Standard Paint Company, manufacturer of the well-known P. & B. products. The furnishings of the P. & B. booth, located on the northern promenade, near the Madison Avenue entrance, were of quartered oak, and the full line of the P. & B. manufactures were attractively displayed. The exhibit commanded much attention. Prominent among the company's representatives at the Exposition were Mr. Ralph L. Shainwald, president; Mr. J. C. Shainwald, of Chicago; Mr. J. N. Richards, manager of the New York sales department; Mr. F. F. Vandewater, New York purchasing agent, and Mr. Charles Earnshaw. Mr. R. L. Shainwald, by the way, has just returned from a business tour over Europe and the continent, extending over three months, and he expresses much gratification at the condition of P. & B. affairs there. The sale of P. & B. materials abroad has constantly increased each year, until they have now come to be quite as familiarly known on the other side of the pond as they are here. In addition to P. & B. electrical compounds, the Standard Paint Company displayed in its booth other goods, such as armature and field coil varnish, insulating tape, waterproof insulating papers, ruberoid motor cloth, preservative paints for poles, hoods, etc., ruberoid floor cloth and ruberoid roofing. The paints mentioned are extensively used as a preventive of electrolysis.

Adams & Westlake Company, of Chicago, etc., had an interesting exhibit in the balcony, and showed its arc headlight, interior arcs, signal lamps—electric and oil—brake handles, etc. The headlight beam was projected on the central floor space, attracting attention all the time. Messrs. Willits, Bartholomew, E. H. Stearns, A. S. Anderson and J. A. Foster were in charge.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, OCTOBER 19, 1901. No. 16.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, ... President and General Manager.

CHICAGO OFFICE, ... 1139 Monadnock Block.
PHILADELPHIA OFFICE, ... 929 Chestnut Street.

EUROPEAN OFFICE, ... A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, ... Editors.
T. R. TALTAVALL, ... Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, ... per year, $3.00
Foreign Countries, within the Postal Union, ... 6.00
Single Copies, ...10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 19, 1901.

CONTENTS.

	PAGE
Editorial	627
Exhibition at Crystal Palace, London	630
Electrical Engineers of the Day—XVI; John F. Kelly	630
A London Joint Central Station	631
Storage Batteries in Traction Work	635
The Inductor Alternator—III, by Edward Heitmann (concluded)	636
The Influence of Polyphase Apparatus on the Design of Railway Power Stations—III, by J. E. Woodbridge (concluded)	638
Elements of Illumination—XXXII, by Dr. Louis Bell	641
Governing Water Wheels Under Abnormal Conditions, by G. U. G. Holman	643
The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour—IV, by Walter Reichel	644
Street Railway Convention Automobile Ride	645
Automobile Ride	645
New Telephone Patents	645
Electro-Chemical Patents of the Week	646
The Edison Storage Battery	647
Kentucky Telephone Association	648
The American Pacific Cable Question	648
Current News and Notes	649
LETTER TO THE EDITORS:	
Some Aspects of Telephony, by H. L. Manton	650
Digest of Current Electrical Literature	651
Features and Exhibits at the Street Railway Convention	655
DEPARTMENTS:	
Financial Intelligence	658
Commercial Intelligence	659
General News	661
Trade Notes	664
Record of Electrical Patents	665
Awards at the Pan-American Exposition	Supplement

PAN-AMERICAN AWARDS

We are glad to be able to give with this issue, in a Special Supplement, a very full list of the awards at the Pan-American Exhibition that concern our readers. As noted elsewhere, some of the largest exhibitors did not enter for awards, hence their names will be missed. It cannot be passed over without mention also that the superb work done by Mr. Luther Stieringer, consulting electrical engineer, and by Mr. Henry Rustin, who carried out with admirable success all the illumination plans, passes, so far, apparently without any official recognition. The wonderfully beautiful lighting of the Exposition was not only its chief artistic feature, but its most brilliant exemplification of progress in the mechanical arts. It would appear, however, that some commemorative diplomas and recompenses to collaborators are to follow. Our readers may be interested to observe that a gold medal has been awarded to the publishers of ELECTRICAL WORLD AND ENGINEER.

CONVENTION ECHOES.

We presented last week in a special supplement a report of the proceedings of the American Street Railway Association, up to the time of going to press with that issue, and in our current number will be found further notes on the discussions, exhibits and exercises. From this, and in many cases from their own participation, our readers will have formed an idea as to the convention, and will certainly agree with us in characterizing it as the best that the association has ever had. The local hospitality was, if we may venture as New Yorkers to speak of it, of the most hearty and liberal character, and such features as the automobile ride in which about 120 electric vehicles took part—all that could be spared from specific duty—were of a more than transient interest. The papers and discussions alike were excellent, while the display of apparatus in Madison Square Garden had to be seen to be appreciated. It was as elaborate and complete as any show got together for a month; and in many respects vied with the Pan-American, or even Paris last year, as an exposition of what is latest and best in the traction art. Moreover, the electrified street railway systems of the metropolis are in themselves an exhibition of the highest order, while the new work going on in the transformation of the Manhattan Elevated and the construction of the Rapid Transit Underground system led the thoughts of the members onward to the great work and larger opportunities lying in the future. Altogether the occasion was one that the Association will find it hard to equal for attendance, quality and for agreeable blending of recreation and instruction. Next year, however, in going to Detroit, another distinct sphere of work will be brought to notice in the interurban, cross-country trolley work, on a gigantic scale, now being carried out by the Everett-Moore syndicate. The American Street Railway Association will celebrate there its coming of age by a significant revelation of its power to include the work of its members that begins on a single street and ends by embracing a State.

AN AMERICAN PACIFIC CABLE.

Note is made elsewhere in this issue of the efforts of the new American company to lay a Pacific cable, backed by Mackay and Commercial Cable interests. The last speech of President McKinley, advocating an American Pacific cable, is now being sold on the streets and makes its appearance as the dying injunction of the great national leader just as the progressive elements we have named

thus declare their readiness to carry out his ideas and plans. The coincidence is striking, may be intentional, but is none the less of good augury. One feature in the matter demands attention at this point. Mr. Mackay has stated distinctly that the new company asks for neither subsidy, bonus nor guarantee. That would imply that steps have already been taken to make the cable in Europe, where large plants stand waiting eager for such a contract. On the other hand, we believe no wrong is done to Mr. McKinley in stating that his desire and intention were to have the cable made in this country and laid by American ships and skill. To that end, a subsidy would doubtless have been offered, and may still be offered by Congress, this year. We can hardly think it possible for a cable across the Pacific to be self-supporting for some time to come; in fact, the English cable will have the benefit of handsome subsidies and guarantees from the colonies, if not from the home government, as we understand it. Be that as it may, Mr. Mackay has our best wishes, and we can only hope that it will be a brace of American cables that he will put down across the profound depths of the Pacific, connecting this country with its new possessions and new markets in Old Asia.

Some Problems in Hydraulics.

Governing a hydraulic plant with precision comes rather near being one of the fine arts, and the little note elsewhere in this issue on what happened in the Levis transmission plant points the moral admirably. In this instance the main switch was pulled when the generators were fully loaded, to test the efficacy of the governor in taking care of sudden changes. The governor attended strictly to business, promptly and completely, and shut the gate with a snap so sudden that the pressure took off the bonnet of a 30-inch valve. Good luck and presence of mind averted very serious results, but the lesson is none the less plain. For successful work in hydraulic governing three factors must be reckoned with, each independent of the others. First and foremost, the governing mechanism must be sufficiently sensitive and powerful to work the gates promptly enough to permit accurate control of the speed. It has taken a good many years to evolve a governor able to meet properly this fundamental condition, and just as in steam engine governing, the introduction of electrical machinery had much to do with the progress of invention. Waterwheels had been in use for many years, but generally in work not requiring very steady speed or, on the other hand, in work at so steady load that there was little tendency for the speed to wander; in fact, until the advent of electrical machinery there was very little work of any kind in which a variation of two or three per cent in speed under changing load was a matter of any importance. Given, however, the necessity for improvement, the improvements came until now there are several reliable relay governors with power enough to move any ordinary gates and sensitive enough withal to take account of minute changes in the speed.

But even this combination of good qualities is not enough to ensure a satisfactory result. Not only must the governor be amply able to move the gates quickly at the least change of speed, but the whole organization of the plant must be such as to enable the prompt opening and closing of the gates to produce steady speed in the machinery. It is of little use to throw the wheel gate wide open if the movement of water in the penstock is so sluggish that the speed can fall seriously before the water gets fairly to work. The hydraulic works must therefore be so planned that governing will be physically possible, granting that the governor does its work properly. We are sorry to say that many plants fail in this particular. We have in this country many skilled hydraulic engineers in the ordinary sense, thoroughly familiar with the technique of developing water powers and installing water plants, but comparatively few of them have a practical acquaintance at first hand with the requirements of an electrical transmission plant. They do not realize that electrical plants present problems that must be treated even in building the dam. Too often the electrical engineer comes upon the scene to find the water power developed and the contract for the wheels already placed. Then he must make the best of a bad matter and take the blame if anything goes wrong. For good governing the one most essential thing is for the water column to respond promptly to the varying aperture of the gates. The shorter the penstock and the sharper its downward pitch, the shorter is the time-constant of inertia in the water column, and the better, on the whole, will be the regulation of the plant. Obviously long and contracted draft tubes and tail-races may seriously interfere with regulation even when the work above the wheel is correctly planned.

The third requirement is that the changes in the velocity of the water column shall not result in dangerous variations of pressure—dangerous either to the pipes or to the governing mechanism. This requirement is sometimes very difficult to meet, as the case in hand would indicate. It is particularly hard to meet without serious waste of water. In the Western plants using impulse wheels under high heads where the wheels are perhaps at the bottom of a sharply inclined pipe half a mile long, governing would be almost impossible save by the use of the deflecting nozzle which allows the stream to maintain nearly constant velocity whatever the work. At rather low heads a stand pipe open at the top meets the difficulty and damps the variations in pressure. This does not waste water like the constant flow method, but becomes very unwieldly above moderate heads. Out of range of the stand pipe the trouble begins. In some instances the governor is arranged to maintain nearly constant flow by opening a relief valve as it closes the gates. But this again wastes water, and as hydraulic development grows there will be less and less water to waste. Many of the high-head plants have ample water supply, but it is a grievous sight to see a big installation running with the streams just touching the tips of the buckets, at a head which gives every facility for cheap storage of power. Relief valves to open on a dangerous increase of pressure are often installed, but they do not seem to have been successful enough to help much in the matter of government. There is certainly a chance open for an improvement in governors that shall save all the water possible and render such an accident as forms the text for these remarks quite out of the question. Incidentally, we remark that it is a rather good plan to keep hydraulic pipes out of the dynamo room upon general principles.

The German High-Speed Experiments.

In presenting to our readers the articles by Chief Engineers Lasche and Reichel on the preparations made for the Berlin-Zossen tests we cannot refrain from expressing our gratitude to the authors for their very full and frank explanations. The work already done represents a very large amount of invention and engineering skill, to say nothing of the expense involved, and even the preliminary account given is of immense value to the art. As to the general line of experimentation to be allowed, it is assured to be such as will bring out the facts as to high-speed work without any disguise effected by unwarrantably favorable conditions. In particular, the track is neither especially straight nor level, and being a standard piece of military road was not designed or constructed to favor speeds higher than those regularly attained on German express trains. In some respects this state of affairs is helpful in that it will fully disclose the feasibility of operating high-speed cars on lines of ordinary construction, but on the other hand, it must be recognized that a speed of two miles a minute is more a question of track and roadbed than of anything else. If the experiments result unfavorably we are disposed to think that the road rather than the equipment will be responsible for the failure. One hundred and twenty miles per hour with a 96-ton car implies very serious stresses on the track, and in this particular we could wish that the conditions were some-

what more favorable. The choice of single motor cars for the tests is likewise far from being an evasion of difficulty. There is a large amount of cumulative evidence all tending to show the advisability of using short trains rather than single cars in high-speed working. A single long motor car has very nearly as great total tractive resistance as a train of two or three times the capacity. And the more serious is their resistance the greater the relative advantage of the train. However, if a single car leads to satisfactory results, the train will take care of itself.

We have already referred to the experiments undertaken to determine the air resistance at very high speeds. The values reached were so much higher than those indicated by any of the American experiments as to lead us to view the conditions of the German tests with suspicion, but since the motors were designed to fit the latter there is no reasonable doubt that the power supplied will prove to be ample. Four motors each of 250 horse-power normal output and capable of being forced to 750 horse-power each during acceleration, ought to be enough for all requirements. We regret that more details of these machines are not at present at hand, particularly regarding the power factors, but from the general character of the design it is safe to predict a rather favorable value at least under full load, which is the normal running condition. The performance of the motors when starting is a much more serious consideration, and although in high-speed work acceleration represents no large portion of the total energy taken, the demand for current is likely to be a severe tax on the capacity of the apparatus. It is quite safe to say that rheostatic control is by far the most feasible method to emply for such a case, and it seems to us that the rather daring arrangement adopted by the A. E. G. is likely to prove a good solution of the difficulty. For the most effective operation the resistance in the secondaries should be capable of continuous and minute variation, and when the amount of energy to be taken care of is so great as in this instance, there is much to be said in favor of liquid rheostats. In the device actually employed an additional advantage is gained by an accurate and automatic adjustment of the rate of acceleration, which should be of considerable service in reducing and steadying the starting currents. In point of fact we think that the class of service permits rather gradual acceleration, the gain in time by forcing the start being trivial on long and fast runs.

The arrangements for braking are, we think, open to some criticism. Under the general conditions selected, the number of wheels to which brakes can be applied appears to be insufficient to ensure adequate braking at very high speeds by the ordinary methods. Neither has motor braking by return of energy to the line ever been put in really practical shape. The other alternative, energizing the motor fields with direct current and depending on the drag of parasitic currents, seems rather clumsy. In the record runs on American railways no especial trouble in braking has been experienced, but we do not think that braking down from the maximum speed was ever tried. Altogether we are disposed to think that braking a 96-ton motor car from a speed of 120 miles per hour is a much tougher problem from a practical standpoint than merely reaching that speed with it, and we should not be surprised if the solution were very troublesome. Another matter of some concern is the collection of current from the working conductors. Some doubt seems to have been raised as to the advisability of carrying the high-tension transformers on the motor car, but we feel very strongly that such is the proper location for them. They are heavy, to be sure, but the transmission system is much simplified and cheapened by carrying the transformers, and what is even more important, the volume of current which has to be taken through the flying contacts is very greatly reduced. The side-bearing bow trolleys adopted should give pretty clean contacts even at very high speed if the working conductors are properly supported, and if there is to be arcing now and then when things do not work properly the smaller the current involved the better for the contacts. We fancy, however, that the support and alignment of the three trolley wires will need considerable tuning up before everything works smoothly. A nearly straight and very smooth track would greatly facilitate this part of the work. But in spite of difficulties we think the general results will be encouraging.

The Electric Theory of Spectra.

An abstract in the Digest of last week related to a very interesting article by Mr. W. Sutherland, which appears in the *Philosophical Magazine* for September. The enormous complication of the spectra of material substances has, until recently, baffled all analytical investigators. It is evident that every molecule of matter must carry with it an electrical apparatus, such that when the molecule is jostled by its neighbors, i. e., when the substance is heated, the electrical apparatus sends out electrical waves into surrounding space. Under some conditions these waves have a very wide range of frequency, with nearly every frequency represented, in which case the spectrum is said to be continuous. Under other conditions, however, the electric waves emitted favor certain definite frequencies, and in extreme cases only a very few frequencies are retained. In 1885 Balmer discovered a simple formula connecting the wave lengths of the thirteen principal lines in the gaseous spectrum of hydrogen, and since that time some advance has been made in spectra a little more complicated than that of hydrogen, by determining that there existed several simultaneously existing series of wave lengths, each belonging to a family obeying the Balmer law, or possessing a particular set of constants in the Balmer formula.

Mr. Sutherland goes to show that the Balmer and Rydberg formulæ can be accounted for by very simple kinetic hypotheses, which do not involve any precise knowledge of the nature or disposition of an atom. It is supposed that electrons, i. e., positively and negatively charged masses of matter, gyrate at an enormous constant angular velocity around an atom, and that this angular velocity is the same no matter what the nature of the atom or the substance to which it belongs. But, although the center of inertia of a positive and negative electron is supposed to travel in an orbit around the atom in the same period of time for any atom of matter, the jostlings which take place between the positive and negative electrons, and which cause electromagnetic waves to be emitted, differ characteristically with each kind of atom. Thus, when an atom of one substance is set in vibration as a whole by the heat jostling of its neighbors, stationary vibrating waves are supposed to be formed upon its surface, and the electrons in their planetary orbits around this atom will receive energy at definite periodic intervals if they strike the atom at successive revolutions, or aliquot fractions of revolutions, corresponding to the nodes of atomic vibration. Upon this hypothesis the Balmer law and its hitherto recognized extensions could be accounted for.

Although the details of this hypothesis may require to be modified in view of future discoveries, yet it seems from the close agreement between calculation and observation afforded by the fundamental formula Mr. Sutherland arrives at, that the cause of spectra must be traced to electro-mechanical resonance, or cyclical repetition of motions of electric charges in atomic orbits. The delineation and computation of these orbits in the sphere of the infinitesimally small is perhaps more difficult than the earlier problem of delineating the planetary orbits of our sister worlds in the solar system of the enormously great. The key to the large-scale problem was found in the continued careful observation of changes in the angles between the planets and the fixed stars. The key to the supposed atomic orbits seems to lie in likewise carefully observing their nodal frequencies, as furnished from spectrum measurements.

Exhibition at Crystal Palace, London.

Mr. Ernest Schenk, president of the Crystal Palace Company, London, is now in the United States in connection with the American Exhibition which is to be held in Crystal Palace from May to September, 1902. In course of an interview Mr. Schenk said: The forthcoming exhibition promises to be the largest and most important exposition of American products, arts, industries and inventions ever seen in Europe. It will be held under the auspices of the Executive of the American Society in London. The American advisory committee also includes a number of names well-known in business circles on this side. The list includes R. W. Blackwell, of the electrical engineering and contracting firm of Robert W. Blackwell & Co., Limited; Charles Churchill, of Charles Churchill & Co., Limited, the pioneer importers of American labor-saving devices into England; Clark Harrison, who represents the British interests of the United States Cast Iron & Pipe Company, and Colonel Millard Hunsicker, who for many years attended to the European business of the Carnegie Steel Company. The English advisory committee includes the Lord Mayor of London and Sir Douglas Fox, the ex-president of the British Institution of Civil Engineers. The exhibition includes machinery and mechanical industries, mining, electrical traction, haulage, etc.; tramway engineering and equipment, automobiles, and virtually the whole range of the arts and industries.

Electrical Engineers of the Day—XVI.

JOHN F. KELLY.

The difficulties of writing a sketch of Mr. Kelly's life will be fully appreciated by his friends, who well know his constant avoidance of any personal reference to either himself or to his works, and in consequence the writer is compelled, for such facts as should have place in a sketch like this, to depend upon his personal knowledge of the man, or to note such as are, of necessity, a matter of record. The ranks of those who have won distinction in developing the great electrical industry of this country to its present high state contain no more interesting nor striking figure, nor a career which has been more brilliant in action, broad in range, or solid in achievement. Mr. Kelly's name, at least to his friends, is suggestive, not only of progressive methods in electrical machinery and station design, but of successful business results.

John Forrest Kelly, at the age of 19, was graduated as a chemist from the Stevens Institute of Technology in the class of 1878. In addition to his chemical work he had time while at the Institute to study the subject of electrical measurements. Three years later he received the degre of Doctor of Philosophy. It is charactristic of Mr. Kelly that the title has never been associated with his name, and it is probable that not more than one or two of his friends of the last fifteen years have ever known that such a degree had been conferred upon him.

His first employment after graduating was in the laboratory of Thomas A. Edison, where he was employed as a chemist for four or five months. On leaving there in September, 1879, he entered the service of the Western Electric Company as electrician of the New York factory, and remained in that employment until January, 1882, when he resigned to take the position of assistant to Mr. Edward Weston, then chief electrician of the United States Electric Lighting Company. Towards the end of that year he left the United States Company to enter the service of the Parker Electric Lighting Company, afterwards known as the Remington Company, and remained with that company for some fifteen months, when he returned to the United States Company.

During the two following years, Mr. Kelly was closely identified with the now historical work of the old United States Company, covering not only the field of electrical machine design, but also that of the incandescent and arc lamp. In July, 1886, Mr. Weston resigned from the United States Company and Mr. Kelly was appointed chief electrician in his place. He remained in charge of all the electrical work of that company until its absorption by the Westinghouse Electric Company. With the latter company his position remained substantially similar, except in title, as he was the electrician of the Newark shops of the Westinghouse Company until his resignation, January, 1892, to join the Stanley Laboratory Company, which had just been organized in Pittsfield, Mass.

Mr. Kelly was actively connected with the Stanley Laboratory Company until January, 1895. During this period he and his associates designed the now well-known "S. K. C." alternating-current inductor generator, and arranged with the Stanley Electric Manufacturing Company to place on the market a complete system for the transmission and distribution of power by alternating currents. In 1895 he resigned from the Stanley Laboratory Company, and accepted a position as consulting electrical engineer to the Stanley Electric Manufacturing Company, of Pittsfield, and the Royal Electric Company, of Montreal, Canada, which companies were at this time actively entering the field of alternating-current work. Mr. Kelly still holds this position to the Stanley Electric Manufacturing Company, and at the same time has full charge of this company's patent work.

As an inventor, Mr. Kelly's career has been active and brilliant. Early in 1891 he showed the prejudicial effects of lagging currents on alternating-current power and lighting circuits, and in conjunction with his associates, at that time patented and developed an alternating-current induction motor having a condenser in parallel with the main motor circuit for furnishing the lagging component of the motor current. In 1892, he pointed out the value of synchronous motors on alternating-current circuits and showed that by a proper adjustment of the field, the armature current of a synchronous motor can be made to lag or lead the e. m. f. of the line as desired, and in consequence can be made to correct, not only the lagging or leading currents of the circuit, but used as a voltage regulator for an entire

transmission system. A patent for a synchronous motor used as a condenser was issued to him in 1893.

During the same year he pointed out that in the operation of alternating-current motors and also of transformers, and in the general transmission of power by alternating currents, it is of considerable importance that the currents and magnetic fluxes should vary sinusoidally, for experience had shown even at that time that the more nearly such a condition is approached the less are the losses and idle currents. A first step toward obtaining these conditions is the making of the impressed e. m. f. of the generator sinusoidal. To accomplish this it is necessary and sufficient that the magnetic flux through the armature coils should vary sinusoidally. In order to accomplish this latter result and obtain a sinusoidal e. m. f., Mr. Kelly, in 1893, designed alternating-current generators in which the poles were shaped so that the clearance or air-gap varied in an inverse sinusoidal manner, and consequently the flux and generator e. m. f. varied sinusoidally. This was probably the first attempt to shape scientifically the poles of alternators to obtain a predetermined e. m. f. wave and was the basis of a United States patent issued to him in 1894.

Among Mr. Kelly's later inventions may be mentioned the "non-hysteresis growth" transformer iron, the static ground detector and various measuring instruments. It is pertinent here to remark that he has always been an advocate of extreme voltages in transmission work and is recognized as the original "60,000-volt man."

Mr. Kelly is a member of the American Institute of Electrical Engineers, the American Association for the Advancement of Science, and the Société Internationale des Électriciens.

A London Joint Central Station.

ONE of the features of the London, England, electric lighting industry as compared with present American practice is the existence of an extremely large number of companies each having a system of its own and differing from that of the others. For the past several years there has been some discussion as to the substitution for these stations of one or more great central generating stations which will supply the entire metropolitan area. Realization of this plan appears to be yet far in the future, but in the meantime some of the companies have entered into arrangements for the building of a joint station of modern design. Two arrangements of this kind have recently been put into effect, one by the St. James and Westminster companies, and the other by the Kensington and Notting Hill companies. We are enabled to present herewith a description of the joint plant of the two latter companies.

In 1898 both the Kensington and Notting Hill companies found themselves in urgent need of new generating stations, and neither was able to secure suitable sites within its respective supply district. As the result of negotiations the two companies decided to erect a joint station in Hammersmith, about 2½ miles from the district of the Kensington Company and 1 mile from the works of the Notting Hill Company.

Considering the distance from the areas of supply, the alternating-current system was decided upon as being the most suitable, and a pressure of 5250 volts at the generating station, with three-phase generators was chosen. Both companies are supplying current under somewhat similar conditions, the three-wire system being used with 220 volts pressure between the outers, whilst in each case special facilities are being given to consumers to change over to the higher pressure, and no houses are being connected at 110 volts, so that the companies hope in the future to change to a three-wire system at 440 volts. At present, however, all the switchboards and generators are made for 220 volts, the balancing being done by existing accumulators at the Kensington Court and Bayswater Road sub-stations; whilst at the new sub-stations of both companies only 220-volt motor-generators are being installed, no arrangements being made for balancing, as supply in their neighborhood is almost altogether at the single voltage. The question of using rotatory transformers, synchronous motor-generators or induction motor-generators was very carefully considered, and it was decided in the first instance to use nothing but the last-named type of machine in the sub-stations. The principal advantage of using the induction motor-generator is on account of the exceedingly rapid increase of load that always occurs in London, and, in fact, in most large towns, due to either a thick fog or a heavy thunderstorm. Speed in starting fresh motor-generators is consequently a great desideratum, and the induction motor-generator can be switched on to the mains within two minutes of starting up. It also takes the whole of the starting current from the supply station, whilst in the case of the synchronous motor-generator the starting current is taken from the side already fully loaded. The mains have been laid with a very wide margin for increased output, so the question of power factor was not considered of prime importance; and, if found necessary, synchronous machines will be installed when extensions are necessary.

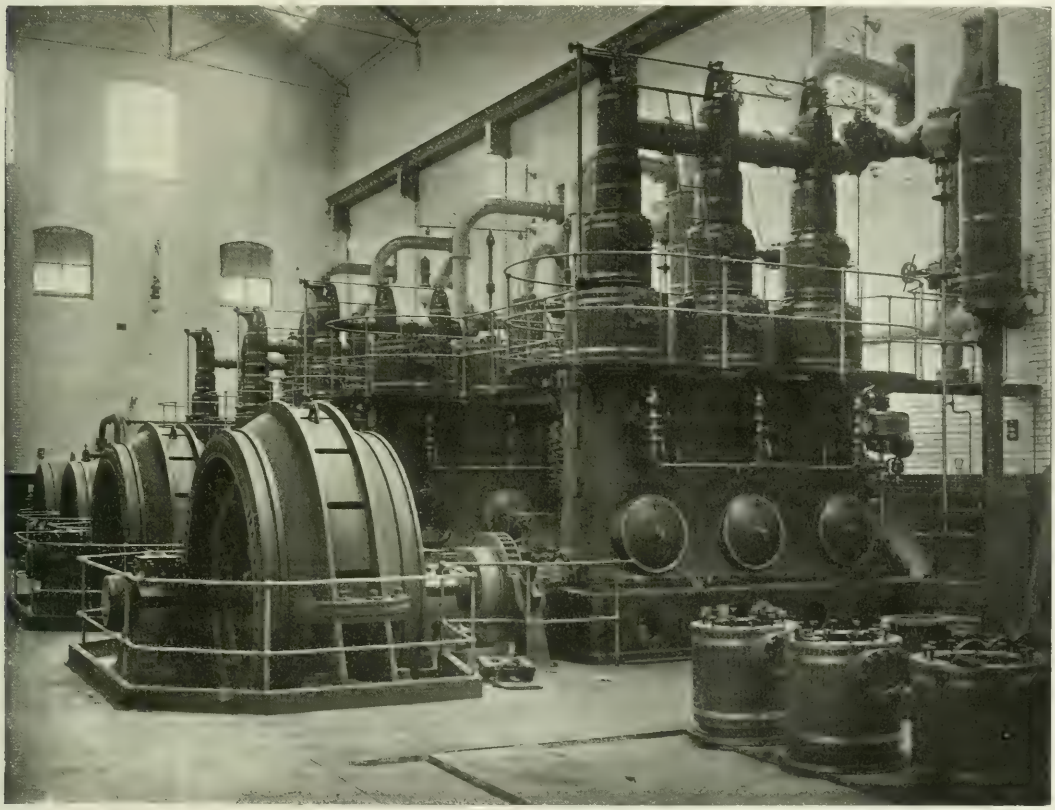


Fig. 1.—Generating Room.

An area of 3¾ acres was acquired on which a boiler house and engine house, each 126 ft. by 45 were erected. On the grounds are sidings from two railroads. The walls of the buildings are faced with special leadless white glazed bricks, with a brown dado and black line formed to a height of 6 ft. above the floor, which is of concrete covered with a maple block flooring. The boiler house roof is constructed with non-inflammable wood and steel, and slated outside. Boyle's air-pump ventilators are fixed on the ridge of the roofs of both engine and boiler house.

The chimney has been designed to deal with the flue gases from boilers of 10,000 horse-power. It is 230 ft. high and 210 ft. above the

ground. The section is circular, with an 11-ft. bore throughout. The excavation was taken down 26 ft. until the hard blue clay was reached, this depth being 13 ft. below the standing water level. The outside diameter varies from 22 ft. at the bottom to 13 ft. 4 inches at the top.

The boiler house provides space for eight Babcock & Wilcox boilers, each having 3654 square feet of heating surface and capable of evaporating 14,000 lbs. of water per hour at 200 lbs. pressure, which is the working pressure. The boilers are equipped with Babcock & Wilcox self-clinkering grate mechanical stoker, the stoker gear being driven by a 5-hp motor. A complete coal and ash-handling system is installed. The coal is delivered to storage bunkers directly over the boilers, 108 ft. long, 17 ft. wide and 17 ft. deep, and capable of storing 800 tons. Measuring chambers are employed similar to those which have been used with such great success in gas works. Owing to the tubes in the boilers having to be taken out, it is arranged that the chute may be swung out of place so as to allow of the tubes being withdrawn without disturbing the coal in the bunkers. Each of the chutes holds 10 cwt. of coal, and is provided with flap doors so that the capacity may be adjusted from time to time, according to the quality of the coal which is being used, and to the lever is connected a counter so that the number of discharges are registered. In addition to this, the chutes are provided with a Graham patent sure-feed, which is a simple and efficient device for preventing the chambers being half-emptied or being tampered with, and the slide having been once withdrawn must remain open until the whole of the coal is discharged. The whole plant is designed to deal with 30 tons of coal per hour, and is driven by two 10-hp electric motors.

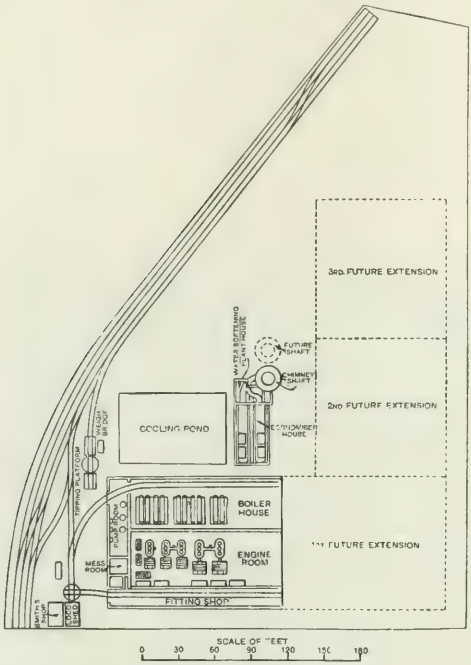


FIG. 2.—PLAN OF GENERATING STATION.

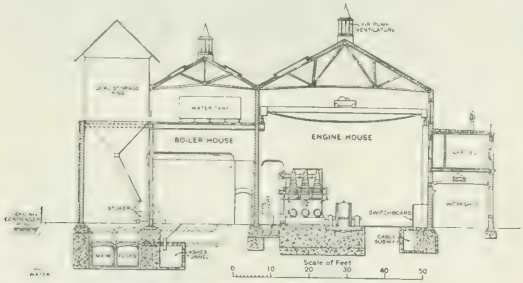


FIG. 3.—SECTION THROUGH GENERATING STATION.

A complete set of apparatus has been provided for testing coal and for boiler trials. It consists of a 2-inch Schonheyder's high-pressure water meter, weigh-bridge for the coal, dasymeter for measuring the CO_2 draught gauge, and pyrometer.

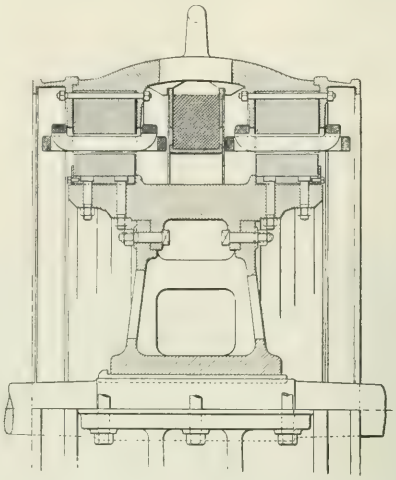


FIG. 4.—SECTION THROUGH 330-KW ALTERNATOR.

Water is obtained either from the water company or by means of a three-throw electrically-driven pump from a well on the grounds. A water-softening plant has been fixed near the economizers capable of dealing with 1500 gallons of water per hour.

Over the boilers are two cast-iron tanks, measuring 112 ft. long by 16 ft. wide by 6 ft. deep, and holding about 55,000 gallons of water, so that at full load the tanks contain half an hour's supply. These tanks give the necessary head of water required by the ejector condensers fixed on each engine, and are filled by one of the circulating pumps, the steam valve on the pump being controlled by a float in the tank.

A cooling pond, measuring 100 ft. by 60 ft. by 7 ft. deep, has been excavated, the bottom being in a thick bed of clay. It has been lined with cement concrete and Callender's bitumen sheeting; 84 jet fountains have been fixed. The pond was designed to deal continuously with the condensing water from about 2500 horse-power, and the water pipes will still be large enough when the pond is increased to twice its present size. The water is pumped to the fountains under a

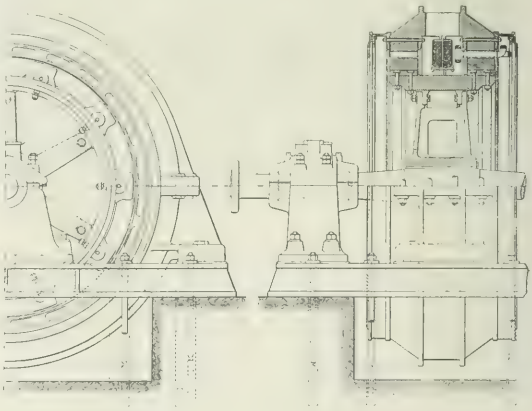


FIG. 5.—550-KW ALTERNATOR.

head of 150 ft., and the whole of the rainwater collected on the roofs is delivered into the pond.

The arrangement of the engines and dynamos is shown in Figs. 2 and 3, whilst the general appearance of the engine room may be seen from Fig. 1. Five sets have so far been installed, and there is still space in the existing building for two larger sets. The smallest unit adopted consists of a 575-hp Willans engine, coupled to a 330-kw Oerlikon alternator, which runs at 300 r. p. m. Three of this size have been fixed, as well as two larger sets. These latter indicate 825 horse-power, and are coupled to 550-kw alternators running at 270 r. p. m. All the engines are of the three-crank triple-expansion type, and each engine is fitted with a Korting ejector condenser, the condensers taking their water from the tanks over the boiler house. The discharge is taken through a 20-inch cast-iron pipe through the pump room to the cooling pond.

The engine cylinders are lubricated by means of pure powdered

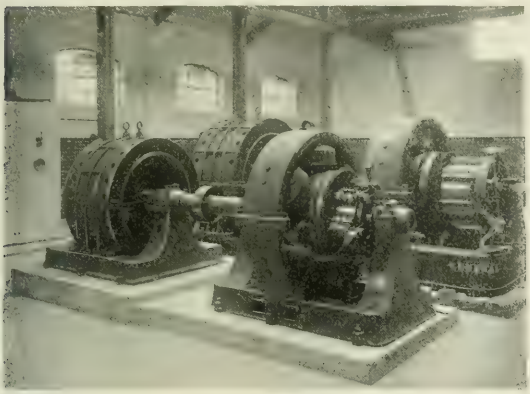


Fig. 6.—Lancaster Road Station.

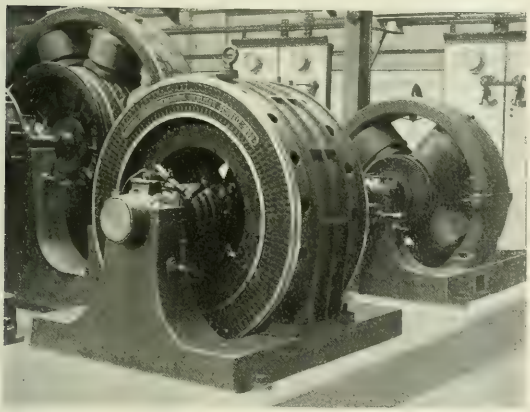


Fig. 7.—High Street Station.

graphite mixed with a small quantity of cylinder oil to form a thick paste. This mixture is put into a grease lubricator, such as is used for forcing grease along pipes to the bearings of engines. The piston of the lubricator is forced down by means of a worm wheel and worm geared to a ratchet wheel, the ratchet of which is given a reciprocating movement from a speed reducing gear driven by belt from the crank shaft. The speed is set so as to give one drop per minute to the engine, the graphite being fed through small copper pipes. One of these lubricators will last for two months without refilling.

The alternators are of the three-phase inductor type working at a pressure of 5250 volts at 45 cycles per second. Fig. 5 gives a half elevation end of the 550-kw alternator, and a side view half in elevation half in section of the same machine, and Fig. 4 is a section through the 330-kw machine.

In the case of the smaller machine the inductor is 5.94 ft. in diameter, and the stator is bored out to a diameter of 5.96 ft., giving a clearance of about ⅛ inch between rotor and stator. The poles are of laminated charcoal iron. The hub and spokes of the rotor are of cast-iron, and the rim is of steel. The outer rim of the stator is of steel, and the magnet spool is of cast iron. The steel shaft is 8.66 inches diameter, tapering to 6.7 inches at the bearings. The diameter of machine over all is 8.2 ft., the length is 9.7 ft., and the width 9.84 ft. The 550-kw machine is very similar in construction, with the exception that the outside rim of the stator is of cast iron, and the field-magnet bobbin is divided by a wrought-iron separator.

The exciting current can be taken either from two Willans-Parker generating units, a motor-generator or a battery of accumulators. The exciters have an output of 40 kilowatts at 450 r. p. m., the engines being of the two crank triple-expansion and condensing type. The accumulators have a capacity of 600 ampere-hours. There are 56 cells, and these may be used also for lighting or working the auxiliary motors in the station. The motor-generator has an output of 600 amperes at 100 volts, and is similar to those in the sub-stations, described below.

The switchboards are in five separate sections, and consist of (1) the low tension board, for the exciters, lighting, power and accumulators; (2) the panels for the three 330-kw alternators and the motor-generator; (3) the panels for the trunk mains to the Notting Hill Company's district; (4) the panels for the two 550-kw alternators and two spare panels for extensions; (5) the panels for the trunk mains

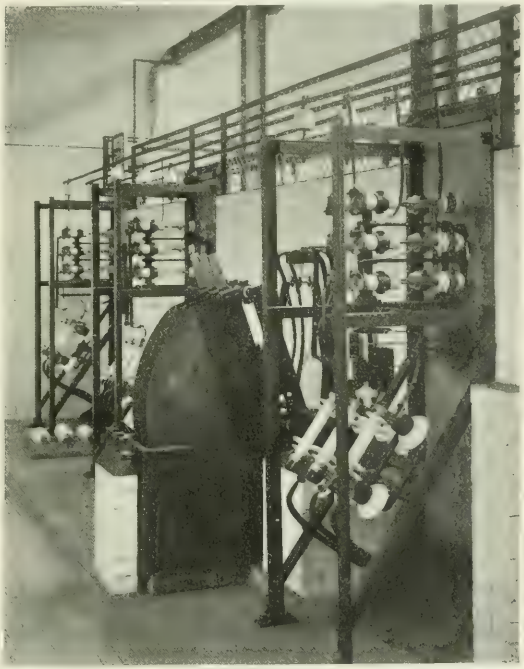


Fig. 8.—Rear View High-Tension Switchboard, High Street Station.

to the Kensington Company's district. The general arrangement of the boards is clearly shown in Fig. 13. The alternator panels are on the left and the motor-generator panel on the right.

In designing the switchboards an endeavor was made to render them safe from accidental contact with any live part. On the front of the high-tension panels and exposed to view are only the instruments and switch handles. The dials of the instruments are seen through holes cut in the marble panels. The glass covering the dial is the only part that can be touched, and this is surrounded by a metal ring connected to earth, as also is the three-pole main switch handle. At the back of the boards the iron framework is formed into cages, one for each panel, and provided with iron doors fitted with Yale locks; but it is possible to go into the space at the back of the boards and look at the apparatus through the iron meshing. The switches

and bus-bars overhead have similar ironwork guards to stop any one reaching up to them. In the event of any of the apparatus at the back of the panels requiring adjustment, it is the duty of the engineer in charge to cut off the current from the particular panel by means of the main switch, and lock it with a Yale lock. The door of the cage may then be opened.

At the bottom of the cage of a 550-volt panel is a smaller cage, which contains the synchronizing transformer. Above this is the resistance and 50-contact rheostat controlling the current through the field magnet. In the center are the three main fuses, synchronizing switch fuses and the voltmeter switch. The main three-pole switch is in the cage above. The feeder panels are separated in a similar manner, but in these the fuses are of a somewhat different pattern. Both types consist of weighted copper wires in asbestos tubes with ebonite handles. With the exception of a few electrostatic Kelvin voltmeters, the instruments are mostly of the Hartmann and Braun hot-wire pattern. In the case of the synchronizing voltmeter there are two scales, one showing the pressure of the bus-bars, the other of

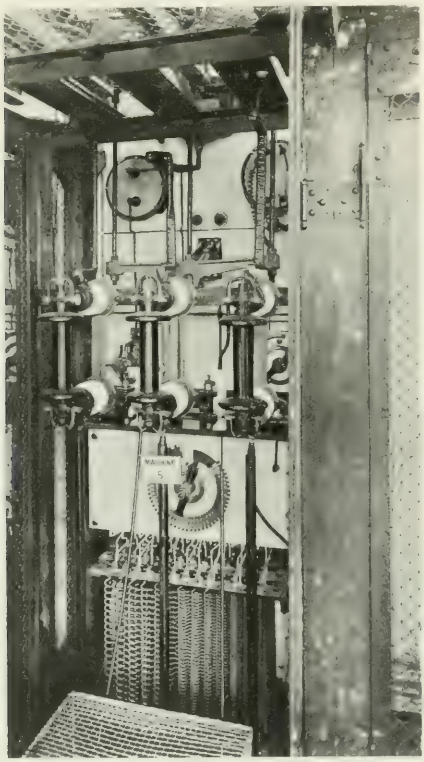


FIG. 9.—550-KW ALTERNATOR PANEL.

the incoming alternator. A Thomson three-phase voltmeter is fitted in each circuit panel and is provided with a needle to indicate the load on the feeder. The whole of the insulators on the boards have been tested up to 20,000 volts.

The feeders from the generating station to the sub-stations are all in duplicate. They are of the clover leaf pattern, taped and drawn into Doulton casing, each conductor being 0.15 square inch in area. Under the switchboards the cables are laid beneath the floor of a cable subway constructed the whole length of the engine house. The mains then pass into the conduits, which are surrounded with 6 inches of concrete. They are carried under and across the lines of the West London and the Hammersmith and City Railways into Hunt Street, and then away to the two companies' districts. Ten out of 12 cables have been drawn in, and before use they were tested up to 10,000 volts for half an hour to earth and half an hour between each of the cores.

The motor-generators used both by the Kensington and Notting Hill Companies are of the Oerlikon induction-motor type, their general appearance being clearly shown in Figs. 6 and 7. The motors have wound rotors, which are provided with slip rings for connecting to the starting resistance. These resistances are placed between motor

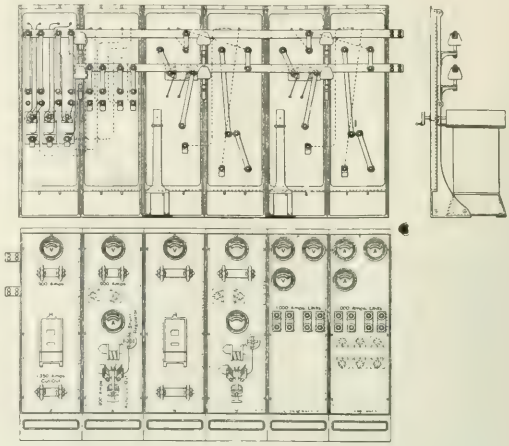


FIG. 10.—LOW-TENSION SWITCHBOARD, LANCASTER ROAD SUB-STATION.

and generator at the Kensington sub-stations and near the switchboards by the Notting Hill Company. When the motor has reached full speed and the rotor resistance is cut out, the brushes can be removed from the slip rings by means of a lever, shown to the right of the motor in Fig. 6. The clearance between the rotor and stator is about 1-16 inch, and liners are used to correct for wear of the bearings. The generators are of the multipolar type with cast-steel yokes, and the field magnets can be excited directly from the brushes or from the bus-bars. Copper gauze brushes are used with one leading carbon brush to each set. The large dynamos have barrel-wound armatures, whilst for the smaller sets evolute end connections are used.

SUB-STATIONS.

The sub-station of the Kensington Company is in vaults at the back of Albert Hall. The present equipment consists of one 100-kw,

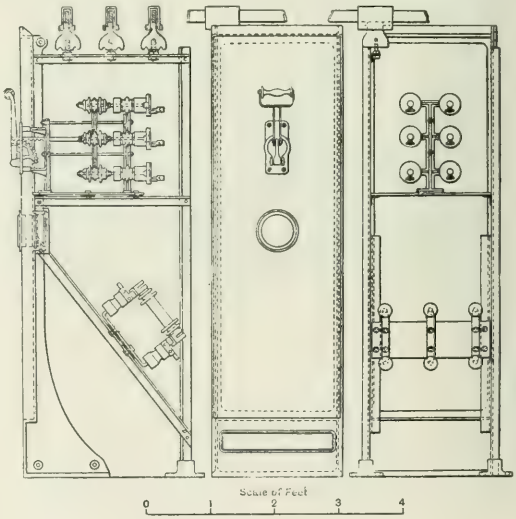


FIG. 11.—HIGH-TENSION PANEL, NOTTING HILL SUB-STATION.

two 180-kw and three 200-kw machines. The smallest-sized unit runs at 420 revolutions and the larger ones run at 380 revolutions.

Four cables from the generating stations enter the sub-station, and are divided into separate cables in joint boxes. Fuses are in circuit

with each cable. The high pressure switchboard is similar in design to that at Wood Lane, and caged in the same way, but there is an additional precaution, the fuses being separated by slate slabs. The bus-bars consist of copper tubes which form a ring main, and they can be disconnected at three places. The three cables to each motor have a lay of about one turn in 10 ft.

On the low-tension board are six generator panels and four feeder

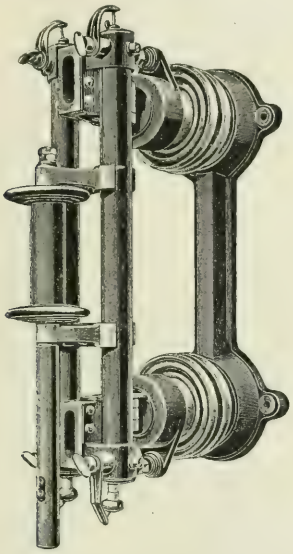


FIG. 12.—TYPE OF HIGH-TENSION FEEDER CUT-OUT AT WOOD LANE AND KENSINGTON SUB-STATIONS.

panels. The fuses are of copper shunted with a small tin fuse in a fibre tube. The instruments are of the Evershed moving coil type. Motor-generators are also being installed at the Kensington Court station.

The Notting Hill Company has made its first sub-station on the same premises as its generating station in High Street, Notting Hill Gate, but it has now nearly completed a second in Lancaster Road. A portion of the first sub-station is shown in Fig. 7. In the Notting Hill sub-station two 60-kw, two 180-kw and one 300-kw motor-generators have been installed, and there is room for one further 300-kw set. In the Lancaster Road sub-station one 100-kw and one 180-kw sets are being erected, the last-named having the generator of the Byng-Hawkins type, which was made in England, the others the General Electric Company obtained from Switzerland.

The principal difference between the Notting Hill station and the Kensington station is in the switchboards. In the sub-station now working the panels are opposite the machines. The high-tension panels are separated by white glazed brick walls, the whole working apparatus being practically enclosed in a separate room with a locked door. The low-tension panels are placed in front with a clear footway between, and the backs are quite open. The high-tension boards are of the standard Oerlikon pattern for this class of work. The switches have a total double break of about 12 inches. This takes place inside a porcelain tube and there is practically no arc. The fuses are of the popgun order with a break of about 8 inches. The actual fuse is made of silver, as this metal is found to be the most reliable, a given size of wire breaking nearly always with the same current; they are inclined so that the fuse and plug are shot in a direction where they will not cause damage.

The rotor of the 300-kw motor-generator is started by means of a water resistance, the starting current being about 700 amperes. A tell-tale, giving the position of the resistance plates is fixed on the wall above the regulating handle.

Each sub-station is in direct communication with the Wood Lane station, the signaling being carried out either by telephone, telescriptor or bell. In the main station there are two separate sets of apparatus, one for each company's sub-stations, and these are placed in chambers between the switchboard sections.

The consulting engineers for the plant were the chief engineer of each company, Mr. H. W. Miller, of Kensington, and Mr. G. Schultz, of Notting Hill, the specification and construction of the joint station being also undertaken by these gentlemen, who were assisted by Mr. C. M. Bennett and Mr. S. F. Weston; and when the work was completed Mr. Bennett was appointed resident engineer, with Mr. Weston as his chief assistant. We are indebted to our London contemporary, the *Electrician*, for the data contained in this article.

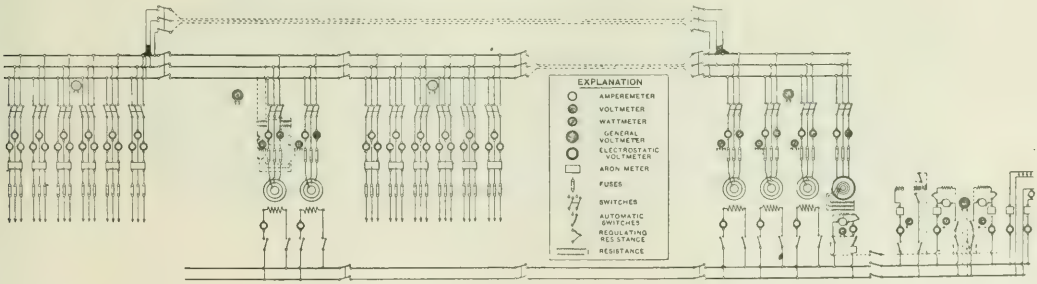


FIG. 13.—GENERAL ARRANGEMENT OF SWITCHBOARDS AT WOOD LANE.

Storage Batteries in Traction Work.

In a discussion of the paper read at the Street Railway Convention by Mr. W. E. Harrington, an abstract of which appeared in our issue of last week, Col. Heft said that he was sorry that his experience with storage batteries had not been very satisfactory, and that he could not recommend installing batteries. Mr. Uhlenhaut said that the cost of maintenance of a battery depended upon its capacity for the work required of it. He referred to two cases, in one of which the battery had been in use for four years with practically no depreciation; another had been expensive in maintenance, and an investigation showed that this latter was overworked. Mr. Wason said that in the arrangement of sub-stations something may be sacrificed in the location of the battery from the engineering point of view in order to install it at a point where it could receive attendance without extra charge. Mr. Davidson, of Pittsburg, agreed with Mr. Wason, and said that the company with which he is connected has chosen three points for sub-stations on a long line, such that the batteries will require scarcely any expense for attendance, as other operations are carried on in the same premises. Professor Roberts said that the Union Traction Company, of Indiana, had found that their storage batteries act as lightning protectors. During heavy storms the boosters are thrown out of circuit and the batteries then serve as efficient lightning protectors. Mr. Crosby said that in Washington the storage batteries installed near the center of the city are able to carry 75 cars for a period something like six hours, should, by accident, the station capacity be put out of commission. When this has occurred there was a heavy drain on the battery, but it did its work satisfactorily. He considered that the surroundings of battery installation have something to do with its efficiency, and mentioned one case where a battery confined in a dark confined space had a disastrous repair account, while another battery properly installed had a repair account which was quite favorable.

The Inductor Alternator—III.

By Edward Heitmann.

(*Concluded.*)

In the preceding article the constructional details of an inductor alternator were given. The accompanying illustrations show some of the more general features.

Fig. 7 is a 1200-kw, 200-r. p. m. inductor alternator, built for direct connection to a waterwheel. Fig. 8 is a large engine-type generator, built to operate at a speed of 100 r. p. m. The construction of the poles characteristic of S. K. C. generators is very well illustrated in this, and other details are also plainly shown. The characteristics of this machine will be given later.

Sometimes in large high-speed generators it becomes impossible for mechanical reasons to use the "magnet bar" construction. The type illustrated in Figs. 9 and 10 is then resorted to. The inductor does not differ from that described before. For the armature, a cast steel ring, as shown, takes the place of the magnet bars and end rings, while the punchings are held in place by means of dovetails and keys similar to those described for securing the pole punchings. In all other respects, this type corresponds with that previously discussed.

Fig. 10 is a 2000-kw, 240-r. p. m. of this type, built for direct-connection to a waterwheel. The characteristics will also be given later.

CURVES AND DATA.

In Fig. 11 are given the saturation curve and regulation curves of a 500-kw, 2500-volt, 60-p. p. s. engine-type inductor alternator designed to run at a speed of 100 r. p. m. The saturation curve is plotted with field currents as abscissæ and volts as ordinates. The regulation curves are plotted with armature currents as abscissæ and volts as ordinates, and show the rise in volts when a given load at power factors from 100 to 70 per cent and 2500 terminal volts is thrown off. For instance, if the generator is carrying its full load of 100 amperes at a power factor of 100 per cent, the e. m. f. will rise to 2640 volts when this load is removed. Thus the regulation is 5.6 per cent on full non-inductive load. This regulation was determined from a test made after the generator was installed, and from the data obtained, the other regulation curves were calculated. The curves are also useful in determining the field current required for a given load and power factor, as follows:

Assume 100 amperes armature current and a power factor of 100 per cent. Starting at 100 amperes on the lower scale, follow this line

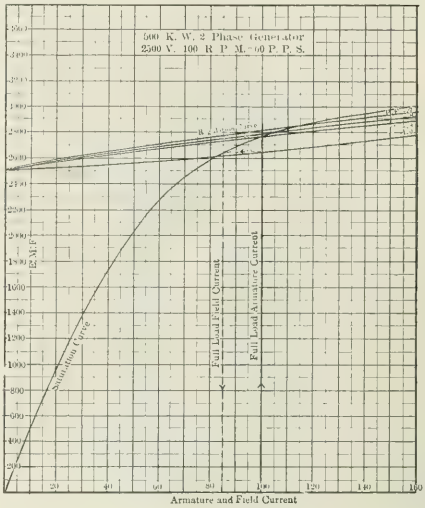


FIG. 11.—SATURATION AND REGULATION CURVES.

upwards until the regulation curve for 100 per cent power factor is reached, then horizontally to the left to the point of intersection with the saturation curve, which will indicate the required field current. From the curves we obtain the following data for full load output:

Power factor.	Regulation.	Field current.
100 per cent.	5.6 per cent.	85 amperes.
90 "	10.5 "	100 "
80 "	11.6 "	105 "
70 "	13.0 "	110 "

The no-load field current is 79 amperes and the increase in field

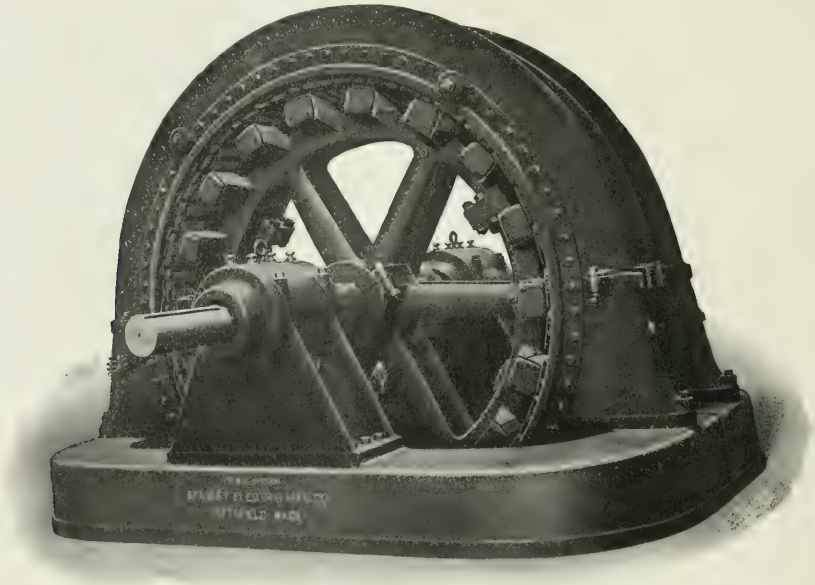


FIG. 7.—1200-KW INDUCTOR ALTERNATOR.

current from no load to full load at 70 per cent power factor is about 40 per cent. This generator will carry 100 per cent load continuously with a temperature rise of 40 degs. C. It will carry 125 per cent load continuously, with a temperature rise of 50 degs. C. and carry 150 per cent for three hours.

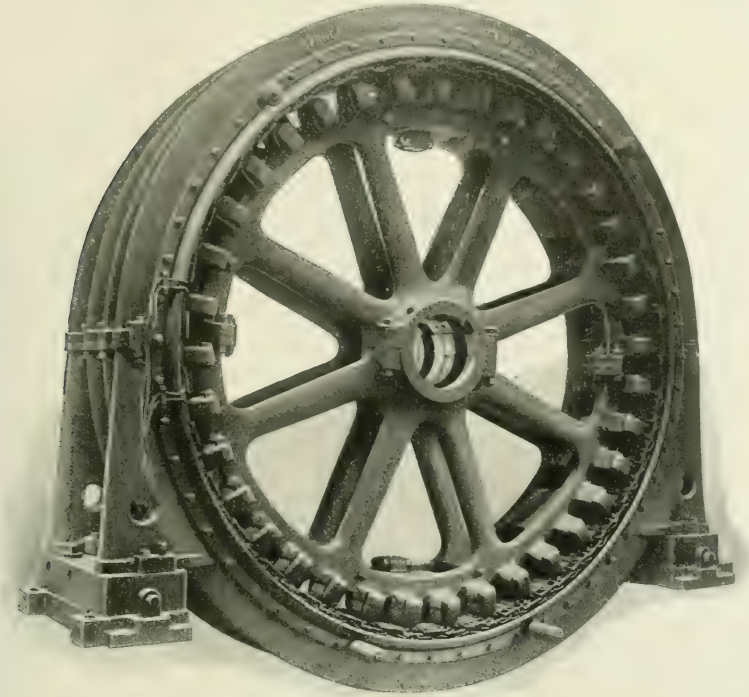


FIG. 8.—ENGINE TYPE GENERATOR.

The efficiencies are as follows:

Per Cent Load.	Per Cent.
125	94.0
100	93.8
75	92.7
50	91.0
25	86.0

In Fig. 12 similar curves are given for a 2000-kw, 2200-volt, 60-cycle generator designed for direct connection to a waterwheel operating at a speed of 240 r. p. m. The non-inductive regulation was determined as before and the remaining calculated. The data obtained from the curves is as follows for full load:

Power Factor. Per cent.	Regulation. Per cent.	Field Current. Amperes.
100	3.0	154
90	8.2	174
80	11.0	180
70	11.4	187

The no-load field current is 146 amperes at 2500 volts, thus the increase in field current from no load to full load at a 70 per cent power factor is about 30 per cent.

This generator will carry 100 per cent load continuously, with a rise in temperature of 35 degs. C. It will carry 125 per cent load continuously with a rise in temperature of 45 degs., and will carry 150 per cent load for four hours. The efficiencies are as follows:

Per Cent Load.	Per Cent.
125	[illegible]
100	94.75
75	[illegible]
50	92.0
25	89.0

The following results were obtained from load tests, both non-inductive and inductive. The first test was made on a [illegible] kw, 900 r. p. m., two-phase, 60-cycle generator, loaded on a water rheostat. The regulation was found to be 10 per cent for full non-inductive load. Sufficient reactance was then put into the circuit to lower the power factor to 65 per cent. The full-load regulation measured was 23.5 per cent, that is, 2.35 times the non-inductive. Similar tests made on a 60-kw, three-phase alternator showed a regulation of 10.6 per cent on full non-inductive load and 23.8 per cent on full load, 76 per cent power factor, or about 2¼ times the non-inductive.

In conclusion, I will give complete data on a 135-kw, 2400-volt inductor alternator, designed to operate at 60 cycles and 900 r. p. m.

All figures and curves were obtained from actual tests of the machine. The non-inductive load tests were made with a water rheostat, the inductive load test with rheostat and reactive coils. All the voltmeter, ammeter and wattmeter measurements were made in the ordinary manner with S. K. C. hot wire and Weston instruments, which were carefully calibrated.

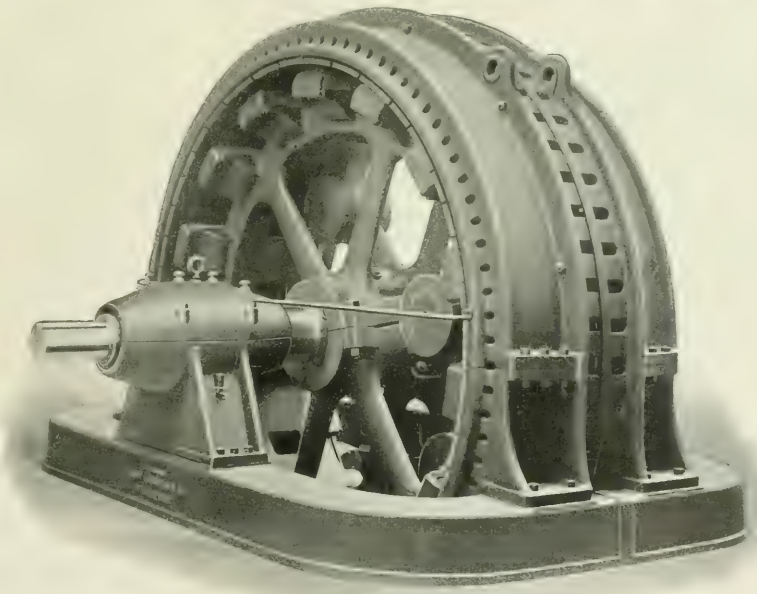


FIG. 9.—ENGINE TYPE GENERATOR.

The full load armature current is 28.1 amperes; the full-load field current, 8.8 amperes. The hot armature resistance is 14.6 ohms per phase. The hot field resistance, 9.35 ohms per phase. Measured windage and friction equals 2000 watts and measured iron loss equals 5000 watts.

Fig. 13 gives an efficiency curve calculated from these data. The

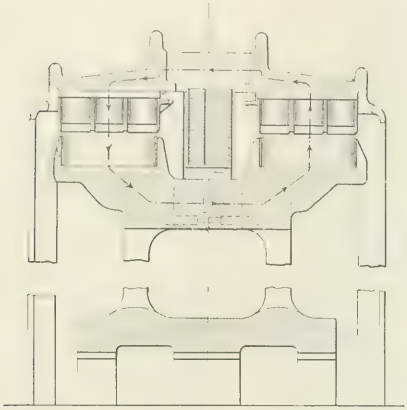


FIG. 10.—SECTION OF GENERATOR SHOWN IN FIG. 9.

full-load efficiency is 93 per cent; for three-quarter, 92 per cent; for half load, 90½ per cent, and one-quarter load, 81½ per cent.

The regulation, from full non-inductive load to no load, is 9 per cent, and for full load, 70 per cent power factor, is 21.8 per cent, or less than 2.5 times the non-inductive. In Fig. 13 the regulation curves for 100 per cent and at 70 per cent power factor are given, as well as the saturation curve.

The generator on which the above tests were made was not especially designed for service on inductive circuits, but a standard ma-

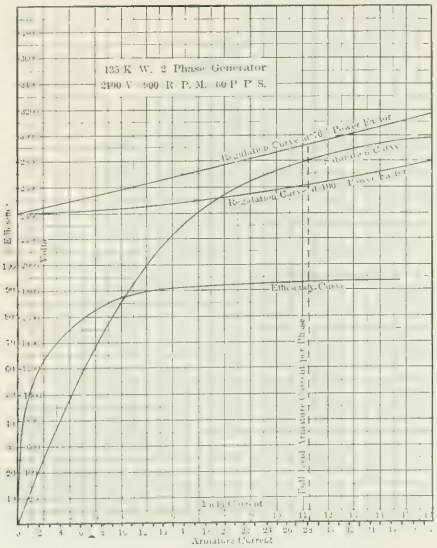


FIG. 13.—EFFICIENCY AND REGULATION CURVES.

chine, and was chosen for this test merely because it was most convenient to use it at the time.

The tests, as well as those given above on other generators, undoubtedly show that an inductor alternator, when properly designed and dimensioned, will successfully meet the most severe conditions met with in its practical operation, and that its behavior under such

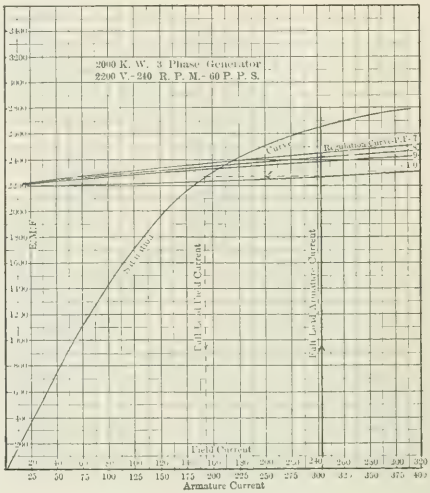


FIG. 12.—CURVES OF 2000-KW GENERATOR.

conditions will be equally as good, if not better, than that of any other type.

The Influence of Polyphase Apparatus on the Design of Railway Power Stations—III.

By J. E. Woodbridge.

(*Concluded.*)

GENERATING STATION ARRANGEMENT.

The arrangement of the apparatus in a steam power station is, of course, fundamentally determined by the requirements of the piping. In order to illustrate the influence of electrical apparatus on such a structure we will again construct as nearly as possible a representative case. We will assume that the power station, as a whole, consists of the usual boiler and engine rooms parallel with each other, with a single row of cross-compound engines in the engine room, with their shafts in line and with their cylinder heads projecting toward the boiler room wall.

For best operation all steam auxiliaries, such as condensers, pumps, etc., should be kept in the boiler room side of the engine room, leaving the opposite side of room clear for the electrical auxiliaries.

The location of switchboard and other electrical apparatus at one end of engine room is not to be recommended, owing to difficulties in extension, as well as length of leads and distance from machines in opposite end of room. The distribution of electrical apparatus along the opposite side of engine room from boiler room wall almost invariably gives the best results.

Owing to the large number of oil switches usually needed in a generating station, it is, as a rule, necessary to place them in two parallel rows behind the switchboard, unless they are forced into the basement or on to a gallery, both of which arrangements work out less satisfactorily in detail than the double row behind panels. The two rows of oil switches call for a depth behind the panels amounting to about 13 ft. As the space usually left between engines and side of engine room does not amount to as much as this, it appears at first sight necessary to build an offset from the building for this apparatus. However, the exciters, transformers, converters and other apparatus which these stations generally contain serve, with offices, and possibly a stock room and oil room, to extend this offset the whole length of engine room, making good use of a rectangular piece of property. Since the traveling crane need not span the electrical auxiliaries, these can be placed in a sort of lean-to outside the

crane and roof-supporting columns, thereby saving considerable in cost of crane and main roof trusses.

Such an arrangement is indicated in Figs. 13 and 14. These show a lean-to, with a width of about 10 ft., containing a switchboard at about the middle of the station, with the exciters to the left of this switchboard and converters to the right. This particular station is one equipped with high-potential generators calling for step-down transformers for the converters. The exciters consist of one engine-driven machine for starting up the plant and for use as a reserve and one induction motor-driven machine for steady use. These machines are located to the left of the switchboard, since it is customary to mount the exciter panels at this end of the switchboard structure. The converters are mounted to the right as near as possible to their respective panels, which are at that end of the board. It

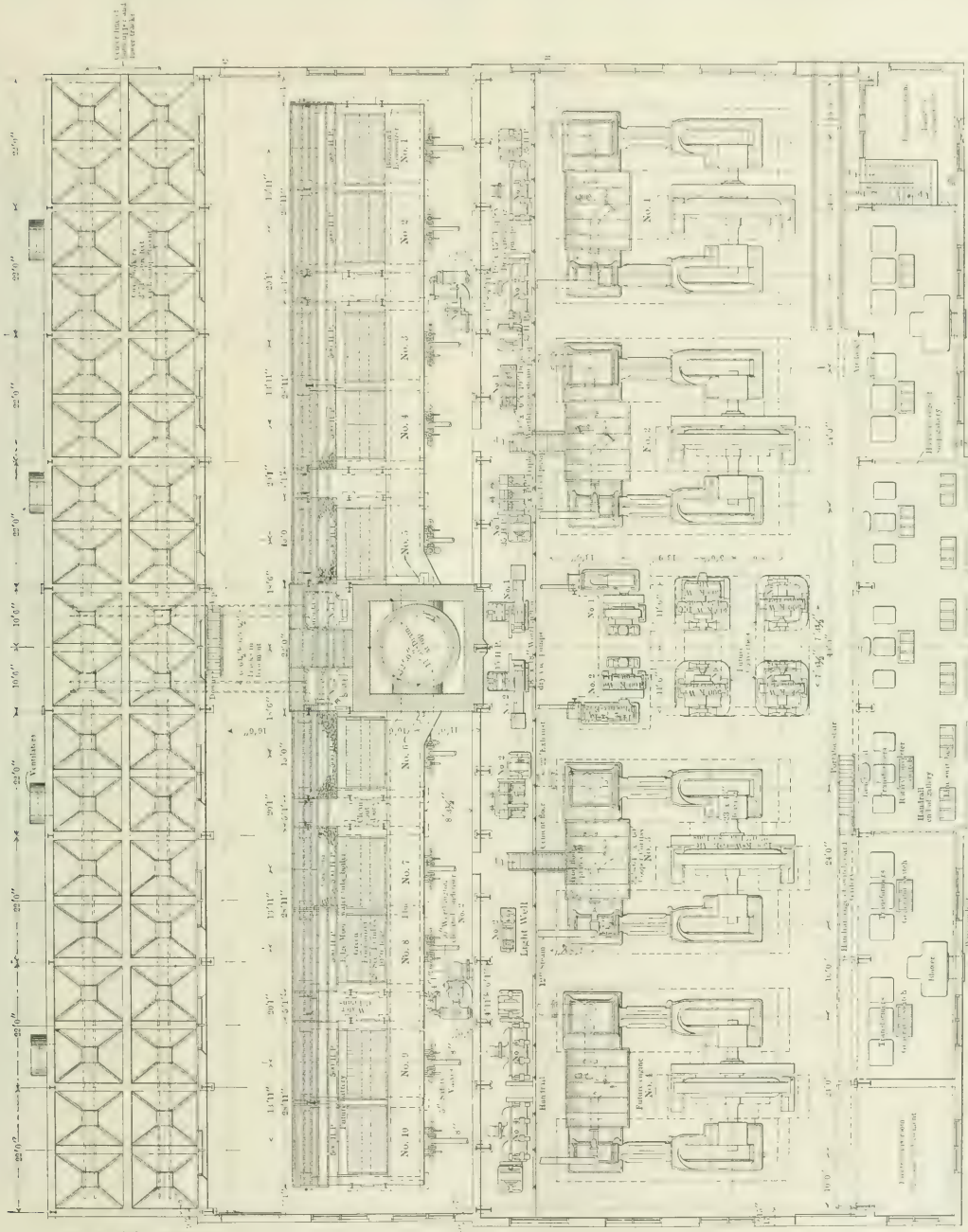


Fig. 12.—Complete plan of Generating Station Now Being Built by Aurora, Elgin & Chicago Railway Company.

might be noted here that a switchboard with the many different classes of panels that are needed for this station should contain either several blank panels at different points or gaps between panels. In the latter case the oil cells behind the boards should be built of suitable brick and with sufficient care to give a finished appearance. In order that these blank panels or gaps may be utilized for extensions of any kind, all panels in the switchboard should, if possible, be of the same width. That part of the lean-to or electrical annex immediately over the oil switch cells is in this station carried up to a somewhat greater height than the rest of the annex, in order to form a wire tower containing lightning arresters, wire outlets, etc. Each outgoing high-tension line is fitted with its own independent lightning arresters. No windows should be located in the back wall of the wire tower.

A section of the basement under the transformers is walled off in this station to serve as a blast chamber, this chamber having full basement depth, and therefore becoming an ideal place for the execution of the large amount of wiring which must be done in it. The blast-chamber wall serves in part as a foundation for the converters, the weight of which is supported on two walls. The floor may be left open under the converter frames as described above for the same machines in sub-stations. In this case the basement space between the two walls forming converter foundations may well be shut off by a door from the rest of the basement in order to keep steam, ashes and coal dust from floating up through the converters.

WIRING OF GENERATING STATIONS.

The same remarks apply to the wiring of the generating stations as are given above for the sub-stations. In addition, the writer prefers to see all exciter wiring carried in iron-armored conduits, on account of the importance of these conductors to the station operation, and the possibility of injuring them mechanically when working on steam pipes or other heavy parts in basement. All field wires and other small conductors of vital importance may well be similarly protected. The precautions considered wise in the wiring of high-class office buildings are certainly none too stringent for power plants, shut downs of which entail large losses.

GENERATING STATIONS WITH STEP-UP TRANSFORMERS.

For extra high voltage transmission, over 15,000 volts, the generators are preferably wound for a comparatively low voltage, such as 2300 volts, the line pressure being derived from step-up transformers. An admirably arranged station of this kind is that illustrated in plan in Fig. 12 and in partial section in Fig. 15. This station is that now under construction by the Aurora, Elgin & Chicago Railway Company at Batavia, Ill., the designs having been made by the Cleveland Construction Company, through whose courtesy the accompanying plans are made public.

This station is built to contain four 1500-kw, 2300-volt, 25-cycle generators driven by horizontal cross-compound engines, the design contemplating the eventual extension of this station to twice this capacity. All auxiliaries of this station are motor driven, the pumps,

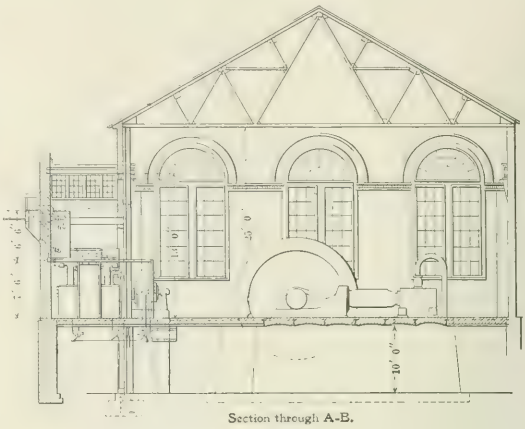


FIG. 14.—VERTICAL SECTION ACROSS ANNEX SHOWN IN FIG. 12.

condensers, etc., being located in engine-room basement in a row along boiler room wall. Main engine room floor is discontinued over these pumps as the plan indicates. The opposite side of the engine room outside of crane-supporting columns is devoted exclusively to electrical apparatus, with the exception of some spaces which are not needed for the latter and are used for offices, repair shop, oil room, etc. A wall in the basement along the face of crane-supporting columns isolates a space about 15 ft. by 180 ft. in size, all of which serves both as a blast chamber for the transformers standing above it and as a bus-bar chamber containing all high-tension wiring. Two large centrifugal steel-plate blowers on the main floor maintain a pressure of about three-fourths ounce per square inch in this blast chamber, the air being drawn from out of doors.

Each generator is provided with an independent group of transformers, which is electrically a unit with the generator, there being

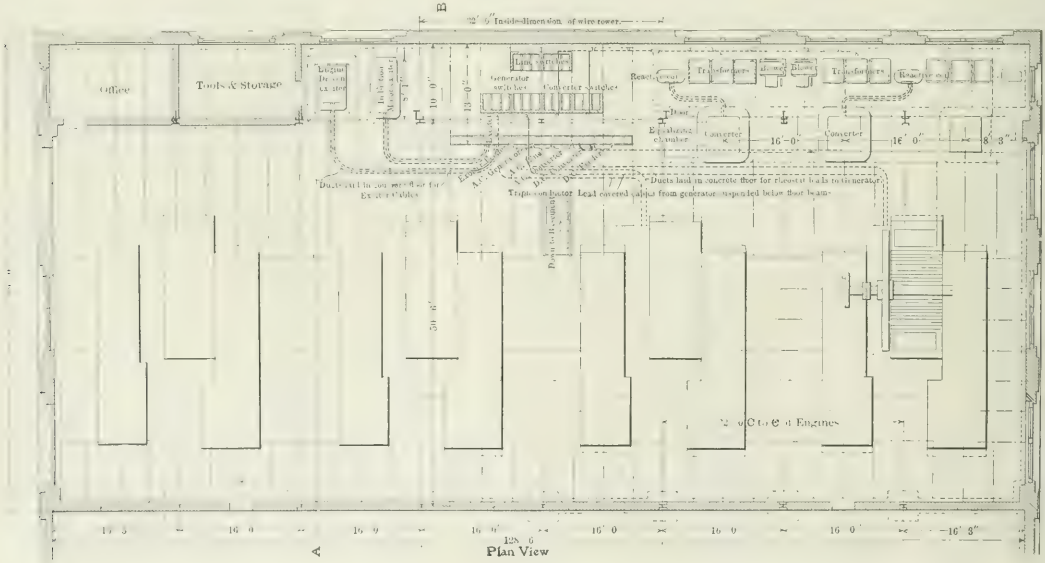


FIG. 13.—PARTIAL PLAN OF GENERATING STATION. SHOWING ARRANGEMENT OF ELECTRICAL APPARATUS.

no low-voltage bus-bars, each generator and its individual group of step-up transformers serving to all intents and purposes as a high-voltage machine. All switching is done in the high-potential 26,000-volt circuits. To each machine requiring a group of transformers there is devoted one bay of the electrical annex, the word "bay" here signifying a space between two adjacent crane columns. It will be noted that the station is laid out for three rotary converters, each of which calls for a group of step-down transformers; thus there will be eventually seven groups of three transformers each in the station. To these seven groups there are assigned seven bays, the two end bays of the nine being devoted to offices. Immediately behind each group of transformers, as seen from the engine-room side, there stands a high-potential motor-driven oil switch.

The 2300-volt leads from the generators pass to the low-tension terminals of the step-up transformers, the high-potential leads of which run directly down into the blast box without issuing from the transformer casing, above the main floor. The oil switches are also connected at the bottom, thus keeping all high-potential wiring in the blast chamber or in flues leading up therefrom similar to those described above in connection with a 26,000-volt sub-station of the same road. Thus there is no insulation required on the high-potential wires in the generating station, the bus-wires and leads being enclosed and surrounded by fireproof non-conducting compartments of brick and concrete, thus removing all probability of accidental short-circuit or personal contact.

This station exemplifies a general principle in arrangement which can be carried out with electrically operated switches, and which, if followed, adds greatly to the ease of working out satisfactory details. This principle is that the transmission of all powers, either steam or electrical, should be carried in as direct a line as possible across the station, any longitudinal mains running lengthwise of the station being simply equalizers or distributers, such, for instance, as steam and exhaust headers, electrical bus-bars, etc. The arrangement of the generating units in a single row, with generator switches, so far as possible, mounted at some distance from each other and located immediately opposite their respective generators, the bus-bars being extended the length of the station in order to tie all switches together, makes undoubtedly the best design of stations of large power. Such is the general plan of the electrical arrangement of the main power station of the Manhattan Elevated Railway Company in New York City, this principle being of great value in this instance in preventing a general congestion of many conductors of great power in one small part of the station.

Fig. 15.—Section Across Electrical Side of Engine Room of Station Shown in Plan in Fig. 12.

Elements of Illumination—XXXII.

By Dr. Louis Bell.

Aside from the sight box the essential parts of a photometer are a long, graduated bar along which the sight box can be slid, suitable supports for the lights to be compared so that they may always be in their proper relation to the graduated bar, and the screens already referred to for cutting off stray light. The elementary arrangement of a Bunsen photometer, except for the screens, is very well shown by Fig. 1. The two lights are supported at known equal distances from the ends of the graduation and the sight box is then slid along the bench until the grease spot shows a balance between the illumination from the two sides. Then the intensities of the two lights are inversely as the squares of their respective distances from the grease spot.

This relation assumes that the lights illuminate their respective sides of the Bunsen screen strictly according to the law of least squares uncomplicated by any sensible regular or diffused reflection. Right here is where the trouble begins. No one who has not tried it realizes the difficulty of eliminating reflection. There must be no reflecting surfaces about the photometer and it must be in a darkened room with non-reflecting walls, as far as it is possible to obtain them. Several coats of dead black paint prepared from lampblack with just enough thin shellac to serve as a medium answers the purpose fairly well. The photometer bench should allow not less than 6 ft. between the lights, and better 8 or 10. A room about 12 ft. by 6 ft. is a con-

venient size for photometric work and the higher the better, as a low room is apt to become unpleasantly hot after working in it awhile. The bench should run along one side and all the apparatus should be stowed on a shelf under it within easy reach of the hand for the room should be kept as dark as possible to avoid loss of sensitiveness in the eye.

A couple of small heavily shaded incandescent lamps with switches in easy reach form a convenient means for securing what little light is needed, and it is convenient also to have a tiny miniature lamp with a ground bulb and an opaque screen to keep the light from the observer carried on the sight box just above the pointer. This lamp should be furnished with a mere contact key on the carriage of the sight box so that it can be momentarily lighted to read the graduated scale.

For very precise work the Lummer-Brodhun photometric screen is sometimes used. This need not be described here further than to say

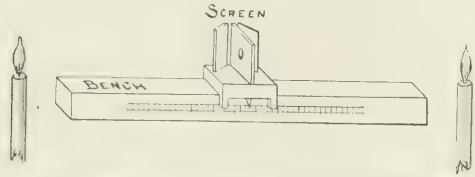


FIG. 1.—ELEMENTARY ARRANGEMENT OF BUNSEN PHOTOMETER.

that it is a somewhat complicated but beautifully effective device, rather costly and not as widely used in this country as the simpler Bunsen screen. Opinions differ widely as to the real relative merits of these two devices. In the writer's judgment, the Lumner-Brodhun screen when carefully used for the comparison of lights not differing greatly in intensity or color, permits a somewhat closer balance than the Bunsen screen, but under ordinary conditions the latter is nearly or quite as effective and much easier to use.

The general structure of the photometric apparatus should be rigid and substantial. All the working parts should more easily and smoothly, and all the accessories should be as accessible as possible so as not to detract the attention of the observer from the work in hand.

Attempts are sometimes made to reduce the photometer to a compact, portable form, that can be easily set up for testing in any convenient location. As a rule, such portable photometers are rather unreliable. It is hard enough to do precise photometric work under the most favorable conditions, and in portable apparatus the tendency is to sacrifice too much to compactness. For certain classes of work in which high precision is not necessary the portable photometers are convenient, but they are not to be advised for general purposes. Many commercial photometers, both permanent and portable, are provided with scales so graduated as to read candle-power, directly assuming a certain fixed distance between the lights under comparison and a fixed intensity of the standard. It is, of course, much easier to make photometric tests rapidly with such a scale, but it should be used with extreme caution, and as an auxiliary. When once correctly adjusted it is most convenient, but it should be assumed to be mal-adjusted at the start, and its correctness carefully verified before it is regularly used. The same precaution should be taken with any other apparatus graduated for convenience in arbitrary units.

The holders for the lights to be compared should be easily adjustable so as to enable the operator to bring the luminous areas into exactly the right position with respect to the graduated scale. When incandescent lamps are under test it is convenient to mount the lamp to be tested upon a rotating spindle so that by revolving it at the rate of three or four turns a second the mean horizontal candle-power may be obtained at a single reading. Other sources of light are generally measured also horizontally, but in a single conventional azimuth, and it is a question whether in the long run it is not better to measure incandescent lamps in a similar fashion. If any mean value of the luminous energy is to be considered important, it is the mean spherical rather than the mean horizontal, and it has already been explained how by changing the shape of the lamp filament the distribution may be widely altered without being changed in amount so that spherical candle-power is really the significant thing.

Rotators for incandescent lamps are, however, convenient, and particularly so if arranged so as to allow the axis of rotation to be tilted at any required angle. But they require watching if accurate work is desired, since it is very difficult to avoid small and variable losses in voltage at the lamp due to varying resistance at the brushes which convey the current from the fixed to the rotating part of the device. Mercury-cup contacts are somewhat more reliable, but do not lend themselves readily to tilting the axis of rotation.

Fig. 2 shows an excellent typical form of photometer intended primarily for testing incandescent lamps, but readily adaptable to more general purposes. It consists of a pair of little standards supported by cast iron columns and supporting the lights and their accessories and the pair of steel shafts extending between them and bearing the photometer carriage. The forward bar carries the graduation. On the left is the carriage for the standard lamp screwed in front and curtained behind, and on the right is the rotator, similarly screwed for the lamp to be tested. A pair of sliding screens help to cut off extraneous light from the sight box, and each lamp is provided with a rheostat for the exact adjustment of its voltage, and with the necessary electrical connections.

In setting up such a photometer even in a room painted dead black the screens supplied should be supplemented by other and larger ones placed nearer the sight box to cut off indirect illumination. It would also be advisable to place a long shelf from standard to standard under the photometer bar. This should be painted dead black and used to carry instruments and accessories ready to the observer's hand. In this instance the distance between lights is made either two or three meters, the longer one being preferable for measurements of precision.

The sight box is mounted on trunnions so as to be reversible as a whole with respect to the ends of the bar. In thus reversing the errors due to difference in the reflecting mirrors or in the sides of the Bunsen screen proper, as well as the personal errors between the observer's two eyes are eliminated from the result. There is, however, a personal error as between different observers that is not easy to be rid of. The idiosyncrasies of the eye in photometric work almost pass understanding. Two observers setting the Bunsen screen alternately on the same lights in quick succession will not infrequently obtain results differing by nearly 10 per cent, each man's readings, however, being closely consistent. The same observer will, as a rule, get consistent results from day to day, but has his own habit of seeing the spot on the screen disappear. Such individual differences are particularly marked when comparing lights differing in color.

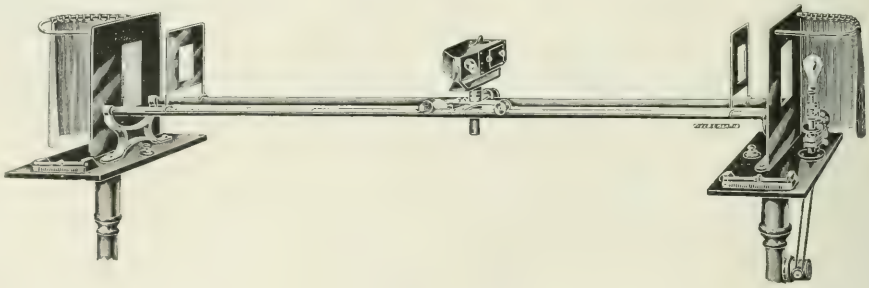


FIG. 2.—STATION PHOTOMETER.

In comparing, however, lights of approximately the same intensity and color, as in testing incandescent lamps, there is a convenient way of avoiding most of the errors in photometry, which can hardly be too strongly commended. It is one of the general processes of physical investigation known as the "method of substitution." It consists of comparing the standard, which we will call A, with an in-

termediary standard B, and then leaving everything else unchanged, replacing A by the object to be tested C.

In applying this method to photometry one would proceed as follows: Place the standard lamp on the rotator of Fig. 2, and the intermediary standard in the socket at the other end of the photometer bar, setting the sight box at the midway point. Then vary the intermediary, either by turning it slightly or by shifting the rheostat belonging to it, until an accurate balance is obtained. Then any lamp of equal intensity with the standard on the rotator may replace it without changing the balance. This eliminates all the errors of comparison save two, first that due to possible variation of resistance in the rotator, and, second, that due to a possible variation in the observer's habit of seeing during the progress of subsequent observations.

Most standard lamps are intended to be used in a fixed azimuth and not in rotation, so that the former error may enter unless the rotator is in first-class order. Its existence is a strong argument in favor of measuring lamps in one or more fixed azimuths.

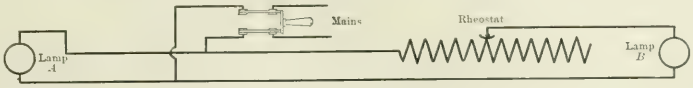


FIG. 3.—CIRCUITS OF THE PHOTOMETER.

As to the second error, it is seldom of much moment in the case of a practiced observer, but may be detected and approximately ascertained by repeating at the close of the observations the original observation with the fundamental standard, setting in this case the sight box without varying either lamp. If the observer has been uniform in his habit of setting and the resistance in the rotator has not varied materially, the sight box will give balance at the middle point as before.

The possible residual error is that due to the varying resistance of the rotator when at rest from its resistance when in motion. This error may be detected if it exists by measuring the mean horizontal candle-power of a lamp having quite uniform horizontal distribution, first, by rotating, and, second, by averaging the readings taken, say, in six azimuths 60 degs. apart. If the rotator has introduced no error the two values thus obtained should check each other within the ordinary error of observation.

In incandescent lamp testing there are two general ways of arranging the connections. In the first, called the two-circuit method, the working standard is placed on an independent source of energy generally a storage battery, brought to its proper voltage by means of a rheostat in circuit with it and a voltmeter and kept constant during the observations by occasional adjustment of the rheostat if necessary. The lamps being tested are similarly treated. When a storage battery is available the method is a very satisfactory one, the only errors involved being those in the voltmeters, which need to be frequently compared, and very carefully read.

The second or single-circuit method is shown in diagram in Fig. 3. Here the two lamps to be compared are put in multiple off the same set of mains worked at the usual voltage. The standard, *B*, is brought to its proper voltage by means of the rheostat and a voltmeter, and afterwards the voltages at the two lamps vary together if at all. This method of connection is very much more convenient than the two-circuit method, especially in alternating-current stations. It is, moreover, sufficiently precise if carefully applied. A second rheostat is employed for lamp A if the voltage of the supply circuit varies from the rated voltage of *A*. The essential difference between the two methods is that in the two-circuit scheme each lamp is tested at its rated voltage, while in the single-circuit method the two lamps are tested either at their rated voltages or at voltages equally at variance from these ratings. In the latter case there is a chance for error unless equal increments of voltage correspond to equal increments of intensity. In other words, if *A* and *B* are once balanced, will variation in the voltage of supply destroy that balance?

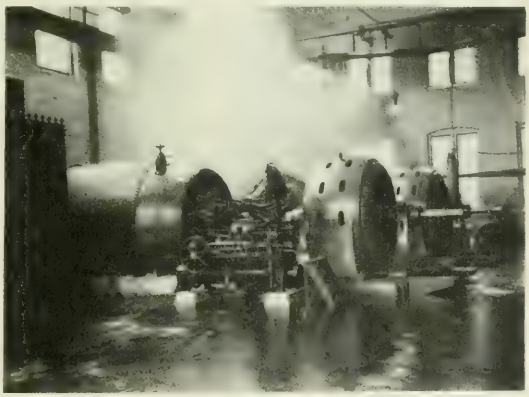
Governing Waterwheels Under Abnormal Conditions.

By G. U. G. Holman.

At the conclusion of some efficiency tests on our waterwheels at the power house of the Canadian Electric Light Company, Levis, Quebec, we desired to learn how the waterwheel governors operating the waterwheel gates would work upon breaking the machine circuit at full load of the generators. This meant the sudden removal of 1000 horse-power. The result was startling, and for the moment appeared disastrous, for one side of the bonnet of the 30-inch gate valve in the main exciter pipe blew out. This valve was right at the connection of the exciter pipe to the main pipe flume, which is 8 ft. 3 inches in diameter. The head at this point of connection is about 97 ft.

The governors worked very nicely, perfectly controlling the McCormick turbines, the normal speed of which is 400 revolutions. The switchboard attendant had presence of mind sufficient to pull the exciter switch and kill the machine, for at the moment it looked as though everything would be deluged with water and spray. The accompanying photograph, which fortunately one of the gentlemen present was ready and able to take, shows how the water shot up into the roof of the power house. In many ways we were extremely fortunate, the break being just within the power house wall, the blown out side of the bonnet being about 8 inches from the power house wall. The impact of the water being upwards (the bonnet being vertical), the water fortunately maintaining a vertical stream, the generators, exciters and switchboard received no water and but little spray. There was a party of 15 gentlemen present, which naturally was an encouragement to the workmen, several of whom ran immediately to the head gate and closed it after a few minutes. A short circuit at ⅞ gate had occurred but a few days previously, and was likely to occur at any time in the future, so that it was well that this weak point in our system developed itself at such an opportune time.

A temporary repair was effected by clamping the broken-out bonnet side partly in place by means of 2-inch oak planks placed at each side of the bonnet, with bolts run through them round the edge of the bonnet. Of course, a great deal of water squirted through the bad joint, and this water was forced to drop into the tail race by keeping canvas over the valve. In this way we were able to run our exciters until 3 o'clock next morning, when the water was emptied,



EFFECT OF SUDDENLY RELEASING WHEEL UNDER FULL GENERATOR LOAD.

the broken bonnet taken off, the gate removed, and on the bonnet flange of the valve a 3-inch oak plank was bolted with a thick gasket. In this way the run was continued until noon, at which time a permanent repair was effected by replacing the plank with a ½-inch boiler plate, which a machine shop nine miles away made for us on record time.

We could discover no flaw in the bonnet of this valve, and the conclusion was forced upon us that it had not originally been built with a view to the service to which it was put. I might add, that the governors are Lombard.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.—IV.

By Walter Reichel.

(*Chief Engineer Siemens & Halske Company.*)

THE TRANSFORMER.

THE only available space for the location of the transformers was beneath the car floor. It was necessary to place the three coils of the three-phase transformers side by side and have their long axis correspond with that of the car itself. In this way it was possible to place pipes within the cores through which cool air would circulate.

The iron cores formed three rectangular boxes between which there were formed two spaces, each 30 mm. (1.17 inches) wide, and 205 mm. (8 inches) high. The boxes are connected by heavy bolts, and they are separated by tubes slipped over the bolts. This is shown in Fig. 22. The iron cores were placed vertically so as to gain strength and avoid any bending action due to the jolts which would result during travel. The yoke is divided into two parts, and this makes the total height of the core at the ends of transformers no greater than the total height measured over the winding. The latter consists of the secondary winding, which is insulated from the core by a layer of mica and the primary winding which is separated into several spools placed above the secondary winding.

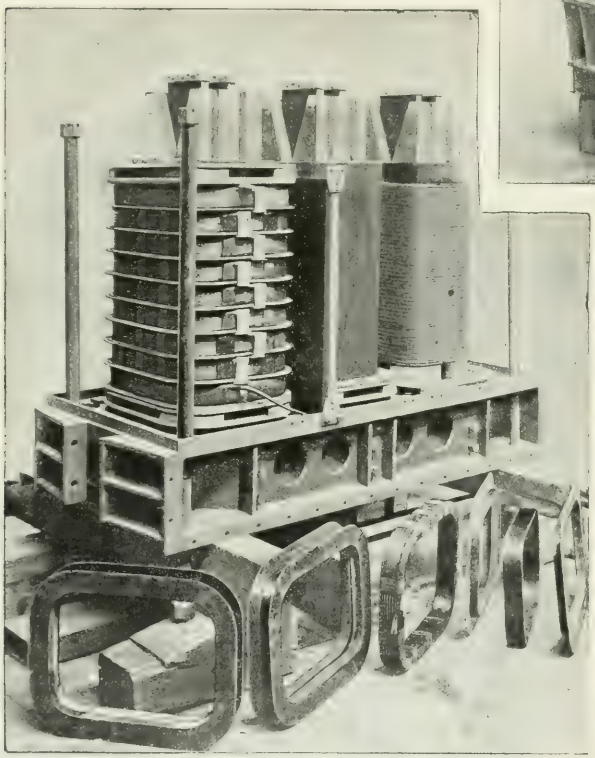


FIG. 22.—LARGE TRANSFORMER DURING CONSTRUCTION.

The two sets of windings are separated from each other by heavy layers of mica. So that the high-tension coils of the three sets do not accidentally make connection with each other they are separated by heavy walls of insulating material. The leads emerge from the coils at their ends. The coils and cores are held together by cast steel plates, into which the yokes are also built. These end plates are connected by four heavy bolts and two U-beams which serve also as a support for the transformers. This is shown in Fig. 23. Here are also shown the openings for admitting the air for cooling purposes, the canals passing from one end plate to the other. The rectangular opening at the top contains the high-tension cables which are led from here to the cableway. The opening is closed by a rubber ring. At the bottom the low-pressure wires emerge.

The transformers are fastened to two extra heavy cross-beams by four heavy angle irons in such a way that by loosening a few bolts they can be quickly removed from the car body.

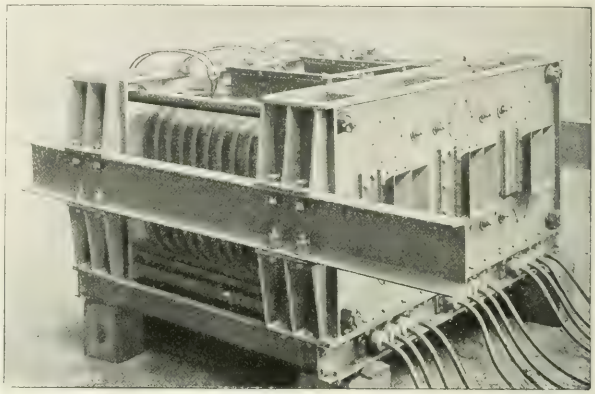


FIG. 23.—LARGE TRANSFORMER COMPLETE.

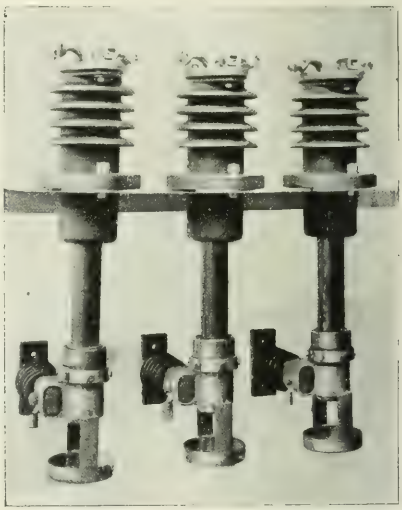


FIG. 24.—MOUNTED HIGH-TENSION FUSES.

This in turn is fastened to a hard-rubber post, horizontally supported, and this carries a small pan for the purpose of catching any metallic particles which may fly off. The entire device can easily be removed from the car. Similarly to this, only with smaller wires and contacts, the high-tension fuse devices for the small air pump transformers are built.

HIGH-TENSION FUSES.

The three loose ends of the large transformers pass through the cableway on hard-rubber supports. Like the mean pressure fuses they are of the enclosed fuse type, and consist of four tubes containing the fuse wires, which are surrounded by a larger tube of mica.

This tube is fastened to a metallic cover at the top which is provided with flanges to which four bent tubes are fastened, which serve to carry away the vapors which are generated. (To these tubes the fuse wires are connected.)

The cover rests on a peculiarly formed insulator on the roof of the car, which is also used for the wires of the high-tension switch and the fuses for the small transformer.

This insulator consists of a hollow metallic cylinder surrounded by a tube of hard rubber, and around the outside are a number of projections which act as drips for the water. This is clearly shown in Fig. 24. At the lower end of the mica tube is a contact ring which is slipped over a permanent contact piece.

The Street Railway Convention Automobile Ride.

On Friday, Oct. 11, an automobile trip was provided for the ladies of the convention through the co-operation of Mr. Henry Sanderson, president of the New York Vehicle & Transportation Company, and member of the entertainment committee.

When plans were made for this novel excursion it seemed likely that not more than 100 ladies would participate, but when the start was made from Madison Square Garden at 11.30 a. m. it proved that such an estimate and provision were alike inadequate. It had been intended at first to furnish accommodation for as many male delegates as possible, but it became necessary to exclude these altogether, and when at last the cavalcade was started, consisting of about 120 vehicles, and inclusive of stages, wagonettes, park busses, hansoms, Victorias and runabouts, no fewer than 360 ladies had been accommodated. It is true that quite a litle crowding was necessary to make room for so many, but whatever crowding was experienced was endured quite good-naturedly.

The automobiles made a sensation as they proceeded through the upper part of the city. Proceeding at an easy pace they went up Fifth Avenue to Central Park and then up the Eastern Driveway to 110th Street. They then crossed over to Riverside Drive and stopped at Claremont. There the famous restaurant was practically turned over to the party, and an elaborate luncheon was furnished to the ladies and to some 40 or 50 gentlemen who had proceeded to the same point by other means of locomotion. The entertainment committee was represented by Messrs. Sanderson, Brady, Cook, Meneely, Wakeman, Martin, Mullin and other members, all of whom were actively employed for an hour or two in attending to the comfort of the ladies in their charge.

After the luncheon to the ladies, and while the committee itself snatched a hasty repast, the party as a whole visited Grant's tomb in the vicinity, or strolled about the plateau around the restaurant looking down upon the new Lafayette Avenue viaduct, the broad sweep of the Hudson, the distant Jersey shore and the misty approaches to the Tappen Zee to the north. About 3 p. m. the party returned to the vehicles, which had been waiting on the drives around Claremont, and proceeded back to the Garden. The trip was of a most joyful nature, the day being bright and the weather balmy and no contretemps of any kind occurring to mar the enjoyment of the occasion.

Mr. Sanderson and his associates were not only voted hearty thanks, but all who participated are entitled to great credit for the smoothness and success with which the thing was handled.

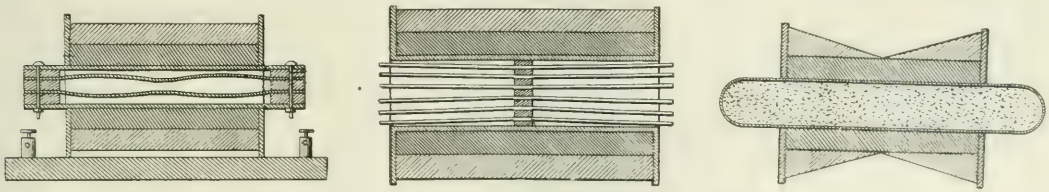
If the rush for seats in the automobiles is any indication of the feelings of the street railway men toward the new means of locomotion, it might well be inferred that they view the coming of the electric automobile with pleasure, regarding it as a valuable adjunct in the near future to existing systems of traction.

Street Railway Convention Automobile Ride—120 Electric Vehicles in Line.

New Telephone Patents.

The telephonic art contributes no less than 15 patents to the total issue of the Patent Office for October 8. Switchboard systems, as usual, are in the majority, and among these are several belated patents on magneto apparatus for which applications were filed between 1890 and 1892.

Taking telephonic apparatus first, a patent is granted to Hans Liebreich, of Detroit, on a telephone transformer (Fig. 1), provided with a laminated core, the leaves of which are capable of vibration within the coil. The inventor claims that the movements of the plates or leaves of the core will produce induced currents in the secondary coils of very high tension. A second patent on the same invention covers an induction coil or transformer (Fig. 2) with laminated core capable of movement in the leaves or plates with the leaves or plates fixed at the center insead of at the ends. A third patent covers an induction coil or transformer (Fig. 3), of which the core is composed of an iron case filled with iron in a finely divided condition. The inventor says: While very fine iron-dust is found to be sufficient for this purpose, I preferably form the core-filling of a series of short sections of iron wire, the interstices between the same being filled with fine iron dust and the whole mass being compressed under hydraulic pressure to form a solid mass.



Figs. 1, 2 and 3.—Telephone Induction Coils, or Transformers.

William E. McCormick, of Chicago, is the inventor of a switchboard system of which the chief feature is a single clearing out signal, which is operated only when the receivers of both stations are replaced on their switch hooks. In the usual common battery board a supervisory signal is provided for each cord and the operator disconnects only when she gets both lights.

In Mr. McCormick's invention, referring to Fig. 4, the clearing-

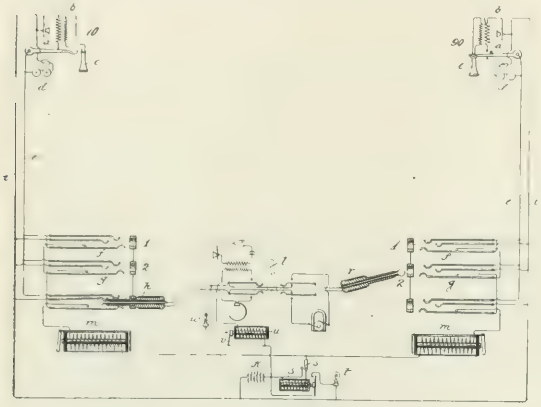


FIG. 4.—TELEPHONE SWITCHBOARD SYSTEM.

out relay *u* is preferably supplied with current from the common battery *K*, the continuity of the circuit including this relay being controlled by the telephone switch hooks at the subscribers' stations and the plugs inserted within the line jacks, this relay being preferably included in bridge between the sides of the telephonic circuit. One terminal of the relay is connected preferably with one of the cord strands of the cord circuit, in this instance the sleeve strand, and thereby with one side of the telephone line, while the other is preferably connected permanently with the remaining side of the telephone line through the common battery. The relay *u* is provided with a contact arm *v*, which is also connected with the common battery.

The contact arm *v* is adapted when released upon de-energization of the relay *u* to engage a contact terminal connected with the signaling lamp *w*, this signaling lamp thereupon being included in a local circuit whose continuity is jointly controlled by the arm *v* and the answering plug with its engaging jack, and also in a second local circuit whose continuity is controlled by the arm *v* and the connecting plug with its engaging jack—that is, the lamp in this instance is common to two local circuits. Two local circuits are thus provided which are independent of the telephone lines, each adapted to include the clearing-out lamp *w*, these circuits being independent of the telephone lines in so far as it is impossible to open and close the same by means of the telephone switch hooks of the connected subscribers' stations.

The clearing-out signal, it is obvious, is not operated until both re-

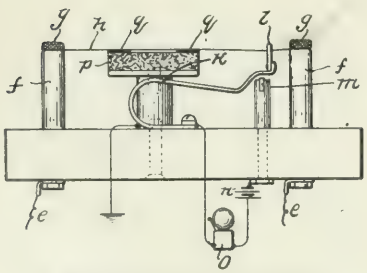


FIG. 5.—TELEPHONE CIRCUIT PROTECTOR.

ceivers are replaced on their switch hooks and is not extinguished until both plugs have been withdrawn from the jacks. This system also includes a supervisory signal (shown at *t* in the diagram with its relay *s*), which may be used either as such or as a calling signal for a number of subscribers' lines associated together, thus serving the purpose of a night signal.

A circuit protector of ingenious form is the invention of Alfred Stromberg, of Chicago. Referring to Fig. 5, *p* is a carbon block across which is stretched the fuse *h*, held in place by the binding posts *g g* and separated from the block *p* by the two insulating strips *q, q;* a hooked spring *k* engages in the fuse and holds it taut over the insulating plates and in close proximity to the carbon block, also serving to close an alarm circuit when released by the rupture of the fuse.

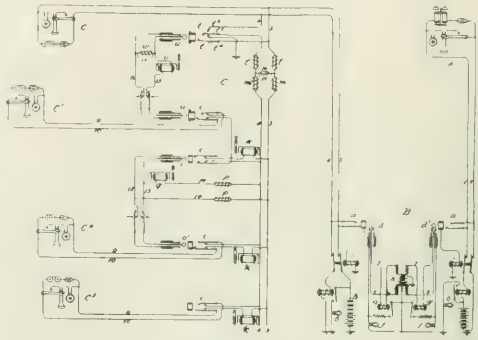


FIG. 6.—BRANCH EXCHANGE SYSTEM.

A telephone exchange system invented by Charles E. Scribner and James L. McQuarrie, of Chicago, is a detailed application of the invention chronicled last week, whereby through an arrangement of impedance coils and condensers, current is supplied from a common battery exchange to extension lines so as to enable communication to be held between the extension lines without interfering with the main line using the same source of current.

Fig. 6 illustrates the system applied to a branch exchange connected to a regular relay central office. *C* is the main station of the branch exchange, and C^1, C^2, C^3 extensions, C^1 being arranged so that it can also communicate over the main line, C^2 and C^3 being able to communicate only with each other or with C^1. To enable C^1 to connect with the main line, special cut-out jacks, shown at i^1 and *t*, and special connecting plugs *u* and u^1 are required. These are made of different size from the other equipment of the branch switchboard so that they may be distinguished readily.

Electro-Chemical Patents of the Week.

The U. S. patent issues of Oct. 8 are of unusual interest from an electro-chemical point of view, and strikingly illustrate the wide

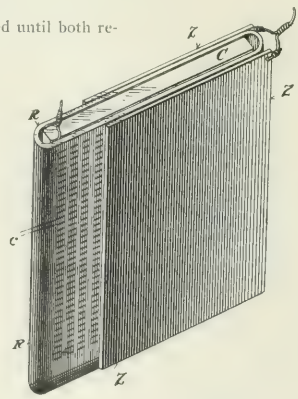


FIG. 1.—POROUS DIAPHRAGM.

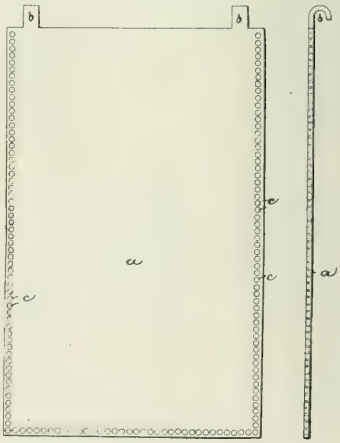


FIG. 2.—REFINING OF METALS.

range of activity in this art. A brief summary of the principal patents is given on next page, and elsewhere a separate notice appears of two patents on the Edison storage battery, now attracting much attention.

POROUS DIAPHRAGMS.

Adolph Wunsche, of Charlottenburg, Germany, prepares asbestos for use as electrolytic diaphragms by a method which is of interest because of its analogy to the felting of animal fibers. The moist asbestos is molded by pressure into the form desired, and then subjected to a reagent which attacks the surface of the fiber itself, and under the action of which the felting takes place. Such a reagent is silicon fluoride, either in gaseous state or in alcoholic solution, and the product of its attack upon the fiber is an acid magnesium silicate which binds the roughened contacting surfaces into a firm board capable of withstanding the action of water and of solutions which are neutral or nearly so. The patent is assigned to the Siemens & Halske Company, of Berlin.

A novel battery cup, patented to Stephen de Ayola, of New York, is formed from a pouch of rubber slitted or punctured, the size of the perforations being so related to the thickness of the walls that in the normal position of the sack the elasticity of the rubber nearly or quite closes them. When, however, the walls are at all distended—and this may be effected by any desired mechanical means—passages are opened for the electrolyte and the battery becomes operative. The size of the openings, and hence the resistance of the diaphragm, is thus capable of minute regulation, and the anode and cathode electrolytes may be completely separated when the battery is not in use. The new cup is very light, and, of course, practically unbreakable; whether it constitutes an efficient low-resistance separator does not appear from data given. This device is illustrated in Fig. 1, in which the diaphragm, *R*, slitted as at *c*, is shown in position as a separator between the usual zinc and carbon plates, *Z*, *C*, of a battery. The bag may conveniently be attached to the cover of the cell, when the horizontal slits is opened by slightly raising it.

BLEACHING APPARATUS.

The apparatus patented to Frank J. Briggs, of Everett, Mass., belongs to the class of devices in which sodium chloride is electrolyzed in a cell divided into anode and cathode compartments by a porous partition, the fabric or other material to be treated being placed in the anode chamber and agitated in contact with the nascent products of the electrolysis. The specification and claims are confined to details of construction which serve to protect, more fully than heretofore, the apparatus itself from the liberated chlorine and caustic.

REFINING METALS.

Two improvements in this line emanate from Perth Amboy, N. J. William A. McCoy proposes to facilitate the removal of electrodeposited copper sheets from the usual metal cathode plates by providing these with an insulating inlaid margin, as a substitute for the cumbersome wooden frames heretofore used. The insulation, which is preferably of a bituminous nature, is either inserted in a series of closely spaced marginal perforations in the plate or simply packed into marginal grooves. Fig. 2 shows in front and side elevation a plate prepared by the former method, the sheet *a*, with the usual supporting lugs *b*, being perforated as indicated at *c*. These holes define the limits of the desired sheet, the outer strips being treated as scrap. The use of scratch-grooves, without insulation, for the same purpose, has recently been described in these columns.

Elliott and Kishner provide each refining tank with a series of lateral spacing pins, corresponding to the intervals between the plates, so that these may be securely held in proper relation and at the same time guarded against accidental short-circuiting from buckling or other cause. The pins are of hardwood, and in their operative position extend between the plates, but are so mounted on horizontal rotatable shafts which traverse the tank from end to end, that by a single movement of a hand-lever they may be raised to a position parallel to the sides of the tank. With the pins thus placed, the tank may be charged, emptied or cleaned without interference.

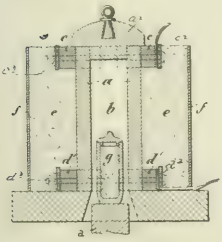


FIG. 3.—ELECTRIC FURNACE.

ELECTRIC FURNACES.

Drs. Nernst and Glaser describe an electric furnace based upon the "Nernst principle," and illustrated herewith (Fig. 3). The resistance heater or glower *a* is a cylinder of dry electrolytes, preferably formed from a mixture of magnesia with a small percentage of calcium carbonate, alumina, silica or kaolin. The cylinder may be covered as at a^2, and jacketed by loose oxides *e* held in position by an envelope *f*, to conserve the heat. The material to be heated is placed within the cylinder, and may be enclosed in a crucible mounted on a movable base, as shown at a^1, *g*. The distinctive feature of the furnace is the manner in which electrical connection is made to the ends of the resistance. For this purpose use is made of an oxide like that of iron, which possesses considerable conductivity at normal temperatures, this oxide, shown at c^1, d^1, being packed around the ends of the cylinder and held in close contact therewith by plates of iron, c^2, d^2, secured by bolts c^3, d^3. When the furnace charge is of such character that danger might arise of fluxing the dry electrolyte, and especially when the crucible is dispensed with, the cylinder is protected by an interior sleeve of pure magnesia, preferably coated with graphite to give it some initial conductivity. This furnace in either of its forms may be excited by a carbon resistance rod inserted temporarily through the bore, or even by a gas flame.

Hudson Maxim has patented a method of making calcium carbide, illustrating and describing an electric furnace for carrying it into effect. The furnace is a rotary structure, vastly complicated, and presenting no clear advantages and one obvious disadvantage as compared with forms in present use; this defect being the necessity for heating a large body of molten carbide to the temperature of complete fluidity. The furnace may be dismissed as without practical interest, but the claim based upon its operation is so broad as to demand attention. The words are: "The method of making calcium carbide, consisting in maintaining a carbide-conductor incandescent by means of an electric current, subjecting carbide-forming materials to the heat thereby engendered, thus converting said materials into calcium carbide, maintaining the cross-sectional area of the carbide-conductor approximately constant by removing the calcium carbide from the furnace as formed, and supplying fresh materials to the heating field."

In explanation of the grant of a claim of this breadth at this date, it appears that the application has been pending before the Patent Office since June, 1895, a period when the carbide art was exceedingly meagre.

The Edison Storage Battery.

Among the patents of last week are two on modifications of the new Edison storage battery. In the form of cell patented some months ago, it will be recalled, the oxidizable element and the depolarizer consisted of finely divided iron and an oxide of nickel (or cobalt),

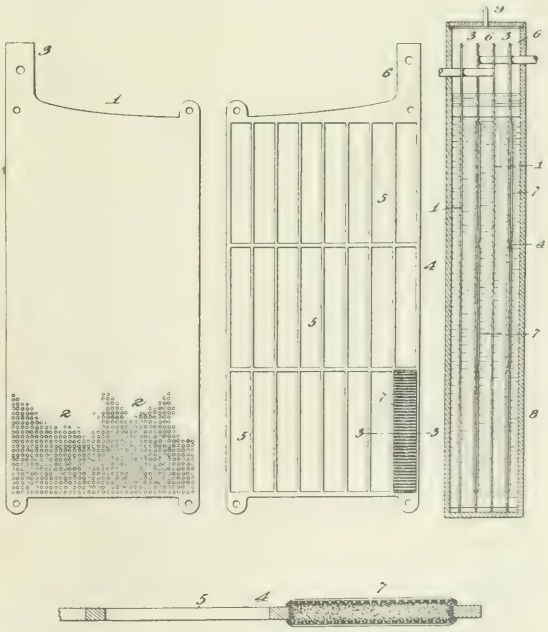


FIG. 1.—EDISON STORAGE BATTERY.

respectively, both elements being preferably mixed with flake graphite to increase their permeability to the alkali hydroxide solution. In the forms now disclosed the oxidizable metal is zinc, the

depolarizer an oxide either of copper or of nickel, and the electrolyte an alkali metal zincate in solution. These combinations are not unfamiliar, but the cells have not, hitherto, been considered as reversible, and the conditions under which they are rendered so are in the highest degree interesting.

If it be attempted to reverse a cell of the usual zinc—alkali hydroxide—copper oxide type, it will be found that the copper passes in part into solution as the so-called "cuprite," and that the zinc is deposited in the form of a loose sponge. Mr. Edison states that if certain precautions be observed in the preparation of the copper oxide, its tendency to solution in the alkaline electrolyte may be overcome, and he considers an essential feature of this preparation to be an extremely fine sub-division of the copper. To secure this, pure carbonate of copper is reduced by hydrogen at the lowest possible temperature, molded into the desired form, oxidized by heat to the

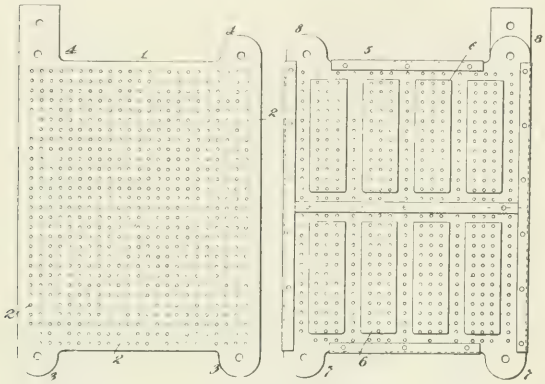


FIG. 2.—EDISON STORAGE BATTERY.

black oxide, CuO, and finally electrolytically reduced to the metallic state. So prepared, it is oxidized in charging the battery to the red oxide Cu_2O, but shows no tendency to pass into solution. It is difficult indeed to believe that this remarkable effect is properly attributed to the state of minute sub-division; if so, the fact is unique in chemistry.

The second difficulty—the deposition of spongy zinc—is overcome by the simple expedient of using as a base for the electro-deposit a thin multi-perforated sheet of magnesium. If it be assumed that the tendency of zinc to deposit in sponge form is due to the partial oxidation of the precipitated metal, then it is readily apparent that the nature of the support may exert a controlling influence on the character of the deposit, and that magnesium, being electro-positive to zinc and entirely unattacked by the caustic alkali, can give rise to no local action, and therefore to no oxidation due to this cause. This is the explanation of the inventor. It is not free from chemical difficulties, for other means may be employed to prevent local action, and yet these have not proven efficient in suppressing the formation of sponge; but the essential commercial point—the fact—seems to have been sufficiently establishd by Mr. Edison's experimental work.

In the accompany illustrations, Fig. 2 represents a plan view of the magnesium support on which the zinc is plated during the charging, a similar view of the plate for carrying the negative element, and a vertical section through a cell formed of four elements. In Fig. 1 are represented similar views of another form of cell, showing a plan view of one of the magnesium supports on which the zinc is plated during the charging operation, a similar support for the depolarizing material, a section of the latter on an enlarged scale and a section through a four-element cell.

Kentucky Telephone Association.

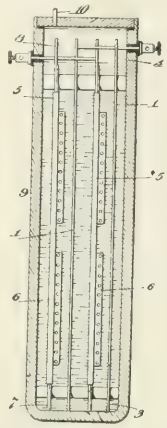
The Kentucky Telephone Association held its annual meeting at Owensboro, Ky., on Oct. 2. The following named officers were elected for the ensuing year: R. V. Bishop, of Cynthiana, was reelected president; H. K. Cole, local manager of the Harrison Telephone Company, vice-president, and James Maret, of Mt. Vernon, secretary and treasurer. The place of the next weeting was referred to the Executive Committee of the association.

James S. Brailey, Jr., of Louisville, read a paper upon long-distance service and H. K. Cole a paper upon exchange service.

The companies of Louisville, Lexington, Winchester, Mt. Sterling, Maysville, Cynthiana, Versailles, Henderson, Morganfield, Uniontown, Fordsville, Slaughtersville and Nicholasville were represented as were the Bastion, of Lancaster; Rough River, of Hartford; Hancock, of Hawesville, and the Green River, the line between Owensboro and Henderson.

The American Pacific Cable Question.

According to special dispatches from Washington, of Oct. 11, Attorney-General Knox was not ready at the Cabinet meeting to report fully on the proposition of Mr. John W. Mackay and associates to lay a cable across the Pacific from San Francisco to Manila, via Honolulu and Guam. The Attorney-General appears to have proceeded far enough in his investigation to determine what is probably the most important point, and that is that the British cable company now doing business in the Philippines did not secure a guarantee of monopoly for 40 years or any other term by either the general or the specific provisions of the Treaty of Paris. The question as to whether or not the President, under his general executive authority, has the power to grant or withhold the landing privileges sought by the Mackay people has not yet been determined by Mr. Knox. However, in view of the probability that the President will have something to say on the subject of a trans-Pacific cable in his forthcoming message to Congress, and also in view of the fact that Congress may insist upon its exclusive privilege to handle the subject, it is inferred that, regardless of the findings and recommendations of the Attorney-General, no action of any kind will be taken on the Mackay proposition by the President.



The matter of the Spanish concession granted in 1898 to the English company, giving it an exclusive franchise for cable connections in the Philippines, was carefully considered. Attorney-General Knox advised the President that this exclusive franchise would not hold. He cited the recent action by the Transvaal Commission, which held that the concessions granted by the Boer Government in the Transvaal would not be recognized as valid by the British Government.

It is regarded as significant that, coincident with the report of the Attorney-General's opinion ignoring the claim of monopolistic rights made by the cable concern now doing business in the Philippines, comes an apparently well authenticated rumor from this city of great activity on the part of Mr. Mackay and his associates in the trans-Pacific cable enterprise. It is said that they are now about ready to begin actual work on the cable, and that they propose to go ahead just as though no question as to landing privileges had ever been raised. If they do begin the work of construction before Congress meets, and without stipulated encouragement from the executive department of the government, it is not doubted that the subject of a government cable to the Philippines touching at Honolulu and Guam will be agitated in lively fashion in Congress this winter, and that an interesting fight between the forces of the Postal and Western Union Telegraph companies will enliven the early proceedings of the session.

The Yale Bi-Centennial.

Electric lighting and decorative effects will form a conspicuous feature of the Yale Bi-Centennial to be held next week. Mr. George D. Foote, an electrical engineer of New Haven, has prepared plans for the display, which have been accepted. There will be a liberty pole of electric lights. A big star will surmount the pole. From the pole there will be festoons with tri-colored lights sweeping in curves from 240 to 420 ft. in length, centering in stars of lights at the old elm trees. There will also be festoons of electric lights between the trees themselves. In these decorations it is stated that 4300 lights will be required. The front of the City Hall will be outlined by electric lights.

CURRENT NEWS AND NOTES.

PAN-AMERICAN AWARDS.—A very full list of Pan-American awards appears in a supplement to our present issue. We are glad to call attention to the fact that a gold medal has been given to the McGraw Publishing Company in recognition of the merit of Electrical World and Engineer and its other technical publications, books, etc.

THE "KRONPRINZ WILHELM," the new steamer of the North German Lloyd, which recently arrived at New York, has a lighting plant of 1900 lamps, supplied from four dynamos. All the clocks are electrically regulated from a master clock in the chart room, and there is a complete telephone exchange system for all departments. She is also provided with a wireless telegraph system.

ELECTRIC POWER IN BELGIAN COAL MINES.—The United States Consul at Brussels, Belgium, reports the installation of a large mining electric power plant at Charleroi, for the supply of three mines situated about a mile distant from each other. Electric pumps are located at the bottom of pits about 1600 ft. underground. The current from the central generating station, presumably alternating, is transmitted at high tension, and conducted into the pits by steel-sheathed cables. There will be four electric pumps of 200 horse-power each, and two generating sets of 1200 horse-power each.

HOLLAND BOATS FOR THE DUTCH.—A telegram from Greenport, L. I., of Oct. 15, says: "Commissioners appointed by the Government of Holland arrived here last night to investigate the workings of the Holland submarine torpedo boat for the purpose of making a report to the Holland Government as to the advisability of adding one or more to the navy of Holland. The commission consists of Admiral Tadema, chief of staff; Captain Wuntholtz, chief of the Bureau of Torpedoes, and Naval Constructor Rappe. To-day the commission went on board the Holland Torpedo Boat Company's steam yacht "Giralda," and, in company with the firm's officers, spent the time at the proving grounds at New Suffolk, where the company's machine plant is situated. The torpedo boat "Fulton" was inspected as she lay at the wharf, and the principles of the craft were explained. The commissioners returned to Greenport to-night. They will go to New Suffolk again to-morrow. Later they will separately be taken under the surf in the "Fulton."

THE NEW YORK CENTRAL TUNNEL.—It is understood that the engineering department of the New York Central will very shortly let contracts for the proposed change in the Park Avenue tunnel. Work will probably be commenced by December 1. It is proposed to experiment on the section from Fifty-sixth to Sixty-sixth streets, or a distance of ten blocks. The cost will be about $250,000, and the work will probably be completed by spring. The work involves tearing down masonry and erecting steel supports and girders. This will allow a freer circulation of air and more light. If this improvement is satisfactory then thirty remaining blocks in the tunnel will likewise be remodeled, but this work will be more arduous and expensive than on the first quarter of the tunnel. About 500 trains pass through the tunnel daily, so progress will be necessarily slow. The entire cost of the completed project will exceed $2,000,000. It will be noted, however, that this does not affect the ultimate solution of all the difficulties by a resort to electricity.

ALTERNATING-CURRENT SERIES ARC LAMP REGULATION.—Eight patents were granted Oct. 8 to M. H. Baker on a method for regulating the current in an alternating-arc lamp series circuit. Briefly, the method consists in the introduction into a circuit of a choke coil the winding of which is automatically adjusted with respect to the core. As illustrated, the core is of U-shape, and the coil embraces a greater or less portion of one of the legs of the U. When the circuit is fully loaded but a slight portion of the core is within the coil, while at the minimum load the maximum amount of the core is embraced. The coil is mounted on one end of a lever, and six of the patents are entirely devoted to means whereby a weight in connection with the other end of the lever is made to move in such a path that its effect will oppose and vary with the magnetic pull of the coil in such manner that the value of the current traversing the coil shall be made practically independent of the resistance of the circuit, thus enabling a constant current to be maintained irrespective of the number of lamps in operation in the circuit. The path which the center gravity of the balancing weight should traverse is determined for a given coil experimentally by cutting successively into the lamp circuit in which it is placed one lamp after another until the maximum number is cut in. The patents describe arrangements whereby the center of gravity of the weight shall be made to traverse this path as the lever moves on its pivot. In one case the balancing end of the lever is placed at such an angle with the coil end as to cause the weight to travel in the determined path. In another case this object is effected by suspending the weight at a certain point of a chain, one end of which is secured to the extremity of the balancing lever, and the other end to the fulcrum of the same. In another, the weight is hung from a chain, which seats in a groove in the upper part of the arm, the arm being curved to cause the weight to move in the predetermined path. In still another case the weight is divided into a large number of disks which are so arranged that as the supporting end of the proper lever ascends or descends one or more of the separate portions of the weights are thrown into or out of service by being seated on a support, or one on top of the other. In still another form the coil is immersed in oil and the necessary balance obtained by a float of determined contour. Another method involves the use of a cam or curved surface, along which the weight in the form of a roller moves. The final patent describes the use of a spring for maintaining the necessary balance between the magnetic and opposing forces.

NERNST LAMP PATENTS.—Among the patents of last week are seven relating to details of the Nernst lamp, four of which were issued to H. N. Potter, two to M. W. Hanks, and the seventh to F. N. Goddard. One of the Potter patents relates to terminals for electric lamp glowers. The ends of the glowers are painted with a thin coating of platinum arsenite then heated to a temperature sufficient to drive off the arsenite. This leaves a thin film of platinum in intimate contact with the material of the glower. A loop of fine wire is then slipped over the platinum film and covered with a body of pasty material similar in composition to the glower itself. Another patent relates to a form of glower heater support. The support is hollow and tubular in cross section, and is made by mixing about 100 parts of soapstone powder with 15 parts of a binding material, such as dextrine, and 40 parts of water. On the thin walls of this tube the heating wire is wound. The two remaining Potter patents are on heater cut-out devices for automatically interrupting the electric heater circuit when the glower becomes conducting. In one form a carbon filament is used as a spring for moving the contact cut-out terminals into engagement, a thermostatic device acting in opposition to the spring to open the circuit; the whole is enclosed in glass tube, which is either exhausted or contains an inert gas. In another patent having the same object in view springs are dispensed with, a magnetic device being substituted. A small iron ball is confined in a tubular cavity between the two poles of a magnet. The cavity is formed of two sleeves slipping over and secured to the respective pole pieces, there being a space between the free ends of the sleeves. The magnet winding is in circuit with the glowers, and when no current is passing the ball makes connection between the two sleeves, which are in the electric heater surface. When current commences to pass through the glower the ball is attracted by one or the other of the pole ends and held out of contact with the sleeves, thereby interrupting the heater circuit. Both of the Hanks patents relate to details of the glower. One describes a glower, the working portion of which is deeply grooved, thereby affording the largest practical amount of light-emitting surface without a sacrifice of strength in the glower. The other patent relates to means for making electrical connection with the ends of the glowers. Each end of the glower is enlarged by applying to it a mixture of one or more oxides of the rare earths moistened with water and held together by a binder such as dextrine. These beads are then subjected to the action of an oxy-hydrogen flame and thoroughly baked. The leading-in wires are then fused to the beads by means of some conducting alloy, such as copper-platinum. The Goddard patent is also on a form of glower terminal. From one up to several fine wires are wound around a form slightly larger than the end of the glower, and the loose ends twisted tightly around the strand. The end of the glower is then inserted within the wires, following which they are twisted just enough to make them bind upon the glower. A paste of the same or similar material as that of the glower is then applied to the outside of the wires.

YUKON CABLE RATES REDUCED.—The Canadian Dominion Government has made a change in the cable rates to the Yukon, which heretofore have been $4 for a minimum of ten words. The future rate is to be 40 cents per word. The press rate, hertofore $3 for 100 words, has been made $1 per 100 words.

THE BUFFALO AUTOMOBILE TEST.—After some careful work the committee of the Automobile Club of America, in direct charge of the run, made public its report last week. David Wolfe Bishop, as was expected, won high honors with a clean record of 15 miles an hour for the entire run, the maximum limit. He used his French machine, a 30-hp Panhard, and was the first to finish each day's run. A fraction below him, with a total average of 14.18 miles per hour, comes Elmer Apperson. Five machines finished the trip below the minimum rate, making a total of 42 vehicles from 80 starters that reached Rochester. Remarkably good showing was made by the Packard gasoline vehicles of the Ohio Automobile Company, one of them rating fourth, and four being among the 20 securing first class certificates. Mr. J. W. Packard is the well-known manufacturer of incandescent lamps.

THE KAISER AND THE CARS.—A recent special cable dispatch to the *New York Times* says: The differences between Emperor William and the representatives of the city of Berlin have been thrown into the background by the dispute regarding the advisability of permitting tram lines to cross Unter den Linden, Berlin's principal and most beautiful thoroughfare. Most people sympathize with the Kaiser's determination to prevent Unter den Linden being disfigured. The question, however, has now assumed a more serious aspect, since it is learned that certain exalted personages led the Berlin magistrates to believe that the Kaiser approved their scheme, and the municipality bought the tramway systems from Herren Siemens & Halske for 10,000,000 marks ($2,380,000). The incident is regarded as another proof of the lack of regular personal intercourse between Emperor William and his Ministers.

IMPORTANT INSTITUTE MEETING.—A very important paper on the general subject of the speed regulation of prime movers, with special reference to the successful operation of alternators in parallel, by Mr. P. O. Keilholtz, of Baltimore, will be read and discussed at the next meeting of the American Institute of Electrical Engineers, to be held at No. 12 West Thirty-first Street, New York City, on Friday, Oct. 25. Short papers on the parallel operation of alternators will also be presented by Messrs. C. P. Steinmetz, W. L. R. Emmet and E. J. Berg. The committee on papers realizing that the problems presented by this question can be better understood, analyzed and solved by intelligent co-operation, or concerted action, between the designers and builders, has invited representatives of the leading electrical steam engine, gas engine and waterwheel manufacturers to take part in the discussion of the subject of the speed regulation in general, and of the control and compensation of variations of angular velocity in particular. All who are interested in the subject are cordially invited to attend.

THE RAILWAY RETURN CIRCUIT.—In the discussion of a paper read at the recent Street Railway Convention by Mr. E. J. Connette on the railway return circuit, an abstract of which appeared in our issue of last week, opinion was quite pronounced against an independent metallic return. Mr. Meyers said that his company had considerable trouble with welded bonds after a couple of years of service. Mr. Harrington considered that the placing of return feeders on a road of ordinary size is not warranted, and described a method of bonding which he had employed with much success. This consists in a heavy copper plate 4 by 6 inches, with two grooves in it, bolted to the web of the rail with two 1-inch bolts with an iron plate grooved for two No. 4-0 wires. He believes that auxiliary copper returns are only needed in the vicinity of the power house. Mr. Pastell, of Worcester, Mass., said that he did not see the necessity of supplementary copper wires unless the output rises to 20,000 amperes or above. On his road every sixth or eighth joint is cross-bonded. He agreed with Professor Roberts that it is well to connect around "special work," tops of hills and other places where the conditions are especially severe on bonding. Mr. Uhlenhaut said the question of using auxiliary returns was largely a geographical one, and mentioned one case where it was found desirable.

LIGHTING THE NEW YORK UNDERGROUND.—It is said to have been decided that the walls of the New York Underground road shall be painted with some sort of "cold-water paint" tinted in blue or gray, enough to modify it from a dead white. The motormen in the Boston Subway, though they pass underground for only a portion of their trip, complain that the whitewashed walls are hard on their eyes. The rows of incandescent lights, breast high, which run along the sides of many steam railroad tunnels, would in this case, it is held, be inadequate. Supplemented by the glare of a locomotive headlight, they show up the track well enough, but not, it is declared, without it. Arc lights only, and at short intervals at that, will give sufficient illumination, but here again there is a difficulty. The brilliant and concentrated light of an unprotected arc light would half blind the motormen, who have to look straight at it, and, on the other hand, most of the ordinary kinds of shades absorb a large share of the light rays. To diffuse the light without losing it is the problem. Mr. Parsons will learn how every other city has done this before choosing a system for this city. There are systems of reflectors which have merits in this direction. Globes are also made of glass cut inside and outside into facets that deflect the light upward, downward, or sideways, making the illumination as soft as from ground glass and with a loss of only a very small fraction. An experiment has been made with a glass covering, such as that used in sidewalks, but the results were not conclusive. The Nernst lamp also comes in as a new possibility.

Letter to the Editors.

Some Aspects of Telephony.

To the Editors of Electrical World and Engineer:

Sirs.—I have been very much interested in the recent editorials in the Electrical World and Engineer upon telephonic subjects. It appears to me that you are rendering the entire fraternity, and particularly the telephonic section, a valuable service in the stand that is taken therein.

From recent observations I am certain that within the next few years the independent movement is going to suffer very seriously from the evil of too cheap construction. I have seen many plants that are attempting to give service upon a basis that will most certainly wreck them within the very immediate future. I have also seen a number of manufacturers who are attempting to sell goods of such a quality as will entail an extremely high maintenance to keep them in working order.

That a certain amount of such error is unavoidable in parties undertaking a business in which they have no experience is certain, but it appears to me that the amount of poor construction and poor service that is now in the field is all out of proportion, and I am sure that the kind of warning which you are giving in your columns should be of the greatest value to those who are attempting to go into the business with a meager equipment of experience.

A few days since the manager of a large independent exchange innocently remarked to me, that they had no depreciation because their plant was new. The effect of such a state of mind upon the management of so complicated and expensive installation as a telephone plant is simply appalling.

You are most unquestionably right in the assertion, that telephone service upon a large scale is much more expensive than on a small scale, and in this respect telephonic service certainly differs widely from many other lines of business, in which expense is cheaper in proportion as the business grows.

In telephony, on the other hand, all items of expense increase rapidly with the dimensions of the service. As the number of subscribers increase the ability of each subscriber to talk increases, the call rate rises, and thus there is more use of the telephone for a subscriber in a large exchange than in a small one. There is, consequently, more depreciation, more maintenance and more cost. This necessitates a large plant in all directions, and increases the investment as well as increasing the rates of maintenance and depreciation.

It is astonishing that a paper so intelligent as the *New York Times* should fail to perceive this very apparent fact, and as a subscriber to the Electrical World and Engineer, entirely independent of any telephonic affiliations, I am certainly grateful to the paper for the knowledge conveyed in the recent editorials.

The factor of public telephonic education is another extremely im-

portant point. It is surprising to me how few people have any knowledge of rightly using the telephone as an instrument, or the laws which obtain in telephonic service.

It appears to me that if the American Bell had departed long ago from their apparently mistaken policy of secretiveness and had taken the public into their confidence and had endeavored to educate them telephonically, that the present situation would have been largely, if not entirely, avoided. It is impossible for an exchange manager to do more good either to the subscriber or to his company than to use every effort in his power to give every subscriber a full and complete telephonic education.

Philadelphia, Pa. H. L. Manton

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers

Heyland Induction Motor with Power Factor Equal to Unity.—E. H.—A French translation of Heyland's German article (Digest, Aug. 31, see also Electrical World and Engineer, Sept. 28, p. 492). The motor, he says, can also be used as a generator and furnish current independently of any other machine. It is self-exciting, its frequency is not, as in other alternators, absolutely fixed by the angular velocity, but depends upon the charge. The translator remarks that this seems to be an inconvenience, as the good operation of the motors fed from an alternating-current network, depends upon the constancy of the frequency.—*L'Ind. Elec.*, Sept. 10.

Heyland.—A reply to this criticism. He states the means for making the frequency absolutely constant for his generator also. "This device consists simply in driving the governor of the engine by a small motor fed with the current of the alternator, instead of by the engine itself." By this means, for the operation of different machines in parallel, the general frequency is kept constant.—*L'Ind. Elec.*, Sept. 25.

Direct-Current Dynamo Design.—Hill.—An article in which he discusses Mavor's paper (Digest, Oct. 12). He thinks that the most important point of the same is that in which it is proposed in designing machines, to commence at the commutating parts, and having settled their proportion suitably for sparkless collection, to build the remaining parts of the machine around them. He discusses at some length Mavor's method of determining the non-sparking proportions from the relationship of the average e. m. f. generated per section of the armature to the reactance voltage of a section undergoing commutation, the ampere turns per pole of armature not exceeding 25,400 per inch-length of air space.—Lond. *Elec. Rev.*, Sept. 20.

REFERENCES.

Synchronous Converters.—De Marchena.—His long paper, read before the Internat. Soc. of Elec., in Paris, on the theory and practice of synchronous converters. He first deals at some length with the theory of the ratio of the alternating to the direct-current voltage, the armature loss, and the armature reaction. He then describes the method of starting, and treats the question of stability of working and capacity of standing overloads. He then discusses the regulation of voltage by field excitation, and deals at some length with compound and shunt excitation. The paper is concluded by some remarks on operation in parallel, and on the use of synchronous converters for converting direct current into alternating current.—*Bull. Soc. Int. des Elec.*, May.

Electrolytic "Valves."—Blondin. His paper in full read before the Internat. Soc. of Elec. in Paris on the Pollak system of electrolytic "valves" for converting alternating into direct current, an abstract of which has been noticed at length in the Digest.—*Bull. Soc. Int. des Elec.*, July.

Lights and Lighting.

REFERENCES.

Bremer Arc Lamp.—Laporte.—His paper in full, read before the Internat. Soc. of Elec. in Paris, on photometric tests of the Bremer arc lamps, an abstract of which has been noticed at length in the Digest.—*Bull. Soc. Int. des Elec.*, July.

Arc Lamp.—Bainville.—An illustrated description of an arc lamp of the Gen. El. Co., of Nancy.—*L'Elec.*, Sept. 21.

Advertisement Lighting.—The first part of an illustrated article on the system of electric advertisement lighting of the Gen. Elec. Co., of Berlin.—*Zeit. f. Beleucht*, Sept. 20.

Power.

Use of Electric Power for Making Water Gas.—Schmidt.—A paper read before the Zurich section of the German Elektrochem. Society. In the process of making water gas, water steam is conducted over glowing coal, with the result that CO and hydrogen are formed. The process absorbs much heat, as in the combustion of C to CO only about half the number of calories which are required for the decomposition of the water are set free. The furnace must, therefore, be supplied, from time to time, with fresh heat. If 42 cubic meters of water gas are produced from 12 kilograms of pure carbon—about 13.5 kilogram of coke—there are missing 28,970 calories, for which about 8.8 more kilogram of coke are required. If instead of the latter, electric heating is used—an efficiency of 80 per cent being assumed—about 42.5 kilowatt-hours are required. If the price of coke is 1 cent per kilogram, the process of electric heating is economical, if the electric power costs not more than 0.21 cent per kilowatt-hour. He thinks that electric power can be furnished at this price at many places in Switzerland, especially at certain hours of small load. Switzerland must import all its coal, but is rich in water powers.—*Zeit. f. Elektrochemie*, Aug. 1.

REFERENCES.

Traveling Cranes.—Hahn.—An illustrated article on electric motors for traveling cranes. He discusses the different types of motors used for this purpose and the method of control.—*Elek. Anz.*, Sept. 8, 12, 19.

Electric Driving.—Hahn.—A mathematical article on the electric driving of grinding machines.—*Elek. Anz.*, Aug. 29.

Gas Engine.—Montpellier.—An illustrated article on the Oechelhaeuser gas engine.—*L'Elec.*, Aug. 24.

Traction.

Trolley System vs. Battery Traction.—An illustrated article on the conversion of the Englewood and Chicago storage battery road to the overhead trolley system. The road was built five years ago, and at that time comprised 12 miles of track. Extensions and branch lines were installed, with which the company now operates a trackage of 28 miles, consisting of 10 miles of double track and 8 miles of single track. The change to trolley operation was mainly necessitated by the difficulty in operating the branch roads economically, as under the storage battery system it was necessary either to build new charging stations or to run branch line cars to the power house every trip for a charge, thus wasting considerable mileage. The original system of charging the batteries was with three different voltages, but later it was found that it is more economical to charge the batteries in groups. Enough batteries were placed in each group to constitute a full load on one of the station generators, of which there were four, each of 190 kilowatts and 200 volts. The charging voltage was begun at 165 volts, and as the generators were shunt wound, they permitted the voltage to increase as the ampereage dropped. When a voltage of 185 was reached, the batteries were considered fully charged. About the same time was used in charging the cells as was consumed in discharging them on the road. The greatest number of miles run by any one battery was 27,449.6, while the average mileage of 62 batteries was 23,125.1. Battery depreciation increased on the batteries toward the last, until it averaged 2.276 cents per car-mile. Under the storage battery operation everything ran successfully and smoothly from a mechanical point of view, but the expenses were too great. Another reason for the change was that the capitalists who had originally built the plant had been interested in a storage battery manufacturing concern, while this connection

has later been severed. The present station is described. The trolley system has now been in use for some weeks. The operating expenses of July 1899 under the battery system and July, 1901, under the trolley system are compared. Of the following numbers the first refers to the battery system, the second to the trolley system: Total expense per car day, $16.2, against $11.9; total expense per car-mile, $0.112, against $0.074; total power station expense, $1,172, against $1,660; pounds of coal per kilowatt-hour, 8.606, against 11.638; power station expense per car-mile, $0.0149, against $0.0168. While since the introduction of the trolley system the power house operating expenses have increased, this is offset by the saving in wages and depreciation. The manager of the road is of the opinion that there is to-day no better, cheaper, or more satisfactory system of street railway traction, with the exception of overhead trolley, than storage batteries, provided that the charging stations are at the ends of lines, that no more than 10 miles are run upon one charge, that there are no grades of over 4 per cent, and that the number of cars run from such charging stations is at least 20.—*West. Elec.*, Oct. 5.

High-Speed Electric Railways.—G. W. MEYER.—A discussion of the relative advantages of the different systems for high-speed electric railways. The direct-current system with third rail is said to be practical only for short distances and for light trains, more especially for city and suburban service. Geared high-speed motors are better than gearless motors. The latter are used on the Wannsee Railroad. A system of alternating-current transmission with sub-stations for converting to direct current should be used in such cases in which the pure direct-current system is impractical on account of great distances or in cases where the traffic would require too thick feeders. He discusses at some length the two kinds of three-phase systems; the one in which high-tension currents are directly supplied to the motor cars; the second, with step-down transformers placed along the line for supplying three-phase current of lower tension to the motor cars. The first of these two systems has the advantage of less first cost of installation, less loss of energy in the line, but it is not as safe as the second one, which is always preferable when the traffic is great and the first cost and cost of maintenance are of less importance than safety of traffic. The first system, however, seems to be the system of the future, as it is to be hoped that railway motors for very high voltages can be constructed and full safety of working can be obtained with them. A frequency lower than 22 periods should not be used.—*Elek. Anz.*, Sept. 12, 22.

Tramway in Sicily.—BIGNAMI.—An illustrated article on a combination of electric and cable systems on a short line between Rocca and Monreale in Sicily, which is only two miles long, but contains a grade too steep for ordinary railway operation. This line is made up of three sections—a single-track length of about 700 ft., the second a three-rail double-track portion about 1200 yards long, with one rail common to both tracks, and with a turnout half way, and the third, again a single-track section, about 800 yards longs. On the double track part the auxiliary cable driven motor cars are used. The electric motor cars are supplied from an overhead conductor by the ordinary trolley system. The auxiliary motor cars, two in number, run on a special narrow-gauge track, laid between the regular track, and are connected by a cable, so that when one is at the lower end of the double-track section, the other is at the upper end, gravity being made use of. The auxiliary cars are placed at the rear of the electric cars. At the lower end of the double-track section there are arranged between tracks properly graded pockets, each large enough to accommodate one of the auxiliary cars, so that the regular passenger car coming from Palermo can pass over it. At the same time, the other car, coming from Monreale at the head of the grade, runs up behind the upper auxiliary car there and is coupled to it. The two cars from the upper stations descend several yards until the auxiliary car at the foot of the grade, which thus is drawn from its pocket, reaches the car at that end with which it has to climb. After reaching the head of the incline the passenger car continues on its way alone, while the brake car is ready to return with another car which may have arrived by that time.—*Cassier's Mag.*, Oct.

Electric Trial Service on the Vienna City Roads.—An account of trials which have recently begun on the Vienna City roads with a view of introducing electric traction. The trials are made on a line of 3.8 km. in length, with an average grade of 0.8 per cent; 1.6 km. of this line is curves. Besides the two-end stations there are two intermediate stations. The trials are made by Siemens & Halske, of Vienna. The third-rail system is used. Each train consists of two halves, each half of four cars, multiple unit control being used. Each half of the train is provided with four motors. Shunt motors are used in order to be able to run the motors as generators on grades and while braking.—*Zeit. f. Elek.*, Sept. 8.

Rapid Transit in London.—SPRAGUE.—An illustrated article on the rapid transit problem in London. He reaches the conclusion that rapid transit in London and its suburbs depends upon a widespread and radical application of electricity, and this is of even more importance than the creation of new tunnels. Locomotive practice should be abolished and trains be operated in small units which could be combined at will. Electric trams should be provided in place of many of the bus lines on crowded streets, and radiate from every terminus of tubular railways and from most of the suburban stations. Every steam railway should equip at least its suburban service with electricity on a plan which permits of variable train lengths, plural control, high schedule speeds, and the maximum use of existing tracks.—*Eng. Mag.*, Oct.

Metropolitan Street Railway, of New York.—PEARSON.—An illustrated article on the electrical distribution of the Metropolitan St. R'y Co., of New York. This distribution is notable as being the largest polyphase alternating-current distribution for railway purposes yet put in operation. The amount of energy required per square mile of territory served is also very heavy. Before the Metropolitan distribution was decided upon, estimates were made on two direct-current power houses to serve the same territory as the one polyphase power house serving it at present. The territory was about nine miles long, and about two miles wide. The preliminary estimate for two direct-current plants, including the real estate and the feeder system necessary to deliver the current at the conductor rails, was $1,650,000 higher than for one alternating-current plant with six sub-stations and all feeders for a capacity of 26,000 kilowatts. The present power house at Ninety-sixth Street has eight 3500-kw generators in operation, three more being installed. These generators have a voltage of 6400, and this current is transmitted by underground conduits to seven sub-stations. At the sub-stations, step-down transformers and rotary converters are used to give a direct current of 550 volts. The power house switchboard is a matter of much importance where such large amounts of current are to be controlled at such high voltage. The oil-break switch is used throughout and several switches are placed in each generator and each feeder circuit, so that the failure of one would not prevent the opening of the circuit. The switches are pneumatically controlled by electrically operated valves. They have never failed in an emergency that has yet arisen, though called on at times to break no less than 2000 amperes. From the power house to the sub-stations three-phase currents are conducted in lead-covered three conductor cables. Paper insulation has been found much more satisfactory than rubber for these high-tension cables. The insulation is 5.5 mm. thick. All apparatus is tested at 25,000 volts for five minutes before being put in service. At manholes the high-tension cables are protected by sheet steel covering. The company has both vitrified clay conduits and iron pipes cement lined. The vitrified conduit has proved by far the most satisfactory because it stands up the best under short circuits. There is enough heat resisting material in the vitrified conduit to confine the destruction caused by a short circuit to one duct, while in a cement-lined iron pipe the heat spreads and destroys several adjacent ducts and cables. Rotary converters at the sub-stations are run with plain shunt-wound fields, although the original plant was to use compound winding on the fields. At each sub-station is a storage battery of a capacity of about 25 per cent that of the rotary converters. This takes up the fluctuations and is used in emergencies and during times of light load when the generating machinery is shut down for the cleaning of switchboards. The all-day efficiency of the distribution of the generators in the power house to the direct-current feeders going out from the sub-stations, is from 90 to 91 per cent. There are 750 switchboard instruments on the system, and two men are constantly at work keeping them correct. Load curves for 24 hours are shown. The maximum output is at 6.55 p. m., when it reaches 22,000 kilowatts.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Comparison of Three Large Traction Stations in New York.—KENT.—A very long and well illustrated article. The three plants discussed are those of the Metropolitan Street Railway Company, the Manhattan Railway Company (elevated railway), and the Third Avenue Railway Company at Kingsbridge. These stations are much larger than any that have hitherto been built for traction purposes. The maximum capacity of the Metropolitan Station is estimated as 66,000 horse-power, and that of the other two stations when com-

pleted will be 100,000 horse-power each. The electrical problem of each of the three stations is to furnish current to several sub-stations located at different points throughout the whole of Manhattan Island and a part of the Bronx district. Three-phase currents of a frequency of 25 cycles per second have been adopted by all the stations, furnished by alternators with revolving fields, containing 40 poles and revolving at 75 r. p. m. A critical review and comparison of the principal features of the three plants is given.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Borough of Bronx.—Maher.—An illustrated description of the lines in the Borough of Bronx, New York, which are all operated by trolley. In 1892 the company was running only 20 horse cars, whereas now 400 electric cars are required for the service.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

General Electric System of Train Equipment.—A complete illustrated description of the General Electric system of multiple unit control which will be used on the Manhattan Elevated Railway in New York. To obtain the highest speed schedule it is necessary not only to have quick acceleration but rapid braking. The motors of the train are controlled from one point, or any motor car can be operated separately. This is arranged by having on each car a number of electrically operated switches, constituting practically a series parallel controller except that there is no revolving cylinder and instead the contact fingers are raised up and down. At the end of each motor car are other controllers called master controllers, which instead of controlling the motors operate the contact switches first named These master controllers are somewhat similar to the ordinary car controllers, only they are much smaller. A cable connects all the controllers of the train. The current of the controllers does not pass through either the master controller or the train cable, as these parts carry only enough current to operate the contact fingers. Each motor car collects its own motor current from the trolley or third rail, and this passes into its own conductors. Each motor controller is also furnished with a reversing switch. The Manhattan Elevated Railway Company will also use a special motor called G. E. 66. The frame is of cast steel and the pole pieces of soft iron. The motor is well ventilated. Full particulars of the construction are gvien.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Alumino Thermic Process of Rail Welding.—Archdeacon.—An article on an improvement in the Goldschmidt method of welding rail joints, which has been described previously in the Digest. The crucible in which is contained the alumino thermic iron, is plugged at the bottom with an iron plug. It is then lighted by ignition in the usual way. When the mass becomes molten, the heat melts the iron plug and the molten mass passes out through the bottom around the rail. In this way the metallic contents of the crucible are first poured around the rail, and after the metal comes the slag. The reverse of the process follows when the metal is poured out of the top of the crucible, that is, the slag will then come first. This, it is thought, gives a much better joint. The amount of "thermit" necessary for a weld depends on the size of the rail, but for a rail weighing about 50 kg. per meter the ordinary quantity is from 8 to 10 kg. per joint.—*St. R'y Jour.*, Int. Ed., Oct.

Trolley Wire Protection.—An illustrated article on trolley wire protection in Santiago de Chile. While originally it had been decided that the ordinary system in which the guard wire is earthed to the rail, should be used, a modification has now been devised by Salazar, in which the guard wire is connected to the rail through a definite resistance. The connections of both systems are shown in diagrams. The new system is claimed to be safer and cheaper.—Lond. *Elec. Rev.*, Sept 27.

REFERENCES.

Block Systems.—Rank.—An illustrated paper on the different block systems for railways which were exhibited at the Paris Exposition. He deals with the following non-automatic block systems: Lartique, Tesse and Prudhomme, Tyrer, Paris-Lyon-Mediterranean system, Sarroste and Loppe, the systems of the French Eastern Railway and the French Western Railway, Cardani, Chassin, Siemens & Halske. Furthermore, with the following automatic blocks systems: Westinghouse, Hall, Krizik.—*Zeit. Oest. Ing. u. Arch. Verein*, Sept. 13, 20.

New York City.—Ford.—A very long and profusely illustrated article on "The traffic conditions of New York City," with numerous maps and statistical tables, covering all the lines in Greater New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

New York City.—Illustrated articles on the traffic and traffic conditions on Manhattan Island. The system of the Metropolitan Street Railway Company, the rapid transit tunnel and railway, the Manhattan elevated system, the system of the Brooklyn Rapid Transit Company, and track construction on the same.—*St. R'y Rev.*, Sept.

Installations. Systems and Appliances.

Charging for Electrical Energy.—Wilkens.—A brief communication in which he criticizes the system of charging proposed by Kallmann, as abstracted in the Digest last week. He thinks it unfair to base this method upon the number of lamps connected to the supply network, instead of the maximum demand really obtained. If Kallmann's method would take into account the latter, a maximum demand indicator would be required in addition to his registering instrument. A still greater disadvantage is said to be the simple addition of the loads in each stage, without taking into account the hours of the day, so that Kallmann does not take into account whether the consumer's load influences the maximum load of the plant or not.—*Elek. Zeit.*, Sept. 12.

REFERENCES.

Starting Resistances.—Kubierschky.—An illustrated article on Bunet's method of calculating starting resistances, which he tries to show by diagrams to be not fully correct.—*L'Ind. Elec.*, Aug. 25.

Bunet.—A reply to Kubierschky's criticism, which, he tries to show, is incorrect.—*L'Ind. Elec.*, Sept. 10.

Wires, Wiring and Conduits.

REFERENCE.

Contact Resistances.—A. H.—A long table, giving the results of measurements of contact resistances, the contacts being made between pieces of various metals and of various forms, by means of screws, under pressure, etc.—*Elek. Anz.*, July 25.

Electro-Physics and Magnetism.

Dielectrics.—Von Hoor.—A long account, with tables and diagrams, of very extended experimental researches made with impregnated vegetable fibre dielectrics, paraffine, gutta percha, glass and micanite condensers. He calls attention to the many sources of error due to small air bubbles, imperfect impregnation due to sticky impregnating material or too low a temperature, traces of acid or impurities. Traces of chlorine have a bad influence and the author believes that the reason why cable manufacturers prefer manila fibre to the more suitable linen fibre, is that they fear bad effects due to the chlorine which has been used in bleaching the linen fibre. Line fibre, jute fibre or manila fibre, if perfectly pure and free of air and impregnated with easily fusible and chemically pure paraffine have qualitatively entirely the same properties. He gives the results of his tests in tables and diagrams. Many of his experiments dealt with the residuum phenomena in dielectrics. The specific resistance is of great influence; in dielectrics with low specific resistance the residuum phenomena are strong and slow. The thickness of the dielectric layers is also of great influence. He found that results of tests concerning the dielectric properties, and more especially residium phenomena, can be directly compared only if the thickness of the layers in the tests is the same. He concludes that the processes in a volume element of a dielectric and the equilibrium in the same are influenced not only by the particles in the immediate neighborhood, but also by those farther away. There is a close analogy between the molecular mechanisms of the magnetic and of the dielectric polarization. He refers to similar well-known facts, for instance, that the breaking-down voltage does not increase proportionally to the thickness of the dielectrics.—*Elek. Zeit.*, Sept. 5, 12, 19.

Magnetic Effect Due to Electric Convection.—Cremieu.—A very brief abstract of a paper read before the Brit. Ass'nt Adv. Sc. His experiments have lead him to think that there is no magnetic effect due to electric convection, as has been repeatedly noticed in the Digest. Cremieu's method, dealt with in the present paper, consists essentially "in suddenly charging a rapidly-moving surface spinning inside a coil placed in a galvanometer circuit." The sudden convection current thus established should have induced a current in the coil, but no such induction took place. In the discussion, Wilson thought that the negative result was due to the "screening effect of the charge induced in the stationary metallic parts of the apparatus. He conceived that as the charge moved round with the rotating part of the apparatus it drew round with an equal and opposite charge in the metal shrouding of the apparatus, this producing a neutralizing

convection current." Larmor did not admit the validity of Wilson's criticism and considered Cremieu's experiments as "good experiments well carried out." He confessed that if Cremieu's conclusions are correct they would revolutionize completely our ideas of the relationship of electricity to matter and the convenient electron would have to be abandoned. Lord Kelvin said what is needed is to repeat the very fundamental experiment as carefully as modern appliances will admit, viz., that a charge should be rotated in proximity to one needle of an astatic pair, the apparatus being reduced to its simplest possible elements in order to eliminate criticism as to the disturbing influence of unnecessary parts. He professed to be fully convinced that electricity in motion must produce an electromagnetic field.—Lond. *Elec.*, Sept. 20.

Magnetic Effect Due to Electric Convection.—EICHENWALD.—An illustrated account of experiments in which he has repeated Rowland's experiment which proved the existence of the magnetic effect due to electric convection. He took every precaution and obtained Rowland's effect. He regards Cremieu's negative result as due to disturbing influences.—*Phys. Zeit.*, Sept. 7; abstracted in Lond. *Elec.*, Sept. 20.

Resistance and E. M. F. of the Electric Arc.—DUDDELL.—A long abstract of a Brit. Royal Soc. paper. He experimented with a direct current upon which an alternating-testing current was superimposed. In order to prove that the arc has a true resistance and to find its value, he showed that it is possible to find a value of the frequency of the testing current for which the power factor of the arc with respect to this current is unity, and that the power factor remains unity and the impedance constant, even when the frequency is greatly increased above this value. When the value of the impedance of the arc is determined under these conditions, this will be the true resistance. With an arc 3 mm. long between 11 mm. solid carbons, the power factor becomes unity for the extremely high frequency of 90,000 p. p. s., produced by a special generator, and it remained unity up to 120,000 periods. The true resistance of this arc through which a current of 9.91 amperes was following was found to be 3.81 ohms. The ohmic drop is, therefore, 37.8 volts out of an observed p. d. of 49.8 volts, so that there appears to be a real back e. m. f. opposing the flow of the current in this arc of 12 volts. With an arc 3 mm. long between 11 mm. cored carbons the power factor became unity at a frequency of 15,000 p. p. s. and remained unity up to 50,000 periods. The true resistance of this arc was found to be 2.54 ohms and the back e. m. f. 16.9 volts. Both the resistance and the back e. m. f. depend greatly on the composition of the electrodes. Thus, simply soaking a paid of solid carbons in potassium carbonate reduced the resistance of the arc between them from 3.81 to 2.02 ohms, and increased its back e. m. f. from 12 volts to 15.6 volts, the arc length and direct current being kept constant. Similar results were obtained by introducing other impurities. He is of the opinion that the resistance between perfectly pure carbon electrodes would be very high, so high that it might be impossible to maintain a true arc, and that traces of impurities are essential to provide the carriers of the electric charges in the vapor column.—Lond. *Elec. Rev.*, Sept. 20.

Velocity Ratio.—ABRAHAM.—An account of some of the most important experimental methods recently used for determining the velocity ratio, i. e., the ratio between the electrostatic and electromagnetic units of quantity of electricity. The mean of the seven measurements which are considered the most accurate is $v = 30,001,000,000$. —*Paris Internat. Phys. Congr. Report* 2, p. 247; abstracted in *Science Abstracts*, Aug.

ELECTRO-CHEMISTRY AND BATTERIES.

Separating Cobalt and Nickel.—BALACHOWSKY.—An abstract of an French Academy paper, describing an electrolytic method of separating these two metals. The only method at present is a chemical one which is rather tedious. The difficulty lies in the identity of the chemical and physical properties of these two metals. He uses an acetate solution mixed with other ingredients. The composition is given. The electrolysis must be carried out at a certain very definite voltage, current density and temperature. The description is not clear, as the meaning of certain reference letters is not given. It seems, however, that below a certain density both cobalt and nickel are deposited, while at a certain other current density and voltage only the nickel is deposited and the cobalt left in solution. (Unfortunately, as in numerous other similar descriptions, nothing is said of the relative position of the electrodes with reference to each other, which so greatly affects the internal resistance, and, therefore, the voltage at the terminals. If this voltage must be so carefully adjusted the portion lost by internal resistance ought to be just as carefully stated.)—*L'Ind. Elec.*, July 25.

Nickel Cells.—MICHALOWSKI.—A communication on the history of the use of nickel oxide electrodes in storage cells. Dun, in 1885, took out a German patent for a nickel-alkali-zinc cell; Desmazures, in 1887, patented a method of making electrodes of porous nickel; Michalowski, in 1899, patented a new process of making nickel electrodes. He was also the first who called attention to the thermochemical properties of nickel, which make this metal especially adapted for the positive electrode.—*L'Ind. Elec.*, Aug. 25.

Edison Battery.—LUCAS.—A reply to Wade's criticism (Digest, Sept. 28). He maintains that the voltage required for electrolysis of any aqueous solution depends on the electrolyte in solution and not on the water, otherwise the voltage required to electrolyze solutions would be the same no matter what salts or bodies are present. He claims that local action "might take place in Edison's negative, even if it were true that the p. d. of the couple graphite-iron were equal to the p. d. required to split up the solution present."—Lond. *Elec.*, Sept. 13.

REFERENCE.

Contact E. M. F. and the Theory of Ions.—A French Academy note. The Lipmann electrometer enables one to determine the contact e. m. f. between mercury and the electrolyte, if one admits that at the moment when the capillary surface tension becomes a maximum, there is no e. m. f. between the liquid and the capillary mercury. He studied the variation of the e. m. f. with the concentration of the solution. The experimental results are in agreement with the theory of ions for dilute solutions.—*L'Ind. Elec.*, July 25.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Hot Wire Wattmeter.—E. H.—An illustrated description of an interesting and extremely simple hot-wire wattmeter for direct and alternating currents, devised by Bauch. The two hot wires *a* and *b* are arranged in combination with two additional resistances *c* and *s*, as shown in the adjoining diagram. Under the supposition that the

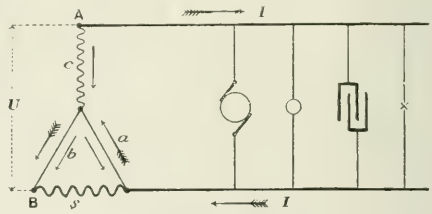


FIG. 1.—HOT-WIRE WATTMETER.

elongation of a hot wire is proportional to the heat developed in it, it is shown that the difference of the elongations of the two hot wires *a* and *b*, is proportional to the product of the e. m. f. *U*, the current *I* and the cosine of the phase difference between *U* and *I*; in other words, this difference is a measure of the real power. The device by which the needle of the instrument gets a deflection, proportional to the difference of the elongations of the two hot wires, is very simple

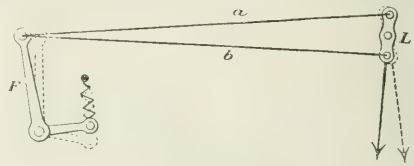


FIG. 2.—HOT-WIRE WATTMETER.

and is shown in the second figure, in which *a* and *b* are again the two hot wires. They are fixed at one end to the lever *F*, acted upon by a spring. The other ends of the two wires are connected to a lever *L* with two equal arms. For slight elongations, the deflection of *L* is proportional to the difference of the elongations of *a* and *b*, and hence proportional to the power to be measured.—*L'Ind. Elec.*, Sept. 10.

Features and Exhibits of the Street Railway Convention.

A special 12-page supplement to Electrical World and Engineer last week gave a report of the convention of the American Street Railway Association up to the time of going to press, as well as details and views of many of the exhibits. Elsewhere in this issue, we close this week our notes, etc., on the convention, and below will be found some further data as to the exhibits, many of which, for importance and completeness, have never been equaled. We are also able to supplement with views our descriptions given last week of the excellent exhibits of the Westinghouse Electric & Manufacturing Company, A. & J. M. Anderson, the Gold Car Heating Company, General Electric Company, Creaghead Engineering Company, and the Bay State Electric Car Heater.

The N. Y. Telephone Company gave an excellent free telephone service at the Garden, and the convenience was highly appreciated by all. Mr. F. H. Bethell, the company's contract agent, placed his temporary Bell exchange in the music balcony over the main entrance into the Garden. It consisted of a two-position switchboard connected with the Madison Square central office by 20 direct lines. To the board were connected 58 long distance telephone stations located at various parts of the Garden in leading exhibits. The "private branch exchange" service was thus illustrated in a most excellent manner. There were also a group of sound-proof booths in the temporary exchange for general use. The New York Telephone Company which now has 64,000 stations in Manhattan alone, and is growing at the rate of 1500 a month, was able to give a splendid test of its system under the great pressure put upon it by the convention work. A neat little brochure on private branch exchange service was distributed.

The Bethlehem Steel Company, on Saturday, after the close of the convention, took a special train with about 200 delegates and ladies out to their fine works at Bethlehem, where four or five thousand men are employed, and where some of the largest guns and heaviest armor plate in the world are made. All this work was, of course, intensely interesting, but at least equally so were the superb steel shafts turned out and being cut by machine tools of Taylor White steel, which will cut steel so rapidly that the chips are heated to a blue tinge. Seeing is believing, but it is even then difficult to persuade oneself that the metal can be worked at such a high rate of speed. Some of the shafts in hand are intended for the new Riverside station of the New York Edison Company and for the power plant of the Manhattan Elevated. A very interesting feature was the "fluid compression" plant. Many devices have been projected to obviate the various defects in ingots, such as blow-holes, segregation, piping, etc., which occur in the cooling of large masses of steel, but the most successful of these devices is the "fluid-compression" process, by which ingots are secured free from defects or flaws of any kind, and the metal is rendered homogeneous throughout. This fluid-compression plant is the only one in this country. In the forge two hydraulic presses, one of 2500 tons and the other of 5000 tons capacity, were operated, forging such work as was found ready at the time. The best practice now calls for steel forgings to be manufactured under heavy hydraulic presses, instead of hammers, as formerly. It is only by means of these improved methods that the metal of the forging is thoroughly worked throughout. The process of hollow-forging on a mandrel, which could be seen under these presses, is one of the latest improvements in the forgeman's art, and a large proportion of the steel forgings turned out by the Bethlehem Steel Company is now of this type. A most enjoyable collation was served in the office building, and many thanks are due Mr. Fitz John Porter, and other officials of the company, for a very delightful day.

Frank Ridlon Company, of Boston, made an exhibit of its specialties, including the Wilson trolley catcher, the Ridlon track drill, and the Weld babbitting device, the latter being a new piece of apparatus for babbitting split bearings in which the work is automatically completed by simply pouring the babbit. Skilled labor is not necessary to cast bearings with this device. Messrs. Frank Ridlon, president; Charles N. Wood, vice-president; N. L. Wood, H. F. Kellogg and Robert Mathias were present.

Globe Electric Manufacturing Company, Cleveland, Ohio, exhibited its headlights in the Morris Electric booth. Mr. George Scroder represented the company.

The Auto-Electric Shunt Company, West New Brighton, New York, which manufactures a device for substituting an incandescent lamp for any one in a series of lamps that may burn out, had some of its shunts on exhibition. Their action was explained by F. W. Wise. The apparatus has been illustrated and described in the pages of Electrical World and Engineer.

The Electric Railway Equipment Company, of Cincinnati, had an exhibit of its line material and general supplies in the space of the

FIG. 1.—CREAGHEAD ENGINEERING COMPANY'S EXHIBIT.

Morris Electric Company, which represents it in the East. Mr. Harten was in attendance.

The Vandorn-Elliott Electric Company, of Cleveland, had a neat exhibit of commutators, armature and field coils and a rewound armature as a sample of the work that it does. W. H. Elliott and W. A. Dutton represented this company.

R. D. Nuttall Company, Pittsburg, had a few gears and pinions and Nuttall trolleys on hand. The Nuttall factory, the largest of its kind devoted exclusively to gears in the United States, is being crowded with street railway work, and is also with turning out gears for other purposes, some of very large size. Messrs. F. A. Estep and L. W. O'Brian were present.

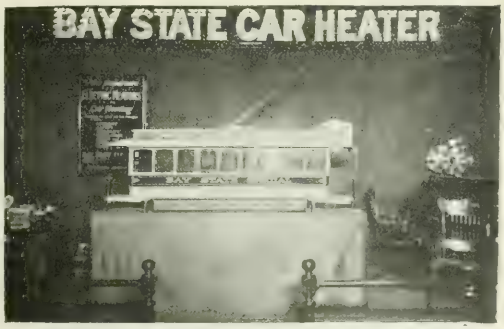


FIG. 2.—BAY STATE CAR HEATER EXHIBIT.

Drake, Breed & Co., engineers and contractors, of Philadelphia, was represented by both members of this firm, which has under contract the construction of the Hamburg Railway, now nearly completed from Buffalo to Hamburg. Plans for an extension to Dunkirk are being prepared. The firm has some other very important work in sight, and its services are greatly in demand.

The Chase-Shawmut Company, of Boston, well known in the electric lighting field, exhibited the Chase-Shawmut flexible rail bond,

which uses solder for attachment to the rail, and has been used at Seattle as well as on other Stone & Webster street railway properties. The reports are excellent as to its durability, conductivity, and easy application. Messrs. George L. Osborn, E. M. Hamlin, F. D. Masterson and H. P. Moore attended the convention for this company.

MR. S. B. CONDIT, JR., of S. B. Condit, Jr., & Co., Boston, was in attendance at the convention on Friday. Mr. Condit discussed the merits of Elden circuit breakers and switches.

THE CROCKER-WHEELER COMPANY exhibited on the central floor space two sizes of its railway generators, one complete with brush

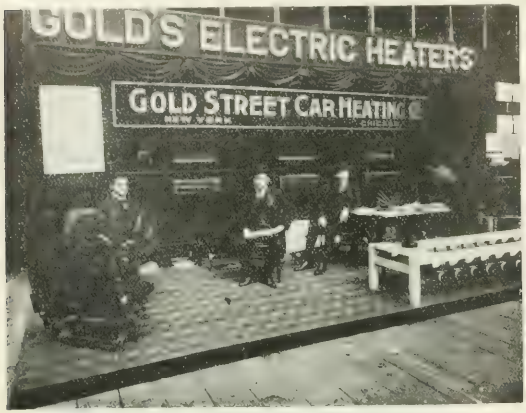


FIG. 3.—GOLD CAR HEATERS.

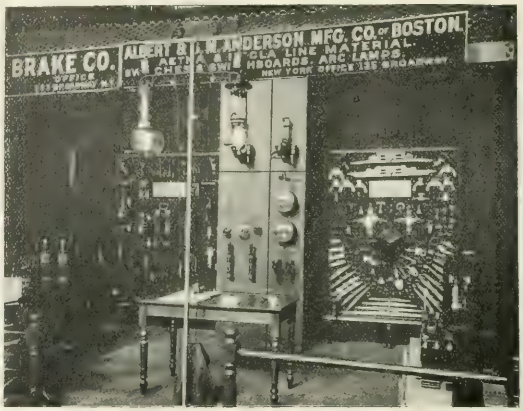
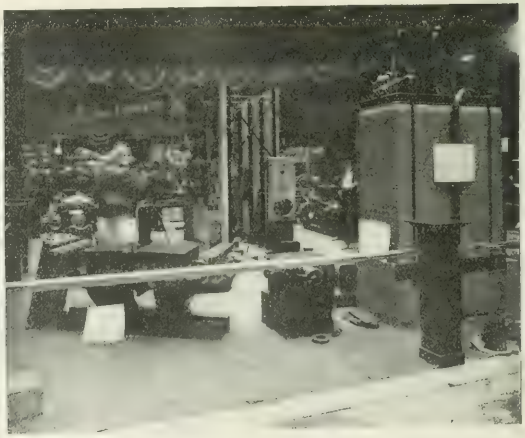


FIG. 4.—EXHIBIT OF ANDERSON OVERHEAD APPLIANCES.

FIGS. 5 AND 6.—THE WESTINGHOUSE COMPANY'S EXHIBITS.



FIGS. 7 AND 8.—GENERAL ELECTRIC COMPANY'S EXHIBITS.

rigging and one showing only the field magnet frame. These sizes have output of 250 and 500 kilowatts at 550 volts. Although this company owes, to a large extent, its reputation in the electrical industry to its many achievements in the development of electrical apparatus for power purposes, no little time has been given during the past few years by its engineering department to the careful consideration of the requirements of electric railroad work. The result of this consideration is a line of generators built upon the most practical design to withstand the severe stresses to which railway machines are subjected. The success attained with this new line is most satisfactory, and the operation of the machines in actual service speaks more emphatically than anything which could be said here. Their regulation is remarkable. There is no perceptible sparking at the brushes under wide variation in load, and the simple construction with liberal margin requires minimum attention; they are free from heating, which feature insures the user against burn-outs, except those which might occur from serious abuse. The special features of the design and construction are: Compactness, simplicity, strength and endurance, low-current density in windings, commutator brushes and other conducting parts; ample cooling surface and adequate means of ventilation; a substantially flat efficiency curve, and a nearly straight compounding curve, low armature reaction and no variation of brush lead. The iron and steel used for the field and armature is selected with special reference to magnetic qualities; the other materials are selected with reference to suitability for duty.

The Darlington Electric Fountain & Supply Company, of Philadelphia, was represented by Mr. F. W. Darlington, consulting electrical and mechanical engineer, and also by Mr. D. Scott Quintin, secretary. Some important developments are afoot, it is rumored, in this enterprise.

The Pennsylvania Electrical & Railway Supply Company, of Pittsburg, Pa., was represented by its secretary and treasurer, Mr. Samuel F. Hammond and Mr. H. M. Laughlin, vice-president.

Franklin Electric Manufacturing Company, Hartford, Conn., maker of the "Femco" incandescent lamps, was represented in the space of the Morris Electric Company. This company is paying special attention to street railway incandescent lamps. It is one of the younger companies in the business, but is forging its way to the front very rapidly. Mr. Jonathan Camp, the manager of the company, is a well-known and popular man in the trade, and has done considerable to make the "Femco" lamp a commercial success.

The Sprague Electric Company had a very interesting exhibit consisting of the Sprague multiple unit apparatus which attracted considerable attention by reason of its simplicity, economy and perfect control of train operation. The exhibit was near the central part of the hall, and showed a complete train equipment of two motor cars and intermediate train line cars, with means for connecting up in various sequential and end to end relations. The controllers were of the type recently introduced on the Boston Elevated Railway, and of a capacity of 300 horse-power each. One was connected to four Lorain steel motors mounted on the floor, and the other to four motors loaned by the Brooklyn Heights Railroad Company, mounted on two of the latest Peckham trucks. The extreme flexibility of the system in accommodating itself to any train make-up and any emergency of service was illustrated in practical operation by no less a personage than Mr. F. J. Sprague himself. The multiple unit system has already become an essential factor in handling the congested traffic on heavy urban and interurban electric railways. Its adoption and successful operation on elevated roads in Chicago, where Mr. Sprague first reduced it to practice on a large scale, in Brooklyn and Boston, and on the Versailles division of the Western Railway of France, has demonstrated the practicability of substituting electricity for steam for all classes of congested railway service. In this system, as exemplified at the Garden, no electric locomotive is required. The train is usually made up of two kinds of cars, a motor car which is completely equipped with motors, controllers individual to their motors for determining their direction and speed, master switches and a controlling train line with connecting jumpers, and a train line car which is provided generally only with the controlling line common to all the cars. Each motor car is an independent unit, and the train may be composed of as many motor cars and train line cars as desired, its operation being in no way affected by changes in sequence or end relation of cars. Train movements, whether of speed or direction, or both, are controlled from any one of the cars through the master switches and controlling line. The speed and direction of the train is initiated at the master switch by a movement of a single handle. The operator can stop or reverse the train by a single throw of the switch handle from one side of the open position to the other. There are various automatic features that prevent interference with the proper operation of the control of train movements, and reduce the manipulation of the train to one of

FIG. 9.—THE SPRAGUE COMPANY'S EXHIBIT

absolute simplicity. It becomes possible by the combination of this positive and semi-automatic control, to combine cars having controllers of different sizes, motors of different capacities, resistances of different gradations, gears of different ratios and wheels of different diameters, and to successfully operate them all from one or more controlling points. The Sprague Electric Company was represented at the exhibit by Messrs. Sprague, F. H. Shepard, G. H. Hill, H. G. Issertel, Alex. Henderson, S. H. Libby and H. M. Davis, and the apparatus was often operated by the young son of Mr. Sprague, Martin Desmond, showing its easiness of control by a mere boy of 14. The Sprague Company was under obligations to the Peckham Truck Company, the Lorain Steel Company and to the Brooklyn Heights Elevated Railway Company for courtesy and assistance in arranging for the exhibit at a late hour.

The Robins Conveying Belt Company, of New York City, exhibited two operating model belt conveyors on a scale of 3 inches to the foot, equipped with an automatic self-reversing tripper. The metal parts of the exhibit were nickel-plated, and the whole exhibit was very handsomely gotten up. The conveyors were in operation continuously during the three days, noiselessly elevating and distributing material, and served to illustrate the types used largely in boiler

FIG. 10.—OPERATING MODELS OF ROBIN'S CONVEYOR.

1 power houses for distributing coal in storage bins and piles, and o for taking it out of the storage. The company issued an illustrated book devoted entirely to descriptions of their conveyors in coal handling plant, and have just gotten out a new edition of their general catalogue containing 76 half-tone views of typical installations, copies of which were greatly in demand.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 3 per cent, nominal. Time money was easier, and the demand more active. The closing rates are 4¼@4½ per cent for high-grade loans, and 4¾@5 for mixed collateral. At the beginning of the week the stock market was unsettled and depressed, but later in the week railroad share values rallied sharply on free covering of shorts and buying for long account. Other classes of securities were favorably affected. Amalgamated Copper attracted the most attention early in the week and declined sharply on further selling pressure, accompanied by reports that a cut in the price of the metal would probably be made. The stock, however, rallied strongly towards the close of the week. In the traction list Brooklyn Rapid Transit was the most active, there being a disposition to cover on the part of shorts, in spite of what is regarded as the poor showing of the annual report of the company. The lowest point reached was 55⅞, the highest being 61½. The total number of shares sold was 240,110, the closing price for the week being 60⅛—a net loss of ⅛ point. Metropolitan Street Railway fluctuated in price between 155¼ and 159¾, closing at 156¼—a net gain of 1½ points. The sales were 68,300 shares. In the electric list General Electric showed the most strength, closing with a net gain of 5 points. The week's quotations ranged between 247½ and 259¾, closing at 255. Ten thousand shares of Western Union changed hands at quotations ranging between 90 and 92¼, the closing figure being 91½—a net gain of ⅞ point. The market for outside securities at the close of the week was irregular and unsettled, and trade generally of small volume. Electric Lead Reduction was in good demand at 2⅜ and 2¼. Apache Copper sold at 52¼. Following are the closing quotations of Tuesday, Oct. 15, at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Oct. 8.	Oct. 15.		Oct. 8.	Oct. 15.
American Tel. & Cable	—	—	General Carriage	1	⅞
American Dist. Tel.	—	—	Hudson River Tel.	112	112
Brooklyn Rapid Transit	57⅝	59⅝	Illinois Elec. Veh. Trans.	—	—
Commercial Cable	—	—	Metropolitan Street Ry.	158	158
Electric Boat	16	22	N. E. Elec. Veh. Tran.	—	—
Electric Boat pfd.	40	45	N. Y. Elec. Veh. Tran.	8½	7
Electric Lead Reduc'n	1⅞	2	N. Y. & N. J. Tel.	166	166
Electric Vehicle	1½	1¼	Tel. & Tel. Co. of Am.	5	5
Electric Vehicle pfd.	3	3	Western Union Tel.	90⅞	91½
General Electric	250	258½			

BOSTON.

	Oct. 8.	Oct. 15.		Oct. 8.	Oct. 15.
Am. Tel. & Tel.	157	157	Mexican Telephone	2	2⅛
Cumberland Telephone	—	—	New England Telephone		
Boston Electric Light	—	—	Westinghouse Elec.	—	71½
Erie Telephone	39	38	Westinghouse Elec. pfd.	—	—
General Electric pfd.	—	—			

PHILADELPHIA.

	Oct. 8.	Oct. 15.		Oct. 8.	Oct. 15.
American Railways	40½	40½	Phila. Traction	95¼	95⅞
Electric Storage Battery	63	64	Philadelphia Electric	5¼	5¼
Elec. Storage Batt'y pfd.	63	64	Pa. Electric Vehicle	½	½
Elec. Co. of America	7	6⅞	Pa. Elec. Veh. pfd.	½	½

CHICAGO.

	Oct. 8.	Oct. 15.		Oct. 8.	Oct. 15.
Central Union Telephone	—	—	National Carbon pfd.	83	83
Chicago Edison	160	160	Northwest Elev. com.	38	40
Chicago City Ry.	202	201	Union Traction	17	17⅜
Chicago Telep. Co.	254*	225	Union Traction pfd.	58	58
National Carbon	18⅜	18			

*Asked.

NEW YORK & STAMFORD STREET RAILWAY.—Messrs. E. H. Gay & Co., Boston, are offering investors $350,000 New York & Stamford Railway Company's first mortgage 5 per cent 30-year gold bonds at 111½ and interest, at which price they net over 4.30 per cent. The railway consists of about 15 miles of track. There is $450,000 capital stock, and $450,000 first mortagage bonds, $100,000 of which are held in escrow by the trustee to be issued for additions to the property. The combined earnings of the Port Chester and Larchmont roads for the year ending July 1, 1901, were $82,168; operating expenses $51,472, leaving a net of $30,696. The earnings for July and August, 1901, were $31,400, an increase of 68½ per cent as compared with same months last year. The company operates through and from Port Chester, Westchester County, N. Y., through Rye, Harrison, Mamaroneck and Larchmont to New Rochelle, where it connects with the Third Avenue surface line of New York City. At Rye the road connects with a line to Rye Beach. The Greenwich Tramway Company, now in process of construction, and which runs from Greenwich to Stamford, in the State of Connecticut, will, when finished, connect with the New York & Stamford Railway, making a through electric railway line from New York to Boston.

WESTERN UNION ANNUAL MEETING.—The annual meeting of the Western Union Telegraph Company was held in New York on Oct. 9. The report for the fiscal year ended June 30 last, shows the following results:

	1901.	1900.	Changes	
Revenues	$26,354,151	$24,758,569	Inc.	$1,595,582
Expenses	19,668,902	18,593,206	Inc.	1,075,696
Profits	$6,685,249	$6,165,363	Inc.	$519,886
Int. on bonds	956,160	*906,102	Inc.	50,058
Balance	$5,729,089	$5,259,261	Inc.	$469,828
Dividends	4,868,008	4,867,984	Inc.	24
Surplus	$861,081	$391,277	Inc.	$469,804
Previous surplus	8,458,205	8,066,928	Inc.	391,277
Total surplus	$9,319,286	$8,458,205	Inc.	$861,081

*Includes $9,797 sinking funds.

EXPENSES.

	1901.	1900.	Changes.	
Operating and general	$13,991,830	$13,220,009	Inc.	$771,821
Rent., leas., lines	1,569,640	1,566,705	Inc.	2,935
Maint, and recon	3,270,425	2,959,998	Inc.	310,427
Taxes	520,155	529,469	Dec.	9,314
Equip offices and wires	316,852	317,025	Dec.	173
Total	$19,668,902	$18,593,206	Inc	$1,075,696

GROWTH OF THE COMPANY.

	1901.	1900.	1891.
Miles p'l's and c'bs	193,589	192,705	187,981
Miles wire	972,766	933,153	715,591
Offices	23,238	22,900	20,098
Messages	65,657,049	63,167,783	59,148,343
Receipts	$26,354,151.00	$24,758,569.00	$23,034,326.00
Expenses	19,668,902.00	18,593,206.00	16,428,742.00
Profits	6,685,249.00	6,165,363.00	6,605,584.00
Average toll per mes.	30.9	30.8	32.5
Average cost to com.	25.1	25.1	23.2

Of the increase in the total revenues for the year, $885,503 came from regular commercial messages, press dispatches and election returns, $363,072 from leased wires and $347,006 from sundry other sources.

INDEPENDENT TELEPHONY.—The reorganization of the directory of the Telephone, Telegraph & Cable Company is now in progress. It is understood that the board of directors will be reduced from 21 to 9. John B. Staffer has resigned as treasurer. Of the four Telephone, Telegraph & Cable Company representatives on the board of the Erie Telephone & Telegraph Company, three will resign, Mr. F. A. Cutting remaining. Mr. Morse will nominate three directors to represent his interests. Three strong Boston financiers have been mentioned. With regard to the situation, the chief owner of the property, Mr. Chas. W. Morse says: "I wish to say once for all, so that the matter may rest, that the Telephone, Telegraph & Cable Company of America has but one object, and that is to compete with the Bell. The system will be built up in all sections of the country, and in a few years it will be able to give a service that will meet every demand. All of the independent lines will be merged, and new communications established. The company is in the field to stay, and will naturally push forward."

ELECTRIC LIGHTING IN BOSTON.—The stockholders of the Edison Electric Illuminating Company, of Boston, at annual meeting last week voted to issue $750,000 additional stock. The board of directors was increased from 9 to 12 members. The following directors were elected: C. W. Amory, Robert Bacon, E. Henry Barnes, Walter C. Baylies, Isaac T. Burr, Everett W. Burdett, Henry B. Cabot, T. Jefferson Coolidge, Jr., George Dexter, Charles L. Edgar, Edward B. Maltby, C. Minot Weld. The directors elected the following officers: President, C. L. Edgar; vice-president, Walter C. Baylies; treasurer, Henry B. Cabot. The directors of the Boston Electric Light Company at a meeting last week also elected C. L. Edgar president, Edward B. Maltby vice-president and Henry B. Cabot treasurer, and the merger of Edison and Brush interests in Boston may now be deemed complete.

DIVIDEND.—The Edison Electric Illuminating Company, of Boston, has declared a regular quarterly dividend of 2½ per cent, payable Nov. 1.

CONNECTICUT RAILWAY & LIGHTING.—The committee on stock list of the New York Stock Exchange has recommended that $8,355,000 of the $15,000,000 first and refunding mortgage 4½ per cent 50-year gold coupon bonds of 1951 be admitted to the Stock Exchange list. With its application to the Stock Exchange, the Connecticut Railway & Lighting Company, submits the following statement, for the eight months ended Aug. 31, 1901:

	Railway.	El. sys.	Gas sys.	Total.
Gross	$718,061	$199,044	$114,509	$1,033,114
Expenses	435,272	144,232	84,500	664,004
Net	$283,088	$55,412	$30,009	$369,108
Interest charges				284,323
Net profits				$84,785

OTIS ELEVATOR.—President Baldwin, of the Otis Elevator Company, made last week the following statement: "The business of the company is very satisfactory; our sales for the eight months of the year are about a million dollars in excess of last year's business, and a million and a half dollars in excess of 1899. The earnings for the past eight months are sufficient to pay the dividend on the perferred stock for the year, and leave a handsome surplus. At the meeting of the board of directors the matter of a dividend on the common stock was informally discussed, but no definite action was taken in view of the large expenditures necessary to provide for the rapidly increasing business of the company."

THE SOUTHERN NEW ENGLAND TELEPHONE COMPANY will increase its capital stock $230,000, raising its total of outstanding capital stock to $2,990,000. The new stock will be issued at par, and will participate in the next July dividend. The money is to be used in liquidating the floating debt incurred by the extension of the plant.

Commercial Intelligence.

THE WEEK IN TRADE.—The general demand for merchandise was somewhat quieter, due partially to weather conditions. Bank clearings showed a further shrinkage, but are still far in advance of earlier years, and railroad earnings, though showing slightly smaller gains than of late note a continued and practical gain over previous years. In general, industrial activity continues. The iron and steel and other industries are working at full speed, and textile industries are likewise fully occupied. The demand for iron and steel continues active, particularly for the cruder forms. The exigencies of the demand for some products are illustrated by the fact that $28 per ton has been offered for steel billets at Pittsburg for immediate delivery, but not accepted, although the nominal price is but $26, at which price future orders are being booked. Heavy sales of steel rails for 1902 delivery are reported at the West. Special activity in lead and zinc is noted at Western primary points. Copper is in hand-to-mouth demand here, but spot prices have advanced in Montana. As Lake copper is mostly engaged from the larger producers, consumers needing prompt delivery are forced to pay the price asked, which is 16½ to 17 cents. With electrolytic copper it is different. Some producers are asking 16⅝ cents, while others are selling at lower prices. The standard casting brands are held at 16⅝ cents, but other brands are to be obtained at lower figures, in some instances as low as 15⅝ cents. The September railroad gross earnings are not quite so good as those for the two preceding months, but the showing made by 100 roads is of a very favorable character, exhibiting a gain of 10½ per cent in favor of September this year as compared with the same month last year. Heavy gains are reported by the Pacific roads and the granger lines, being 20.2 and 15.2 per cent, respectively, while the Southwestern carriers show an advance of 12.7 per cent, the trunk lines 9.8 per cent, Central Western 8.9 and the Southern roads 4.5 per cent. The failures for the week, as reported by *Bradstreet's*, aggregated 183, as against 175 the week previous, and 210 the same week last year.

AMERICAN BICYCLE COMPANY.—The annual report shows net profit for year of $850,682, against $855,579 for ten months of previous year. The following directions have been elected to the American Bicycle board for three years: H. A. Losher, A. Featherstone, William Barbour, J. E. Bromley, O. Unzicker. President Coleman says: "The automobile department has been gradually developing, and is now on a profit paying basis. Our policy was not to offer vehicles for sale until we could produce them as good or better than others. At Toledo, Ohio, we have the largest and finest automobile factory in the world at which is manufactured our steam automobile, the 'Toledo,' the most perfect self-propelled vehicle of its type. The Automobile & Cycle Parts Company organized and taking in all our six parts factories in January last, is proving a success, and is already upon a dividend-paying basis. The National Battery Company, owning the Sperry battery, has more orders and contracts on its books than it can fill in the next six months. The American Wood Rim Company, to which we sold our wood rim plant at Plymouth, Ind., and in which we are stockholders, is in a flourishing condition, and paid on the past year's business a dividend of 10 per cent. The Auto-Street Sweeper Company, in which we own a controlling interest, is a new enterprise, and promises to be a profitable one. Several of the fatcories discontinued as bicycle factories, have been utilized for the manufacture of automobiles and batteries; the balance have been sold or rented so that at the persent time we have but one factory that is standing unoccupied and idle."

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Oct. 9: Antwerp—18 cases electrical material, $689. Athens—1 case, $100. Argentine Republic—38 cases, $245. Alexandria—5 cases, $120. Azores—2 packages, $109. Bilboa—1 case, $50. British Australia—54 cases, $1,292. British West Indies—18 packages, $479. Brazil—224 packages, $16,272. Chili—23 packages, $1,255. Christiania—1 package, $33. Constantinople—1 package, $50. Cuba—113 cases, $3,649. Glasgow—1 package, $11. Havre—18 cases, $650. Hamburg—105 cases, $5,901. Liverpool—43 cases machinery, $1,289; 82 cases material, $2,320. Leeds—1 case, $44. London—137 packages machinery, $21,041. Manchester—122 packages machinery, $22,317; 1 package material, $24. Marseilles—1 package, $250; 3 packages machinery, $1,200. Mexico—64 packages, $7,299; 7 packages machinery, $1,519. Newcastle—21 packages machinery, $5,300. Newfoundland—43 packages machinery, $1,268; 2 packages railway material, $854. Nova Scotia—31 packages, $439. Naples—9 packages, $600. Peru—43 packages electrical material, $1,637. Rotterdam—3 cases, $110. Southampton—18 packages machinery, $2,012. Trieste—5 cases machinery $340.

THE WISCONSIN RIVER PULP & PAPER COMPANY, of Stevens Point, Wis., has recently installed three pairs of 36-inch McCormick turbines built by S. Morgan Smith Company, York, Pa. Each pair is mounted on a cast iron draft chest in a steel flume and develops 350 horse-power, with 200 revolutions, under a working head of 18 ft. In fact, the Smith Company claims to build the highest speed cylinder gate turbines now in use. It also furnished the International Paper Company three pairs 39-inch and one pair of 36-inch McCormick turbines mounted in a similar manner, which when tested at Holyoke gave 85 per cent efficiency and extraordinary speed. These wheels are developing 7200 horse-power under 50 ft. head, and are used for operating pulp grinders at Rumford Falls, Me.

BALL ENGINE ORDERS AND INSTALLATIONS.—The Ball Engine Company, Erie, Pa., has recently furnished the Providencetown, Mass., Electric Light Company with an engine. The Ball Engine Company has also recently furnished an 80-hp engine, arranged for direct connection to generator, to the Omaha High School. The Sweet Home Plantation, Assumption Parish, La., is to have its own electric plant. The engine was built by the Ball Engine Company. Two engines, each arranged for direct connection to generators, have been recently installed in the New York Infant Asylum by the Ball people.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, reports a shipment of 37 switchboards for the last week in September and first week in October, 13 of which were magneto and the remainder 24 common battery boards. The shipment for Saturday, Oct. 5, alone was eight switchboards, five of which were magneto and three common battery. Such figures give a vivid idea of the great activity in the telephone field.

MENOMINEE ELECTRIC MANUFACTURING COMPANY.—Mr. R. E. Jennings, president of the Menominee Electric Manufacturing Company, was a visitor in New York City during the past week and stated while here that the company is preparing to place upon the market a fan motor of attractive design for desk or bracket use.

CHICAGO OFFICE FOR THE S. K. C. SYSTEM.—Mr. John H. Finney, late of Washington, D. C., has been appointed the Western sales manager of the Stanley Electric Manufacturing Company, with offices in the Monadnock Block, Chicago. Mr. V. W. Bergenthal, formerly of Pittsfield, will be engineer of the Western sales office.

MONTAUK FIRE-DETECTING WIRE COMPANY, of 100 Broadway, New York City, has just completed a fine installation of its wire in the Manhattan Theatre, Thirty-third Street and Broadway. This wire, it will be remembered, gives an instantaneous automatic electric alarm upon the slightest heating in its vicinity, and its value is evident at a glance.

JANDUS AND BUCKEYE COMPANIES.—The two above-named companies have located their New York office at 115 Broadway, and have placed in charge Mr. Arthur Organ, who for some few years past has been stationed by them in Philadelphia. He will not only handle the Jandus enclosed arcs and Buckeye incandescents, but will supply inner globes for all makes of enclosed arc lamps.

SOUTH AMERICAN TRADE.—The recent departure from Washington of the special train carrying the United States and numerous other delegates to the approaching Pan-American Conference to be held at the City of Mexico lends especial interest to some figures on the commerce of the United States with the territory at the South, which the Treasury Bureau of Statistics has compiled for the convenience of the United States members of that Congress. The importance of development of our commerce in this particular direction is pointed out by this publication, which proves that our exports have shown less growth to the countries of Central and South America than to any other parts of the world. The commerce of the United States with the American countries lying south of her borders, it points out, has long been an object of solicitude to her statesmen, economists and business men. With the English-speaking people of American territory lying upon the north her commercial relations have rapidly grown and proven mutually satisfactory. With those of another language, occupying the contiguous territory at the South the growth has been slower and less satisfactory, and as the distance increases the growth decreases. To British North America the United States supplies 52 per cent of the total imports for consumption; to Mexico, equally adjacent, but speaking another language than our own, 40 per cent; to the Central American States, next removed by distance, though readily reached by water and now being tapped by railways, 35 per cent; to Colombia, a trifle farther removed, but equally accessible by direct water communication, 33 per cent; to Venezuela, equally accessible, 27 per cent; to the West Indies, which lie in close proximity, but which have been up to the present time controlled by commercial nations whose policy in many cases has been to retain their commerce for their own people, 20 per cent; to the Guianas, also readily reached by water, 25 per cent of the imports of British Guiana, 17 per cent of those of Dutch Guiana, and but less than 6 per cent of those of French Guiana.

NEW ELECTRIC TRACTION SYSTEM FOR TRINIDAD.—The Trinidad Electric Company, Limited, has just been organized by a group of prominent American and Canadian capitalists for the purpose of acquiring the Trinidad Electric Light Company and the Belmont Tramways, now operating in Port of Spain, Trinidad, British West Indies. The capital of the concern is $1,500,000. The American portion of the capital comes chiefly from New York, F. S. Pearson, consulting engineer of the Metropolitan Street Railway, being primarily interested in the enterprise. B. F. Pearson, of Halifax, Nova Scotia, is also understood to have a considerable interest in the company. Sir William Van Horne, formerly president of the Canadian Pacific Railway, is also a heavy stockholder. The company proposes to convert the Belmont Tramways, which are operated partly by mules and partly by narrow-gauge electric lines—about 12 miles in all—into a broad-gauge electric traction system, and to extend the road for a distance of about 18 miles, which will make a total of 30 miles of line when the projected work is completed. T. W. Teele, formerly of the Boston Elevated Railway, has been appointed manager of the Trinidad Company. He is now in Port of Spain for the purpose of determining as to the exact requirements of the company in the way of material, equipment, etc. Everything will be purchased in the United States. It is expected that the initial equipment of the road will result in an expenditure of at least $1,000,000. Mr. Teele will, according to present arrangements, return to New York inside of three weeks, when it is anticipated contracts will be given out. Mr. W. E. Plummer, whose office is in the Cable Building, 621 Broadway, has been appointed purchasing agent of the Trinidad Company.

VARIOUS FOREIGN AND DOMESTIC ORDERS FOR CRANE PIPING, ETC.—The Crane Company, of Chicago, has recently secured a contract calling for the shipment of some $20,000 worth of pipe, etc., for use in the Russian Government mines in Siberia. The pipe varies from 4 inches to 24 inches in diameter. The company is also turning out a $10,000 lot of pipe, valves and fittings, which will be installed in an electrical plant at Lima, Peru, the entire contract for the equipment of which has been allotted to the General Electric Company. Domestic contracts secured within the last week comprise orders from the Harrisburg Traction Company, the Cincinnati Electric Traction Company, the Boston Elevated Railroad Company, the Houston (Texas) Street Railway Company and the Pennsylvania Traction Company. These orders call for an aggregate of about $80,000 worth of pipe, valves and fittings to be installed in new plants.

CONTRACTS FOR EXTENSION OF MEXICO TRAMWAYS.—Mr. A. E. Worswick, resident manager of the Compania Limitada Tranvias de Mexicana, of the City of Mexico, has left New York *en route* for the Mexican capital. While here he placed some substantail orders for equipment necessary for an extension of the system to Toluca, a suburb about 11 miles distant from the city. The St. Louis Car Company secured a contract for cars, which are to have trucks manufactured by the J. G. Brill Company, of Philadelphia, and motor equipments built by the General Electric Company. The Morris Electric Company, of 15 Cortlandt Street, is reported to have been allotted an order for various supplies representing an aggregate value not far short of $50,000.

GOOD OPENING FOR MACHINERY IN SPAIN.—Mr. Carlos Yensen, of Bilboa, is at present inquiring here for large quantities of electrical machinery for the Spanish market. There is said to be a rapidly increasing demand for such apparatus of American manufacture in the Bilboa district, owing to the mining activity there. Within the last two months over $15,000,000 is said to have been invested for the development of various Bilboa mines. Mr. Yensen's firm, with a view to facilitate the handling of the large business in American machinery which is anticipated in the immediate future, is being converted into a joint stock company with a capital of some $1,500,000. Mr. Yensen, who was until recently United States Consular agent at Bilboa, will be managing director.

BIG BRITISH PRINTING PLANT.—Messrs. J. Upcott Gill and Alfred Bradley, who are associated together in the operation of the London & Country Printing Works, Drury Lane, London, W. C., are now in the United States for the purpose of placing contracts for American equipment to be installed in a new plant to be built on the other side by them. The projected works will, it is claimed, be the largest of their description in Great Britain, if not in Europe. Electricity will be exclusively used to operate the various machinery. Messrs. Gill and Bradley will visit Cleveland, Pittsburg, Chicago, Cincinnati and other machinery centers. They expect to return to New York early next week. Mr. Gill is the publisher of *The Bazaar, Exchange and Mart*, and various other periodicals.

MORE ELECTRICAL EQUIPMENT FOR VANCOUVER.—Mr. J. Keith Fisher, of the Pacific Coast Portland Cement Company, which, it will be recalled, is about to erect a large plant at Vancouver, B. C., for the manufacture of Portland cement, is due to arrive from Europe Oct. 23, when further orders relating to the electric equipment of the projected works will be determined on. It was stated Monday that the plant called for in the original plans will be considerably enlarged, and that fully $50,000 more will be expended in electrical machinery. The Bullock Electric Manufacturing Company, as already stated by us, have secured a contract for some $90,000 worth of generators and motors.

PROJECTED MERIDA-PROGRESO ELECTRIC ROAD.—Vales Castillo, the Merida banker, who is primarily interested in the scheme for building a 25-mile electric road between the Yucatan capital and Progreso, its flourishing seaport, has arrived from Europe, and is expected to make arrangements while here for the placing of contracts for material, equipment, etc., for the construction of that system. Mr. Castillo is staying at the Hotel Jefferson, East Fifteenth Street. He may also be reached through Felipe G. Canton, Columbia Building, 29 Broadway.

THE MANHATTAN RAILWAY COMPANY, of New York City, has awarded a contract to the Siegrist Lubricator Company, of St. Louis, Mo., to install its system of automatic lubrication for the entire power plant of 96,000 horse-power. The Siegrist system is also being installed in the De Beers Consolidated Diamond Mines Company, of Kimberly, South Africa, and the Glasgow Tramways Company, of Glasgow, Scotland, the largest plant in Great Britain.

BRILL SPECIALTIES FOR FRANCE AND ENGLAND.—The J. G. Brill Company, of Philadelphia, is about to make shipment of car wheels to the French Thomson-Houston Company for use on the Lyons Tramways. A quantity of Eureka maximum traction trucks are also about to go forward to G. F. Milnes & Co., the British car builders.

WESTINGHOUSE IN RUSSIA.—The Westinghouse interests, it is stated on good authority, are considering the advisability of erecting extensive works in St. Petersburg, with a view to the manufacturing of various electrical equipment for the Russian market.

PUMP EQUIPMENTS FOR CHINA.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, has secured a contract calling for a shipment of 15 pumping engine equipments for various uses in China. The order came through Reuter, Brockelman & Co., of Shanghai, China.

THE SPRAGUE ELECTRIC COMPANY recently held its annual meeting and re-elected the following officers for the ensuing year: John Markle, president; Edward C. Platt, first vice-president; Allan C. Bakewell, second vice-president; Harry R. Swartz, secretary and treasurer.

STILWELL FEED WATER HEATERS and purifiers have recently been supplied by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, to the Austin Rapid Transit Company, Austin, Texas; Kankakee, Ill., Electric Railway Company, and the Boonville, Ind., Electric Light & Power Company.

MUNICIPAL PLANT WANTED.—The village of Bradner, Ohio, is going to install a municipal electric light plant to cost $13,500. Mr. E. Y. Dow, of Toledo, Ohio, is the engineer. The clerk of the village is Mr. Henry Ahlf.

THE TOKIO ELECTRIC RAILWAY COMPANY is the title of a concern now being organized in Japan for the purpose of constructing and operating an electric traction system, which will be built in the various important thoroughfares of the Japanese capital.

General News.

THE TELEPHONE.

COURTLAND, ALA. An effort is being made to establish a telephone exchange at Courtland. Many of the large planters who live in this town and have plantations in the adjoining country, desire this method of communicating with their plantations.

KISSIMMEE CITY, FLA.—The Kissimmee Telephone Company has let the contract for the construction of its plant.

DUBLIN, GA.—A. I. Smith has been granted a franchise to establish a telephone exchange.

ATLANTA, GA.—The Southern Bell Telephone & Telegraph Company will erect a $30,000 addition to its building.

SAYBROOK, ILL.—A new telephone line is being built southwest of town.

LIBERTY, ILL.—The Industry Rural telephone line is now being extended from here to Augusta.

WENONA, ILL., is to have another telephone exchange put in by the Wenona Union Telephone Company.

BEASON, ILL.—The farmers south of town are building a telephone line from here through the Harmony neighborhood.

SPRINGFIELD, ILL.—The Lewiston Automatic Telephone Company, Lewiston, capital $2,000, has been incorporated by George F. Loar, Ralph Hanson and Lucien Gray.

PAXTON, ILL.—The Central Telephone & Telegraph Company has been incorporated; capital stock, $30,000. C. H. Langford, H. B. Henderson and W. B. Henderson are the incorporators.

ALTON, ILL.—The Kinloch Telephone Company has been allowed to resume work on its system in Alton, with the understanding that nothing will be done at the points where trouble arose over the setting of poles.

NEW CASTLE, IND.—The New Castle Telephone Company has been incorporated; capital stock, $30,000. The directors are William O. Mathews, Lewis Sands and W. S. Bowler.

LOGANSPORT, IND.—The Logansport Home Telephone Company has been incorporated; capital, $150,000. Directors: M. A. Jordan, Walter D. Uhl, M. B. Lairy, Sol. D. Brandt and J. F. Digan.

MARION, IND.—The City Council of Marion has granted permission to the United Telephone Company to remove its overhead wires in this city and place its wires underground. The central energy system will be adopted.

MUNCIE, IND.—The telephone war between the Central Union and the independent company that is seeking entrance to the city has become lively. Both companies are actively canvassing the city with petitions. On one petition appear the names of those who are opposed to a new telephone company, and on the other the list of those who favor its entrance.

NORTH MANCHESTER, IND.—The Eel River Telephone Company, the newly organized concern at Rochester, has awarded contracts for an up-to-date local exchange. The company will build toll lines to all surrounding towns.

INDIANAPOLIS, IND.—The Luce & Ohio Township Telephone Company has decided to issue new capital stock to the amount of $8,850, the proceeds of which will be employed in making extensions and betterments of the company's service.

INDIANAPOLIS, IND.—The Cass County Telephone Construction Company has been incorporated; capital, $60,000. Wm. J. Vesey, Charles A. Wilding, A. S. Coverdalem, S. M. Foster, Geo. W. Seybold, J. G. Powell, M. F. Mahoney and J. H. Foley are the incorporators.

LOGANSPORT, IND.—The Logansport Home Telephone Company, recently granted a franchise in this city, has begun the construction of an extensive modern plant. The contract was let to the Cass County Telephone Construction Company, and the work will be pushed to rapid completion.

ELKHART, IND.—The county officers have gone back to primitive methods of communication. None of the county offices is now to be reached by telephone; the twelve telephones that were in use, having been taken out because the County Council refused to make an appropriation to pay the rents, aggregating $24 a month.

INDIANAPOLIS, IND.—The City Suburban Telegraph Association of Ohio, with a total capital of $3,465,000, of which $13,430 is represented in this State, complied with the foreign incorporation law by filing articles of incorporation with the Secretary of State and designating E. W. Swarthout, of Aurora, Ind., as resident agent.

WEISER, IDAHO.—The Council has notified the Idaho Independent Telephone Company to begin operations here within 60 days, as provided by the franchise.

CENTERVILLE, IA.—The Centerville Telephone Company is putting in a local exchange at Mystic.

REDDING, IA.—The Farmers & Merchants' Mutual Telephone Company has been incorporated; capital stock, $2,000.

SHENANDOAH, IOWA.—A new rural telephone line is now being built from Clarinda to Page Center, and it will be extended from there to Yorktown.

ALBIA, IOWA.—The Albia Telephone Company has been incorporated; capital stock, $26,000. O. M. King, J. C. Robeson, J. S. Moon and G. M. Reiseman are the managers.

IOWA FALLS, IA.—Steps were taken looking to the organization of another rural telephone company to run a line southeast from this city to Eagle City and thence to Owasa in the center of the county.

FRANKFORT, KY.—The Jessamine Home Telephone Company has increased its capital stock from $10,000 to $30,000.

FREDERICK, MD.—The Chesapeake & Potomac Telephone Company is building a new line to Jefferson, Petersville and Brunswick, this county.

SPRINGFIELD, MASS.—Following a recent reduction in service charges, both local and long distance, the New England Telephone & Telegraph Company announces that it will install free residence telephones in the Springfield district through September and October for trial, without charge until Jan. 1.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has assumed possession of the Calhoun Telephone Company's plant at Battle Creek. Charles F. Rood, E. B. Fisher, W. J. Stuart and C. E. Torbe have been elected directors and officers.

MOUNTAIN GROVE, MO.—The Wright County Telephone Company, of Mountain Grove, has been incorporated, with a capital stock of $2,500. The incorporators are J. H. Medley, J. F. McCourt, W. C. Dugan and others.

RALEIGH, N. C.—The long-distance line from Raleigh to Newbern, N. C., will, it is stated, be completed within a few months. The system will be controlled by the Henderson, N. C., Telephone Company.

TRENTON, N. J.—The entire system of the Inter-State Telephone Company in South Jersey is to be rebuilt.

SWEDESBORO, N. J.—The Woolwich township has given the Interstate Telephone Company permission to run its lines through the township.

FORT EDWARD, N. Y.—The Hudson River Telephone Company is rebuilding its exchanges in this village and at Glens Falls.

ALBANY, N. Y.—The Southern New York Telephone Company of Albany was incorporated on Oct. 4, with a capital of $100,000 to operate a telephone line in the lower Hudson River counties, connecting Kingston, Jersey City, New York and Poughkeepsie and places between and near by that general route. Elyria, Ohio, capitalists, who have organized many telephone companies to operate in different sections of the State, are behind this company.

ST. BERNARD, OHIO.—Work has commenced on the telephone system for this place.

BATAVIA, OHIO.—The Citizens' Telephone Company, Batavia, has been incorporated; capital stock, $50,000.

SEBRING, OHIO.—The village Council of Sebring has granted a franchise to the Central Union Telephone Company.

ASHLAND, OHIO.—Work of rebuilding the local exchange has been completed and the system is now in first class order.

MANSFIELD, OHIO.—The Mansfield office of the Central Union Telephone Company has been made the headquarters of the northern division of Ohio.

AKRON, OHIO.—The United States Telephone Company is building a direct line of four circuits from Massillon to Akron, connecting at the latter place with lines to Cleveland.

ASHTABULA, OHIO.—The Ashtabula Telephone Company has declared a semi-annual dividend of three per cent, payable Nov. 1. The affairs of the company are in excellent shape.

TORONTO, OHIO.—New switchboard, cable and other equipments are being installed by the Citizen's Telephone Company, which is building exchanges at Toronto and New Cumberland.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has petitioned the Board of Public Service for the privilege of making some extensive improvements in its overhead system.

TOLEDO, OHIO.—The Central Union Telephone Company at Toledo is installing new switchboards to accommodate 10,000 subscribers. In the future the business will be divided between branch exchanges.

CLEVELAND, OHIO.—The telegraph and telephone officials of the companies in this city will confer with the city officials this week to discuss measures for placing underground all wires in the downtown section.

JEFFERSON, OHIO.—The Central Union Telephone Company is extending its service into the rural district in the vicinity of Ashtabula. A number of telephones have recently been installed in neighboring towns.

ELYRIA, OHIO.—The Seneca Falls Home Telephone Company has been incorporated in New York State, with $100,000 capital stock. Addison E. Lord, F. H. Sudro, and J. A. Make, of Elyria, Ohio, are directors in the new company.

CINCINNATI, OHIO.—A syndicate is talked of for this city, whose business it shall be to organize and conduct a company for the transmission of news by telephone to subscribers throughout the city. The afternoon papers will oppose the plan.

CLEVELAND, OHIO.—The Northwestern Telephone Company, of Aurora, Ill., in which a number of Cleveland people are interested, has declared a quarterly dividend of one per cent. The company will make numerous extensions throughout Whiteside county.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) is installing apparatus in a new exchange recently completed on Cheshire Street. It is stated that the company is doing an excellent business and is installing an average of twelve telephones per day.

PORTSMOUTH, OHIO.—The United States Telephone Company (long distance) is pushing construction work on a line from Portsmouth extending up the Ohio Valley to Gallipolis. It connects the exchanges at Ironton, and a number of small towns, and crosses over to Huntington, W. Va.

LIMA, OHIO.—The cutting over of the new system of the new Lima Telephone & Telegraph Company, which has succeeded the Lima Telephone Company, is now going on and the next few weeks will see 1200 telephones in operation in this county. The old independent company or the Bell Company never had over 700 telephones.

MANSFIELD, OHIO.—The Mansfield Telephone Company is making rapid strides in the remodeling of its exchange building and the installation of the new boards will soon be completed. This exchange will be one of the finest in Ohio. It will have 1200 lines in the city and will give connection to about 600 subscribers on farm lines and in sub-exchanges at Belleville, Butler, Lexington and other hamlets.

BOWLING GREEN, OHIO.—The Wood County Telephone Company has been organized, with a capital stock of $200,000. The directors are Captain L. Black, James Hickox and F. A. Baldwin, of this place; Mr. Morrison, of Bryan, and Mr. Woodbury, of Cleveland. The Bowling Green Telephone Company was absorbed by this company, which will at once extend its lines in this county. A large farmers' system is to be built.

CLEVELAND, OHIO.—President B. G. Hubbell, of the Consolidated Telephone Company, which is building exchanges in New York State, has returned from an eastern trip. He says that the entire issue of $382,000 in bonds of the Consolidated Company, which was announced a short time ago, has been taken up and the lists closed. Nearly all of the securities were taken up in cities in New York State, in which the company is locating exchanges.

CLEVELAND, OHIO.—It is stated that the Federal Telephone Company has added to its plants, exclusive of Cleveland and Columbus, new business to the amount of $39,090 during the month of August. If this increase is followed out during the year it would mean a total increase of $469,080. The prospects for the development of the various properties throughout Ohio is very flattering, and it is believed that much new business will be secured during the winter months.

CLEVELAND, OHIO.—The Federal Telephone Company held its annual meeting at East Orange, N. J., recently. The following directors were chosen: H. A. Everett, E. W. Moore, J. B. Hoge, R. A. Harmon, John Sherwin, Maxime Reber, H. D. Critchfield, J. B. Dill, Barney Mahler, C. W. Wason and J. B. Hanna. The board remains practically as before, the number of directors being increased from nine to eleven by the election of H. D. Critchfield and Maxime Reber. The officers will be chosen at a later meeting.

AKRON, OHIO.—A strike of the linemen on the Central Union and People's Telephone companies is assuming a serious aspect. The Central Union Company imported a number of men from Findlay, Mansfield and other points, but the strikers induced nearly all of them to return to their homes. Only about six linemen are at work in the city, and these are followed from place to place and in many cases their work is undone as fast as completed. A large number of telephones have been put out of service, and many connections tampered with.

CLEVELAND, OHIO.—The strike of electrical workers which started at Akron, is spreading. The trouble is pronounced among the employes of the Central Union Telephone Company, and its men are out at Akron, Fostoria, Mansfield, Tiffin, Alliance, Canton and Findlay. At Massillon the men were ordered to go to Akron to take the place of strikers, and upon their refusal they were discharged. At Findlay, employes of the Findlay Home Telephone Company went out because thirty linemen were temporarily laid off because of non-delivery of material.

CLEVELAND, OHIO.—The Inter-State Telephone Company, which is the long-distance department of the Consolidated Telephone Company, of this city, is building a through trunk line from Birmingham, N. Y., to State Line, Pa. This line touches all of the independent exchanges in southern New York State, and it will connect with the lines of the United States Telephone Company, at State Line. Work on this line is being pushed, and when completed it will form part of the chief independent trunk line, connecting the western systems with the east.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has made a supplemental mortgage for $2,223,000 to the Dime Savings & Banking Company, as trustee, covering all the real estate, franchises, equipments and other personal property. J. B. Hoge, treasurer of the company, states that the filing of the mortgage was a mere formality made necessary through a slight change in the wording of the original mortgage, which was made about two years ago. The amount of the mortgage and the assignment and terms of the stocks and bonds of the company continue as heretofore.

CLEVELAND, OHIO.—Mark Davis, the retiring general manager of the Cuyahoga Telephone Company, was presented Friday of last week by his associates in the employ of the telephone company with a magnificent diamond stud. He formally severed his connection with the company on that day, and before leaving his office, he was asked to step into the corridor, where he was confronted with all of the employes at headquarters. Treasurer Hoge, of the company, made the presentation speech. Mr. Davis will make his headquarters in Cleveland, and will represent an insurance company.

CLEVELAND, OHIO.—President B. G. Hubbell, of the Consolidated Telephone Company, says the long-distance company is defendant in a peculiar law suit brought by the Bell Company at Courtland, N. Y. On a certain highway the independent company has right of way and built on one side of the road while the Bell Company occupied the other. Because of physical conditions it became necessary to cross to the other side of the road, and the independent company placed its poles up through the Bell lines and strung its wires above. The Bell Company asked for injunction, and the final hearing is to be heard at Courtland, Oct. 21. It is stated that this is the first case of the kind to be tried in the East. In Ohio a similar case has been settled in favor of the independent company, the court holding that it had the right to cross over.

CLEVELAND, OHIO.—A gentleman who is prominent in the independent telephone field gives information relative to the Frontier Telephone Company, which has just been incorporated in New York State. Although the company states in its charter that it will build long-distance lines to a number of leading cities in that State, it is not the intention to enter into competition with the Consolidated Telephone Company, of Cleveland, which is building extensive long-distance lines in New York, but simply to make arrangements to give long-distance connection for an exchange which the company proposes to build in Buffalo. The new company is backed by Judge Thomas, of New York, and E. C. Lufkin, of Fredonia. It proposes to give a portion of its gross receipts to the city, to furnish free city telephones, to furnish $50 business telephones and $36 residence connections, and to furnish bond not to sell out or consolidate with other companies.

COLUMBUS, OHIO.—The appraisement of the telephone properties of the State has been completed, with the exception of the Columbus Citizens', the Cleveland (Bell) and Cuyahoga, of Cleveland and the City & Suburban (Bell) of Cincinnati, which will be announced later. With these estimated Auditor Guilbert places the valuation at $8,183,775; last year it was $5,838,834; increase, $2,344,739. The appraisements on companies over $10,000 are as follows: Akron People's, $49,050; Ashtabula, $21,240; Bellefontaine, $14,000; Black River, $16,200; Bowling Green, $11,751; Bucyrus, $16,000; Cambridge Home, $12,000; Central District & Printing (Bell), $303,836; Central Union (Bell), $2,815,986; Delaware Citizens', $10,500; Washington C. H. Citizens', $12,000; Citizens' Telephone Message Company, $14,340; Clinton, $13,000; Columbiana County, $77,273; Conneaut, $12,500; Flyria, $17,875; Galion, $10,000; Gallipolis, $10,500; Tiffin Home, $12,000; Chillicothe Home, $20,145; Jefferson & Warren, $15,140; Lawrence, $13,000; Lima, $19,670; Massillon, $15,275; Miami, $24,180; Millersburg, Wooster & Orrville, $25,493; Mt. Vernon, $11,520; Newark, $11,860; New Harrison, $30,000; Northwestern, $10,000; Ohio Telephone & Telegraph (Bell) $601,809; Painesville, $10,500; Piqua Home, $31,500; Portsmouth, $18,600; Putnam, $11,440; Sandusky, $21,600; Sidney, $10,000; Steubenville, $16,000; Tuscarawas, $10,800; United States, $300,803; Urbana, $15,600; Warren & Niles, $20,300; Youngstown, $80,382.

PITTSBURG, PA.—A contract has been signed by James T. Doyle, for the Pittsburg & Allegheny Telephone Company, with the Union Telephone & Telegraph Company for an interchange of long-distance service in their respective territories. This opens up to Pittsburg and Allegheny and vicinity an immense territory not hitherto covered, direct communication being established with Erie, Meadville, New Castle, Mercer, Clarion, Franklin, Warren, Petroleum Center, Ellwood City, Sharon, Conneaut Harbor, Tionesta, Shenango, and other points.

UNION, S. C.—The Bell Telephone Company will construct a long-distance line from Spartansburg to Union, S. C.

ABERDEEN, S. D.—The Dakota Central Telephone Company has purchased the Eureka telephone exchange and the line from Eureka to Mound City.

GAINESVILLE, TEX.—The Southwestern Telephone Company will grant the request of the Red River Telephone Company and give a connection in Gainesville.

SALT LAKE CITY, UTAH.—The Never-Find Mining Company, of Deep Creek section, will equip its mine and mill with telephones. It will also install about 300 lights in its mine and mills.

SALT LAKE CITY, UTAH.—The Eureka-Nephi telephone cut-off is complete to Mona and the work on the Beaver line is being pushed west of Joseph. The material for the Milford and Frisco line has been ordered and General Manager Murray states that the line will be completed this fall. The Syracuse and Hopper line out of Ogden will be connected up by the middle of October. In Wyoming the work of construction is being pushed with vigor. The line south of Rollins to the Snake River country on the border of Colorado, which has for many years been notorious as a refuge for train robbers, has been completed to a point beyond Dickerson.

SALT LAKE CITY, UTAH.—Salt Lake will have an independent telephone system composed entirely of local business men, headed by S. F. Fenton, P. W. Madsen. The company has closed a deal by which it becomes the owner of the interest in the Salt Lake Home Telephone Company, owned by E. W. Hammer. The price paid for Mr. Hammer's interest is $5,000. Some time ago the Home Company was organized for the purpose of obtaining a franchise to put in an independent telephone system. The franchise was shelved by the City Council, and has never been acted upon. The new company, it is said by those interested, will try and obtain a franchise alike in almost all particulars to the one now with the Council. In the new franchise the company agrees to build an underground system and to put in an exchange large enough to accommodate 3000 subscribers. The city will be given 5 per cent. of the net receipts, and also thirty telephones free. The cost of all telephones in business houses will be limited to $48 per year and individual lines into private houses will cost $2.50 per month.

ST. ALBANS, VT.—The Addison County Telephone Company is extending its line to North Ferrisburg so as to make a Burlington connection.

SEATTLE, WASH.—The permit will soon be given out for the new telephone building of the Automatic Company. W. D. Kimball is the architect and Windham & Comb, the contractors. The cost is to be $30,550.

RACINE, WIS.—The Wisconsin Telephone Company has decided to extend its system as far as Franksville.

MANITOWOC, WIS.—The Green Bay & Lake Michigan Telephone Company has asked for a franchise in this city.

MILWAUKEE, WIS.—The extension and improvements of the telephone service of the Milwaukee Electric Railway & Light Company and the installation of the new Stromberg-Carlson system which have been in progress since May 1 will soon be completed. The commercial and dispatching systems are separate. The full capacity of the latter board will be 1500 outside telephones, but only 120 will be installed now. As it is, this nearly doubles the present capacity, which is 65 telephone stations. The commercial switchboard will be separate by day, but consolidated with the dispatcher's board at night, when the latter will attend to them both. The commercial board connects with the homes of employes, car barns and outside offices, and will not be enlarged for the present.

ELECTRIC LIGHT AND POWER.

WASHINGTON, D. C.—The District Commissioners are inviting sealed proposals until Oct. 26, for the construction of a power-house and nurse's home, with stack and equipment, on the Providence Hospital Grounds in that city.

WALLACE, IDAHO.—The electric light and water power plant in Wallace, Idaho, has been acquired by Spokane men. The new company is the Wallace Light & Water Company. It was organized by Robert E. Strahorn. The officers are: F. F. Johnson, president of the First National Bank of Wallace, president of the company; Robert E. Strahorn, vice-president and manager; E. J. Dyer, president of the Exchange National Bank of Spokane, secretary and treasurer. The directors are Robert E. Strahorn, John A. Finch and R. J. Danson. Mr. Danson is the attorney.

INDIANAPOLIS, IND. The Remey Electric Company, of Anderson, has filed articles of incorporation with the Secretary of State, capital, $10,000. B. P. Frank and I. and B. M. Remey are the promoters and officers.

ST. LOUIS, MO. The property of the Suburban Electric Light & Power Company at Webster Grove, has been leased to the St. Louis Electric, Construction & Maintenance Company, for a term of forty-one years. The Suburban Company held the contract for lighting Webster Grove, and had, previous to last Spring, lighted Kirkwood also. Last April, however, the Kirkwood Board of Aldermen put in a plant for the municipality, though the Webster Grove Company still maintains several lighting contracts with individuals and private corporations in Kirkwood. B. F. Delafield took temporary charge of the plant last week for the new company. He stated that he would make improvements in the plant at once.

GOLDSBORO, N. C. The Board of Aldermen of Goldsboro has decided to call an election on the question of issuing $110,000 in bonds, $25,000 of which will be for an electric light plant.

NEWBERN, N. C. At a meeting of the City Council it was voted to discontinue the arc street lights at the expiration of the contract. It is said, however, that the company will continue to furnish light and sue for the pay. On account of alleged bad service it was decided to hold an election on the question of establishing a municipal plant, but this failed.

WADESBORO, N. C. Samuel F. Stowe, of Charlotte, N. C., and Mr. Thurston, of Maine, have been engaged in surveying the water power at Bluitt Falls, near Wadesboro, N. C., where it is proposed to develop considerable water power. The power will be transmitted to neighboring cities. There is also some talk of constructing a street car line in Wadesboro.

COLUMBUS, OHIO. The Indianola Electric Heating & Light Company, of Columbus, has broken ground for a new power plant. The company will furnish light and heat.

SHELBY, OHIO. The electric light fund of this city has been overdrawn $12,000 because of the expense in operating the municipal lighting plant. The expenses each month exceed the receipts and the plant is plunging the village into heavy debt.

COSHOCTON, OHIO.—The Coshocton Electric Light Company has been granted a franchise for a steam heating system in the streets of the village. It will be operated in connection with the lighting plant, and $75,000 worth of new machinery is to be installed.

GENEVA, OHIO.—The Everett-Moore syndicate, which has bought out the plant of the Geneva Electric Light Company, is installing considerable new machinery and is purchasing a number of enclosed arc lamps for city lighting, the contract for which has recently been closed.

SALT LAKE CITY, UTAH.—A. L. Woodhouse and E. L. Lackneron petitioned the County Commissioners for a franchise to erect poles and wires and engage in the electric light and power business in West Mountain mining district. They represent that by securing arrangements with the Telluride Power Company they will be able to furnish lights and power from Provo Canyon to that district at a cheaper price than is now being charged, and with better service. Mr. Woodhouse is general superintendent and Mr. Lackneron attorney for the Utah division of the Telluride Company.

SPOKANE, WASH.—The County Commissioners have granted a franchise to the Washington Water Power Company to construct pole lines, etc., through the county.

THE ELECTRIC RAILWAY.

ROCHESTER, IND. The City Council has granted a franchise to the Rochester-Wabash Electric Railway Company. A franchise was also granted to the Logansport, Rochester & Northern Traction Company, granting it the right, on certain conditions, to run and operate an interurban line through Rochester. The Wabash-Rochester line is being financed by Cleveland men, and they have accepted the franchise, closed all contracts and will push work with a view of opening up a country between this city and Chicago through which no railroad operates.

INDIANAPOLIS, IND. The managers of the steam roads claim that they have a difficult problem to solve in meeting the competition of the electric roads. The Big Four has demonstrated that it does not pay to put on additional short trains and reduce the rate and has taken off six trains on the Eastern division, where it sought to compete with the Union Traction Company. The reason assigned is that these trains interfere with the operation of the freight and fast through passenger trains. The most potent reason is that the trains did not yield revenue sufficient to justify their continuance. The Pennsylvania lines on the Columbus & Louisville division have experienced the same difficulty in their endeavor to compete with the electric lines, and are about ready to discontinue their short line trains.

BALTIMORE, MD.—The Maryland Electric Railway Company, which has a charter granted in 1898 by the Maryland General Assembly, has had an ordinance introduced in the City Council granting the new company the right to construct and use electric railway tracks on many streets. Among the inducements offered are provisions that the company shall sell tickets six for 25 cents, and that the company is to pay 9 per cent of gross receipts as a park tax. Free transfers are to be issued on all its lines and for exchange with other lines.

BENTON HARBOR, MICH.—The West Michigan Traction Company, known as the Tunnel line, has accepted the franchise recently granted by the city.

RALEIGH, N. C.—The street railway line to the Union Passenger Depot at Raleigh is being torn up. For several years the cars have been operated on this line, because receipts did not meet the cost of operating.

WILMINGTON, N. C.—The Wilmington Street Railway has been sold at auction under foreclosure to Hugh MacRae & Company, of Wilmington, for $101,500. The purchasers of this line have recently secured the controlling interest in the road to Wrightesville Beach, which will be equipped electrically, and the two operated jointly. Extensive improvements may be made.

YOUNGSTOWN, OHIO.—The East Sharon Street Railway Company has been incorporated.

LORAIN, OHIO.—The Lake Shore Electric Railway has accepted the franchise recently granted in Lorain.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railroad is to be changed into an electric line.

CLEVELAND, OHIO.—The passenger receipts of the Northern Ohio Traction Company, during the month of September were $49,644.13, a gain of $10,964.59.

WARREN, OHIO.—Owing to the inability to secure teams and men the work on the extension of the Cleveland & Eastern Railway from Garrettsville to Leavittsburg is being greatly delayed.

CLEVELAND, OHIO.—The village of Collinwood has agreed to grant a franchise to the Cleveland Electric Railway Company, which will enable it to make a long contemplated extension to Nottingham.

LIMA, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has filed a mortgage for $100,000, to guarantee the construction of the section of the road between Lima and West Minister.

CANTON, OHIO.—The Everett-Moore syndicate has been balked in its attempt to secure a franchise in Canton for its proposed Akron, Massillon & Canton Railway by the action of the Council in refusing the grant.

CINCINNATI, OHIO.—Dr. Samuel F. George, president of the Fort Wayne, Dayton & Cincinnati Traction Company, is arranging for the extension of his line into Cincinnati. Dr. George is now in New York City placing the bonds.

CLEVELAND, OHIO.—Dividends were declared Oct. 5 by both the Cleveland Electric Railway Company and the Cleveland City Railway Company. The former company paid a quarterly dividend of 1 per cent and the latter of 1¼ per cent.

UPPER SANDUSKY, OHIO.—The Council at Upper Sandusky has granted franchises into town to two electric railways. One of them is the Findlay & Marion Railway and the other is the Tiffin & Southern, of which Dr. O. C. Stutz is trustee.

COLUMBUS, OHIO.—The Columbus, Grove City & Southwestern Railway Company has filed a mortgage for $250,000 to the Continental Trust Company, of New York City, covering a bond issue to that amount. The issue secures 20-year 5 per cent gold bonds.

CLEVELAND, OHIO.—The passenger receipts of the Cleveland, Elyria & Western Railway for the month of September were $27,391.66, a gain of $8,528.50 over the same period last year. The net receipts were $14,995.54, which is a large gain over last year.

CANTON, OHIO.—Work has been started at Canton on the Stark Electric Railway, which is promoted by Cleveland people. The road is practically completed from Alliance to Sebring. An extension will be built to Salem. This will give a through line from Cleveland to Salem.

COLUMBUS, OHIO.—The Board of Public Works has announced that franchises for lines through the city will be granted only to the lowest bidder. The Columbus & Southern Railway Company has just applied for a franchise and the right over the route is to be advertised for sale.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has temporarily abandoned its attempt to extend its line to Chillicothe because of the difficulty in securing right of way. The Circleville and Lancaster divisions can not be completed until next spring because of delay in securing rails.

CLEVELAND, OHIO.—Manager Allen F. Edwards, of the Detroit & Toledo Shore road, states that overhead work on the line has been started. The National Conduit & Cable Company is furnishing 20 miles of cable and the American Steel & Wire Company the wire and the copper bonds.

CLEVELAND, OHIO.—The passenger receipts of the Detroit United Railways for the month of September were $275,280.40, an increase of $39,871.34. The receipts of the Rapid Railway System, which is not at present managed as a part of the Detroit system, were $41,221.60, a gain of $3,341.70.

CINCINNATI, OHIO.—The Traction Company has shipped to Tokio, Japan, a complete set of overhead double trolley crossing devices. The shipment is a direct result of a visit paid by two Japanese gentlemen—M. Euya and Y. Kasuya, electrical experts. They visited every city of importance in the United States.

GENEVA, OHIO.—The Cleveland, Painesville & Eastern Railway has purchased a site at Geneva for a power-house for the Ashtabula extension. The syndicate also has a contract to furnish electric lights in Geneva. The locating of a power-house at Geneva indicates that the road is to be extended still further East, probably to Erie, Pa.

DAYTON, OHIO.—The Dayton, Covington & Piqua Traction Company, formerly known as the Dayton & Stillwater Valley Traction Company, has increased its capital stock from $50,000 to $1,150,000, of which $550,000 is to be 5 per cent. preferred stock. Judge Dennis Dwyer is president of the company. The road is under construction.

CLEVELAND, OHIO.—The Everett-Moore syndicate is securing right of way to extend its Detroit, Rochester, Romeo & Lake Orion line, now in operation to Flint, on to Saginaw and Bay City. This will give a line almost across the southern peninsula, and will give direct connection for Detroit to 125,000 people in these towns and vicinity.

CONNEAUT, OHIO.—Officials of the Pennsylvania & Ohio Railway state that the road will be in operation between Conneaut and Ashtabula by Nov. 1. As soon as this line is in operation, a road will be built from Ashtabula south to Jefferson which will probably be extended to Andover. The new power-house in Ashtabula will supply both lines with current.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has bought another road. This time it is the Ohio Central Traction Company, which operates a line from Bucyrus to Galion, and which has an extension to Crestline partially completed. The portion of the extension which has been completed will be utilized and the balance of the route abandoned.

FOSTORIA, OHIO.—The directors of the Toledo, Fostoria & Findlay Railway met in Fostoria, to decide on the route for the northern portion of the line to Toledo. The road will probably touch Rising Sun, Bradner and Pemberville. Construction work is to be pushed until stopped by cold weather. The road is being built by E. P. Roberts & Company, Cleveland.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate, which owns the Southern Ohio Traction Company's line, is preparing plans to consolidate that company with the Hamilton & Lindenwald Transit Company, and the Miamisburg & Germantown Traction Company. To absorb these lines it will be necessary to increase the capital stock and bonds of the Southern Ohio Company.

COLUMBUS, OHIO.—The Central Ohio Traction Company has been incorporated with $100,000 capital stock by W. F. Carr, S. H. Tolles, J. E. Morley, Reuben Hitchcock and C. H. Gale. The company proposes to build an electric line from Tiffin to Fremont.

THE AUTOMOBILE.

THE AUTOMOBILE DEPARTMENT of the American Bicycle Company entered four vehicles in the first annual race meet of the Detroit Automobile Racing Association, held at the Grosse Pointe track, Detroit, Oct. 10, 1901. The three races in which entries were made were: 5 miles for steam carriages, 1 mile open to all vehicles weighing less than 1500 lbs., and the obstacle race. In the 5-mile event the Toledo carriage secured the second place, while the two vehicles entered in the 1 mile open divided first and second honors between them. In the obstacle race the Toledo carriage scored 100 per cent. making the total Toledo winnings for the day one first and three seconds, which was the best showing made. The day previous to the race, 5 standard Toledo carriages, which were to take part in the Automobile parade in the morning, and two of which were later in the day to participate in the race, left Toledo at half-past ten, arriving in Detroit at 1:15, making the run of 63 miles in 2¾ hours. The roads part of the way were in fairly good condition, while those encountered from Trenton on were in pretty poor shape. The 5 Toledos after arrival were washed down, and with very little attention beyond application of oil to the working parts, lined up for the parade in exactly the same condition as they left Toledo. At the close of the racing for the day, two of the carriages started on the return journey to Toledo, the other three remaining until the morning following. All five reached Toledo in perfect condition.

NEW INDUSTRIAL COMPANIES.

THE UNITED STATES ELECTRIC CLOCK COMPANY, of New York City, has been incorporated, with a capital of $500,000. Among the directors are William M. Townsend, Joseph Delafield and Edward A. Siegel, of New York City.

THE ELECTRICAL INVESTMENT COMPANY OF INDIANA, a Ft. Wayne company, has filed articles of incorporation, with $100,000 capital stock. The company proposes to buy bonds and stocks of electric companies and assist in the financing of electric railways. All of the incorporators are Ft. Wayne men, the board of directors being headed by Louis Fox.

OBITUARY.

MR. J. LEE JUDSON.—We regret to note the death of Mr. J. Lee Judson, of Rochester, in that city. He was born in 1847 at Cincinnati. After pursuing the manufacturing interests established by his father, he became one of the founders of the Edison Lighting Company, of Rochester, and its president. Upon the consolidation of the various lighting interests in that city, he was made president of the Rochester Gas & Electric Company, which has been very successful under his management. He was of late actively engaged in the plans to increase the supply of electric power from Genesee water storage, etc. He was prominent in the business, social and intellectual life of Rochester, and his death is deeply regretted. He leaves a widow and five children.

EDUCATIONAL.

EVENING TRADE SCHOOLS.—The Springfield, Mass., evening school of trades is said to be the first school to be established in this country for the teaching of trades at public expense. The character of the teaching is strictly technical, and the men employed in teaching are practical mechanics of the highest order, and bring to their work an expert knowledge of the needs of the shop world. Instruction is given in machine shop practice and tool making, in joinery and pattern making, and in plumbing. In connection with these classes there are classes in mathematics for mechanics. Certificates of proficiency will be awarded to those who complete the course satisfactorily. The announcement of classes for the present season show the courses to be very practical. Residents of Springfield receive free tuition, but non-residents are required to pay a tuition fee, the term covering 21 weeks. Mr. Charles F. Warner is the principal of the Mechanic Arts High School, Springfield.

NEW YORK TRADE SCHOOL.—Beginning with Nov. 1, and every alternate Friday evening thereafter until March 14, 1902, lectures for journeymen electrical workers will be given at the New York Trade School, First Avenue, between 67th and 68th Streets, New York. The lecturer is Mr. Arthur A. Hamerschlag. The course embraces ten lectures on subjects that will be helpful to the journeyman in his daily work. Problems of common occurrence will be discussed and explained, accompanied by practical demonstrations. A course of ten lectures will also be given under the same auspices and by the same lecturer for the benefit of journeymen steam engineers. The lectures will be given every alternate Wednesday evening, beginning with Oct. 23, and ending March 5, 1902. The subjects, as outlined in the announcements of these two courses, are of the most practical kind. The object of these lectures is not to make them a financial success, but to engage and interest journeymen in new development in connection with their work.

PERSONAL.

MR. J. M. GRAVES, of Philadelphia, has just accepted a position as electrical and mechanical engineer for the Chicago Insulated Wire Company, of Chicago.

SIR CHRISTOPHER FURNESS, the leading English shipowner, and now one of the directors of the London underground, is visiting this country studying the traction situation.

MR. C. W. MORSE, the new "independent" telephone capitalist, has also been investing heavily in New York banks, and has just secured control of the National Broadway Bank, a well known institution.

MR. H. C. ADAMS, JR., has resigned his position as secretary of the Phillips Insulated Wire Company and on Nov. 1 will assume new duties as New York manager for the Peru Electric Manufacturing Company.

MR. FRANK J. SPRAGUE contributed to the *Engineering Magazine* for October a most interesting and valuable article on the "Rapid Transit Problem in London." It has now been issued in neat pamphlet form.

MR. A. J. WURTS, of the Westinghouse Electric & Manufacturing Company, who has made the subject peculiarly his own, lectured on the Nernst lamp on Oct. 16, before the Franklin Institute, Philadelphia. The lecture was accompanied by a display of the lamps and of their constituent parts.

MR. A. H. POTT, who has been for some few months in this country representing the engineering firm of Preece & Cardew, and has been investigating electric railway practice, spent last week at the American Street Railway Convention, and then sailed for London. Mr. Pott won many friends and made many acquaintances while in this country.

PROF. S. H. SHORT, technical director, English Electric Manufacturing Company, is in this country on a brief trip, accompanied by Mrs. Short. He was a greatly interested visitor to the Street Railway Convention and a warmly welcomed guest at the annual banquet. Prof. Short reports great activity on the part of his company in the production of electric railway apparatus.

MR. L. B. STILLWELL, the well known electrical engineer, has in connection with his work for the New York Rapid Transit Subway Construction Company the official title of electrical director, as he had at the Niagara power plant. Associated with him as mechanical engineer is Mr. John Van Vleck, lately prominent on the engineering staff of the New York Edison Company.

PROF. R. A. SMART has resigned his position in the Department of Experimental Engineering of Purdue University at Lafayette, Ind., and connected himself with B. F. Sturtevant Company, of Boston, Mass., with whom he will become the head of a department of experimental engineering which is being established for the purpose of investigating all problems relating to blower practice and of developing new and more efficient applications of the fan-blower in all lines of industry.

MR. Z. S. HOLBROOK has resigned as president and director of the Massachusetts Telephone & Telegraph Company, and also as vice-president and director of the Boston & New York Telephone & Telegraph Company, in order to accept the presidency of the American Electrolytic Company. This last company has purchased of the National Salt Company its immense plant at Rock Glen, N. Y., and will at once begin the manufacture of caustic soda bleaching powder and allied products.

MR. JAMES FERGUSON, formerly general superintendent of the Municipal Electric Light Company, Brooklyn, N. Y., and later superintendent with the Edison Electric Illuminating Company, has accepted the position of general superintendent and consulting engineer of the McRoy Clay Works, of Brazil, Ind. Conduit work is at once a growing and important branch of electrical engineering, and Mr. Ferguson's new field of manufacturing and installation affords an excellent field for his experience and ability.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is pushing Adams-Bagnall 3½-ampere arc lamps for all circuits, to meet gas or gasolene competition.

THE ABBOTT ELECTRIC & MANUFACTURING COMPANY, of Cleveland, manufacturer of electrical specialties, will soon remove to Warren, Ohio, where the business will be expanded and new lines produced.

MACHINE TOOLS.—The line of high grade machine tools manufactured by the Springfield Machine Tool Company, Springfield, Ohio, is described and illustrated in a pamphlet just issued by this company. Specifications of the various machines are given, together with a cable code to facilitate ordering by cable or telegraph.

MILLING MACHINES.—Kempsmith millers are described and very artistically illustrated in a 56-page pamphlet issued by the Kempsmith Manufacturing Company, Milwaukee, Wis. The front cover is a very handsome example of the engraver's art.

TELPHERAGE.—Various applications of the system of the United Telpherage Company, New York, are described and illustrated in a 16-page circular just issued by the company. The advantages to be derived in the use of the system in factories are also pointed out.

REMOVAL NOTICE.—The H. P. Cameron Electrical Manufacturing Company has moved its business from Syracuse, N. Y., to Ansonia, Conn., where it will be better able to serve its customers. In addition to its business in general commutator work and supplies it is equipped with facilities to rewind armatures and execute all kinds of repairs.

I. P. FRINK, 551 Pearl Street, New York, reports a fresh importation of fine French silk and velvet flowers, used for decorative purposes on electric lamps. Mr. Frink has not been able to get any of these for some time, but now has a fine assortment on hand, in poppies, fleur de lis, and roses, in a good variety of colors—all the delicate tints of old rose, pink, yellow, lavender, red, etc.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, exclusive territorial agent for the Adams-Bagnall enclosed arc lamps, state it is meeting with great success with its constant current series enclosed lamps. This lamp has a solid copper, weather-proof case, which renders it practically impervious to all attacks of the elements. Descriptive matter, prices, etc., will be mailed on application.

A "SOLID" RECEIVER.—Wm. J. Murdock & Company, Chelsea, Mass., make telephone receivers styled "solid" receivers. The title would imply that these instruments are substantially built and made for heavy service, and it appears from a folder issued by the firm that the receivers possess these features to an eminent degree. The firm makes two styles, the Bell and the watch case, both of which are illustrated in section and perspective.

MR. A. L. DYKE, the pioneer automobile supply and parts dealer, of Linmar Building, St. Louis, informs us that his new 50-page catalogue is now ready for distribution. He regards this as the most complete catalogue which has yet been issued. It contains sectional views and illustrations of three types of gasoline machines, and two styles of steam machines, together with full description of Dyke's carburetter, coils, plugs, batteries, etc. A stamp gets one.

ENLARGING FACTORY.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., informs us that, owing to the rapid growth of its business, it has been compelled to increase its manufacturing facilities. It has added a new building to its Milwaukee factory, which gives additional floor space of 8000 square feet, making the total space of the factory about 55,000 square feet, all of which is devoted exclusively to the manufacture of rheostats and circuits breakers.

TOLEDO TELEPHONE PLANT.—We have been requested by the Sterling Electric Company, of Lafayette, Ind., to state that the entire Toledo telephone contract, as noted in our issue of Oct. 12, was awarded to it, and that no part of the contract went to the Kellogg Switchboard & Supply Company, as was stated in the earlier news items on the subject. The first and only award, President Cook says, was to the Sterling Company.

LEATHER BELTING.—A catalogue and price list of 112 pages has just been brought out by the Charles Munson Belting Company, Chicago, Ill. It contains many illustrations showing the process of belt manufacture, belt accessories, pulleys, etc., besides giving some practical hints and suggestions regarding the use of leather belts, and general tables for calculations. The catalogue is very complete, and includes copies of many testimonial letters and a long list of names of concerns using Munson belts. It also contains a concise telegraph code.

THE WAGNER ELECTRIC MANUFACTURING COMPANY has recently developed an interesting field of application for its single-phase motor generator sets in the mining industry. These sets, made up of single-phase induction motors driving compound-wound, direct-current generators, are being extensively used for supplying direct current to electric drills from high tension multiphase alternating current distribution systems. Such an equipment calls for one transformer only, stepping down from 10,000 or 20,000 to 200 volts alternating, at which pressure the single-phase induction motor operates. The equipments are compact, automatic in their operation, and thoroughly reliable.

GOLD MEDAL FOR HOLOPHANE.—In the list of Pan-American awards printed in this issue is note of a gold medal to the Holophane Glass Company. The "Holophane" globes are attracting universal attention and elicit high encomiums. They were awarded the John Scott medal by the Franklin Institute "for giving much better diffusion and more satisfactory distribution than any other globes known," and at Paris, two gold medals were secured for scientific accuracy of calculations and excellency of workmanship and quality of glass," as well as "the best light diffusing and [illegible] for electricity and gas." At that Exposition they also secured a silver medal for valuable improvements in lighting appliances."

CABLE TESTING APPARATUS FOR TELEPHONE COMPANIES.—The larger telephone companies recognize the fact more fully than ever before that it is necessary to make frequent tests of insulation and capacity to determine whether their cable systems are in proper condition. Morris E. Leeds & Company, of Philadelphia, working in conjunction with Mr. Henry W. Fisher, of the Standard Underground Cable Company, Pittsburg, have brought out a series of cable testing outfits that have been most highly prized by such telephone engineers as have had opportunity to use them. Not only the independent telephone companies are installing these outfits, but some of the big Bell subcompanies have made similar investments. Recently Mr. James G. Biddle, of Philadelphia, who is sole selling agent for Morris E. Leeds & Company, took important orders for cable testing equipments from the Keystone Telephone Company, Philadelphia, and the Interstate Telephone Company, Trenton, N. J. The apparatus purchased by these companies is fully described in special Catalogue 360, which can be obtained without charge by addressing Mr. Biddle.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 8, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

683,515. CONDUCTOR CLEANER AND CARRIER; A. H. Stewart, Nashville, Tenn. App. filed July 3, 1901. A device for removing material from overhead conductors consisting of a carriage adapted to travel on the conductor and carry a torch and a knife. (Issued Oct. 1.)

683,924. ELECTRIC ELEVATOR SYSTEM; E. M. Fraser, San Francisco, Calif. App. filed July 20, 1899. Two motors are connected with the car in such a way that when they are both running at same speed, the car will remain stationary. The speed of either motor is altered from the car by short-circuiting the current through a portion of the field to cause the car to travel either up or down.

683,927. TROLLEY SWITCHING DEVICE; F. W. Garrett, Johnstown, Pa. App. filed Dec. 3, 1900. The trolley pole is swung laterally slightly by the motorman, to cause the wheel to move from one rib to the other of a switch.

683,936. MOTOR CONSTRUCTION; G. H. Hill, Glenridge, N. J. App. filed Aug. 5, 1901. The bolts securing the field coil between the arms of the yoke pass through open slots in the end of the yoke, so that the coil can be removed without entirely withdrawing the bolts.

683,952. TELEPHONE TRANSFORMER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 646.)

683,953. TELEPHONE TRANSFORMER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 646.)

683,954. TELEPHONE TRANSFORMER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 646.)

683,962. METHOD OF MAKING CALCIUM CARBID; H. Maxim, New York, N. Y. App. filed Jan. 25, 1895. (See page 647.)

683,969. TELEPHONE EXCHANGE SYSTEM; W. E. McCormick, Chicago, Ill. App. filed Dec. 6, 1899. (See page 646.)

683,982. INCANDESCENT LAMP ATTACHMENT; G. D. Pogue, St. Louis, Mo. App. filed April 29, 1901. A dimming attachment comprising an artificial resistance which is operated by the act of screwing the lamp into the socket to a greater or less extent.

684,007. CIRCUIT PROTECTOR; A. Stromberg, Chicago, Ill. App. filed Oct. 11, 1900. (See Current News and Notes.)

684,032. PROCESS OF MANUFACTURING OBJECTS FROM ASBESTOS; Adolf Wunsche, Charlottenburg, Germany. App. filed July 20, 1901. (See page 647.)

684,049. PLATE SEPARATING DEVICE FOR ELECTROLYTIC TANKS; E. G. Elliott and V. Kishner, Perth Amboy, N. J. App. filed Dec. 24, 1900. (See page 647.)

684,083. SELF-REGULATING SYSTEM FOR ELECTRIC LIGHT AND POWER; M. Moskowitz, Brooklyn, N. Y. App. filed March 16, 1901. In a car-lighting system wherein the dynamo is driven from the axle, the field magnetism of the motor which drives the exciter of the generator is varied to correspond with variations in the armature current of the generator.

684,090. FUSE PLUG; C. D. Platt, Bridgeport, Conn. App. filed April 27, 1901. Details.

684,092. TERMINAL FOR ELECTRIC LAMP GLOWERS; H. N. Potter, Gottingen, Germany. App. filed Aug. 9, 1899. (See Current News and Notes.)

684,093. HEATER FOR ELECTRIC LAMP GLOWERS; H. N. Potter, Gottingen, Germany. App. filed Aug. 14, 1899. (See Current News and Notes.)

684,094. HEATER CUT-OUT FOR ELECTRIC LAMPS; H. N. Potter, Pittsburg, Pa. App. filed Feb. 14, 1901. (See Current News and Notes.)

684,111. TELEPHONE EXCHANGE SYSTEM; C. E. Scribner and J. L. McQuarrie, Chicago, Ill. App. filed Jan. 29, 1900. (See pages 645-646.)

684,114. SWITCH FOR ELECTRIC CONDUCTORS; T. B. Shaffer, Westmoor, Pa. App. filed July 23, 1901. Details.

684,122. TROLLEY; G. H. Spafford, Baltimore, Md. App. filed March 13, 1901. Details.

684,133. ELECTRIC TROLLEY CONSTRUCTION; E. G. Thomas, Cambridge, Mass. App. filed April 18, 1901. A flat trolley wire twisted to bring its width in a vertical direction to engage with the supporting clips.

684,136. TROLLEY WHEEL SUPPORT; C. Tochterman, Brooklyn, N. Y. App. filed March 8, 1901. The wheel has a certain lateral movement controlled by springs.

684,165. METHOD OF REGULATING ELECTRIC CIRCUITS; M. H. Baker, New York, N. Y. App. filed Sept. 5, 1899. (See Current News and Notes.)

684,166. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed March 12, 1900. Renewed March 9, 1901. (See Current News and Notes.)

684,167. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed March 21, 1900. Renewed March 9, 1901. (See Current News and Notes.)

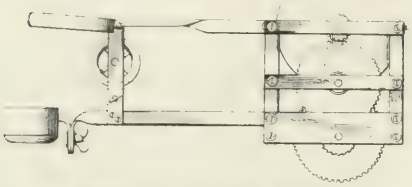
684,168. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed March 21, 1900. Renewed March 9, 1901. (See Current News and Notes.)

684,169. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, Newark, N. J. App. filed March 23, 1901. (See Current News and Notes.)

684,18[illegible]. APPARATUS FOR BLEACHING ANIMAL OR VEGETABLE FIBER AND FABRIC MADE THEREFROM; F. J. Briggs, Everett, Mass. App. filed Jan. 17, 1901. (See page 647.)

684,188. BRUSH HOLDER; J. Bruke, Berlin, Germany. App. filed Nov. 2, 1899. Details.

684,194. SIGNAL FOR TELEPHONE TRUNK LINES; Henry M. Crane, of New York. App. filed Feb. 25, 1901. Provides means whereby the supervising operator at the A board may reset the ringing-signal to order the incoming trunk operator to ring again, thus avoiding taking up the time [illegible]



684,[illegible]. Conductor Cleaner and Carrier

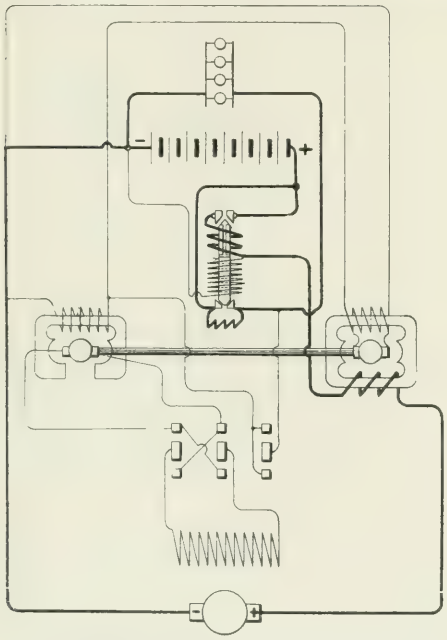
684,[illegible]. LOCK-OUT DEVICE FOR TELEPHONE SYSTEMS; Alfred Durbin, of McConnelsville, Ohio. App. filed Feb. 13, 1901. Provides means by which all the parties upon the line of a selector system except the central office and the subscriber or the two connected subscribers are prevented from using the line when the device is operated.

684,204. REVERSIBLE GALVANIC BATTERY; Thos. A. Edison, Llewellyn Park, N. J. App. filed Oct. 31, 1900. (See page 647.)

684,205. REVERSIBLE GALVANIC BATTERY; Thos. A. Edison, Llewellyn Park, N. J. App. filed June 20, 1901. (See page 647.)

684,222. TERMINAL FOR ELECTRIC LAMP GLOWERS; F. M. Goddard, Pittsburg, Pa. App. filed July 20, 1899. (See Current News and Notes.)

684,[illegible]. ELECTROMEDICAL DEVICE; G. Graybill, York, Pa. App. filed [illegible]



684,083. Self-Regulating System for Electric Light and Power.

March 6, 1901. The electrode of absorbent material is connected with a reservoir of medicine so that the current and the medicine can be simul[illegible] applied to the body.

684,229. GLOWER FOR INCANDESCENT LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed March 24, 1899. (See Current News and Notes.)

684,230. GLOWER TERMINAL FOR ELECTRIC INCANDESCENT LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed Sept. 27, 1899. (See Current News and Notes.)

684,255. ELECTRIC CABLE HANGER; G. W. Hughes, Philadelphia, Pa. App. filed [illegible] A loop of sheet metal having its ends brought together and bent back upon themselves to reinforce the part which receives the supporting hook.

684,[illegible]. ELECTRICAL APPARATUS FOR BODY WEAR; J. Kornitzer, Socorro, Territory of New Mexico. App. filed Aug. 12, 1901. Details.

684,274. AUTOMATIC LIGHTING SYSTEM FOR TELEPHONE STATIONS; Frederick Edward Lister, of Minneapolis. App. filed Jan. 14, 1901. Provides means for automatically switching on and off light in telephone booth by means of switchhook on which telephone directory is hung.

684,289. SIGNAL FOR TELEPHONE SWITCHING SYSTEMS; Frank R. McBerty, of Evanston, Ill. App. filed Jan. 26, 1899. A system of signals for use in connection with call distributing systems to indicate to distributing operators whether a multipled trunk line is busy or not.

684,291. CATHODE PLATE; W. A. McCoy, Perth Amboy, N. J. App. filed Sept. 14, 1900. (See page 647.)

684,296. ELECTRIC FURNACE; W. Nernst, Gottingen, and L. Glaser, Coburg, Germany. App. filed July 6, 1900. (See page 647.)

684,303. ELECTRIC TELEPHONE SYSTEM; William E. Pembleton, of Wittenberg, Wis. App. filed Jan. 18, 1901. A device for eliminating resistance of the coils of magnets, bells and generators from the talking circuits of electric telephone systems.

684,315. MULTIPLE SWITCHBOARD SYSTEM; C. E. Scribner, of Chicago. App. filed Oct. 19, 1891. This patent, issued nearly ten years after the date of application, covers a system whereby the line drops, shunted by a low-resistance high impedance clearing out drop, fails to respond to a call signal sent after connection has been established; the necessity for contact points in the jacks being consequently done away with. The extensive adoption of relay switchboards makes this invention practically obsolete.

684,316. MULTIPLE SWITCHBOARD SYSTEM; C. E. Scribner, of Chicago. App. filed Feb. 11, 1892. Another invention in multiple switchboard systems rendered obsolete by the adoption of the relay board.

684,317. TELEPHONE EXCHANGE APPARATUS; C. E. Scribner, Chicago. Application filed March 24, 1890. Renewed May 9, 1893.

684,326. VACUUM ELECTRODE FOR THERAPEUTIC PURPOSES; R. H. Wappler, New York, N. Y. App. filed March 5, 1901. A glass electrode, hollow and containing a vacuum chamber, is adapted to be adjusted to a metallic handle.

684,332. CONTROLLER HANDLE; E. A. Wildt, Scranton, Pa. App. filed Feb. 27, 1901. The handle is locked at each step, and must be unlocked before it can be moved onward.

684,338. SYSTEM OF ELECTRICAL DISTRIBUTION; H. J. Gille, St. Paul, Minn. App. filed Nov. 15, 1900. A number of sources of electrical energy, a series of bus bars of uniform potential each connected to one pole of one source of energy, a neutral bus-bar connected with the remaining pole of each source of energy, one or more three-wire translation circuits, the neutral conductor of which is connected to the neutral bus bar and means for connecting the external conductors of said translation circuit or circuits respectively with pairs of said bus bars.

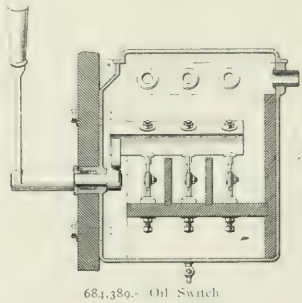
684,340. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed March 21, 1900. (See Current News and Notes.)

684,341. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed May 11, 1900. (See Current News and Notes.)

684,342. REGULATING DEVICE FOR ARC LAMP CIRCUITS; M. H. Baker, New York, N. Y. App. filed March 12, 1900. Renewed March 9, 1901. (See Current News and Notes.)

684,351. ELECTROTHERAPEUTIC INSTRUMENT; A. W. Pourtney and J. S. Mead, Buffalo, N. Y. App. filed Dec. 19, 1900. A device for passing current through the male genital organ.

684,366. TELEPHONE EXCHANGE APPARATUS AND CIRCUIT; Georg Grabe and Lupa Polnikowsky, of Berlin. Application filed May 25, 1901.



684,389.- Oil Switch

Covers method of locking call signal on multiple board with electro magnetic signals.

684,373. TROLLEY GUARD; R. Inglis and E. Wilks, Jersey City, N. J. App. filed Aug. 3, 1900. Details.

684,376. STORAGE BATTERY; Levi W. Lombard, of Boston, Mass. App. filed Nov. 15, 1900. A series of separately formed strips of trough shape are united together in the form of a plate, the strips having a series of fine longitudinal corrugations. The spaces between the troughs are occupied by active material.

684,378. ELECTRIC LAMP; H. N. Potter, Pittsburg, Pa. App. filed Feb. 14, 1901. (See Current News and Notes.)

684,389 OIL SWITCH; J. H. Vail, Philadelphia, Pa. App. filed Dec. 28, 1900. Details.

684,391. POROUS CUP; S. De Ayola, New York, N. Y. App. filed May 1, 1901. (See page 647.)

Awards at the Pan-American Exposition.

We present below a list of recompenses adjudged to exhibitors at the Pan-American Exposition, Buffalo, as determined by the various Juries of Award, and embracing those of interest to our readers in the various fields of electricity, transportation, mechanics, liberal arts, etc.

It may be stated that the exhibits at the Exposition were grouped in 17 divisions, and that in all 7000 exhibits were examined and reported upon, while 150 persons well-known in the arts and sciences served upon the juries under the general direction of a superintendent of awards. The work of these juries was supplemented by that of a Superior Jury, which included about 40 persons, who reviewed the work of the separate juries, determining finally and without appeal the order of merit of the awards .

It should be noted in passing that a considerable number of exhibitors, some of them amongst the largest and best-known corporations and individuals in the country, did not compete for awards by submitting their exhibits to the jury, a fact which should be borne in mind in view of the absence of such names from the list. Four classes of awards were offered the exhibitors, viz., diplomas of gold medals, diplomas of silver medals, diplomas of bronze medals, diplomas of honorable mention.

Several of the Government departments come in for special mention in the report of a special jury. Particular attention is called in it, for example, to the Patent Office, and amongst the machines included in the exhibit there are mentioned the telautograph and the electrograph. In the exhibit of the War Department special attention is called to the display by the Signal Corps, and it is noted that the apparatus for wireless telegraphy added much to the attractiveness of the space by its daily demonstrations.

Altogether, the work done by Dr. Henry S. Pritchett, superintendent of awards, appears to have been put through with promptness and carefulness and absolute fairness. This early publication of the list of awards is a subject for high commendation.

DIVISION VIII.—MINES AND METALLURGY.

EXHIBITORS HORS CONCOURS.

Massachusetts Institute of Technology, Boston, president of Institute chairman of superior jury.

GOLD MEDALS.

American Steel & Wire Company, Chicago, Ill., steel and finished steel products.

Acheson, Edward G., Niagara Falls, artificial graphite and carborundum.

SILVER MEDALS.

Baker & Co., Newark, N. J., platinum metals and products.

Johns Manufacturing Company, H. W., New York City, exhibit showing evolution of asbestos.

Michigan College of Mines, Houghton, Mich., collective exhibit of ores, minerals and photographs illustrative of the mineral resources of Michigan.

BRONZE MEDALS.

McKenna Brothers, Pittsburg, Pa., laboratory ore grinder.

Sills-Eddy Mica Company, New York City, samples of mica mined in United States.

DIVISION IX.—MACHINERY.

JURORS.

Ira N. Hollis, chairman; Luis de Arozarena, William L. Aughinbaugh, R. C. Carpenter, Mortimer E. Cooley, E. G. Fischer, Charles T. Higginbotham, Emique Lanz, Cecil H. Peabody, Perry Benjamin Pierce, H. W. Spangler, Frederick A. Tennant.

GOLD MEDALS.

UNITED STATES.

Alberger & Son, J. L., Buffalo, 125-hp Buffalo tandem gas engine.

American Steam Gauge & Valve Manufacturing Company, Boston, steam gauges and engine fittings.

American Tool Works Company, The, Cincinnati, Ohio, radial drill.

American Tool Works Company, The, Cincinnati, Ohio, lathe.

American Tool & Machine Company, Boston, Mass., centrifugal machine.

Acme Machine Screw Company, Hartford, Conn., multiple spindle automatic screw machine.

American Steel & Wire Company, Chicago, diamond dies for drawing wire.

Buffalo Forge Company, Buffalo, steam engines.

Buffalo Forge Company, Buffalo, blowers and fans.

Bullard Machine Tool Company, The, Bridgeport, Conn., turret and engine lathe.

Bullard Machine Tool Company, The, Bridgeport, Conn., boring mill.

Bement, Miles & Co., Philadelphia, steam hammer.

Becker-Brainard Milling Machine Company, Hyde Park, Mass., vertical milling machine.

Carborundum Company, The, Niagara Falls, N. Y., carborundum.

Cincinnati Machine Tool Company, The, Cincinnati, Ohio, upright drill.

Cincinnati Milling Machine Company, Cincinnati, Ohio, universal milling machine.

Cleveland Twist Drill Company, Cleveland, Ohio, twist drills, reamers and cutters.

Cleveland Machine Screw Company, Cleveland, Ohio, automatic turret lathe and chucking machine.

Cleveland Machine Screw Company, Cleveland, Ohio, worm milling machine.

Fayerweather & Ladew, New York City, Hoyt Brand leather belting.

Ferracute Machine Company, Bridgeton, N. J., stamping machinery.

Gray Company, The G. A., Cincinnati, Ohio, planers (metal).

Heald & Son, L. S., Barre, Mass., American twist drill grinders.

Jenkins Brothers, New York City, steam and water valves.

Jenkins Brothers, New York City, Jenkins 96-sheet packing.

Lunkenheimer Company, The, Cincinnati, Ohio, valves, lubricators and engine fittings.

Long & Allstatter Company, Hamilton, Ohio, power punching and shearing machine.

Lodge & Shipley Machine Tool Company, The, Cincinnati, Ohio, engine lathe.

Marinette Iron Works Manufacturing Company, Marinette, Wis., Walrath gas engine, 125 horse-power.

Mietz, August, New York City, kerosene engine.

Morse Twist Drill & Machine Company, New Bedford, Mass., machine tools.

Niles Tool Works Company, The, Hamilton, Ohio, boring and turning machines.

National Meter Company, New York City, water meters.

National Meter Company, New York City, gas engines.

Otto Gas Engine Works, Philadelphia, Pa., gas engines.

Pond Machine Tool Company, The, Plainfield, N. J., planer.

Pratt & Whitney Company, Hartford, Conn., drills, reamers, cutters and measuring tools.

Pratt & Whitney Company, Hartford, Conn., profiling machine.

Pratt & Whitney Company, Hartford, Conn., double-head milling machine.

Robins Conveying Belt Company, New York City, belt conveyor.

Rodney Hunt Machine Company, Orange, Mass., waterwheels and pumps.

Reeves Pulley Company, Columbus, Ind., variable speed transmission.

Roebling's Sons Company, John A., Trenton, N. J., power transmission (wire rope).

Roebling's Sons Company, John A., Trenton, N. J., wire.

Straight Line Engine Company, The, Syracuse, N. Y., steam engine.

Schieren & Co., Charles A., New York City, "Bull's Head" Electric and "Royal Extra" brands leather belting.

Struthers, Wells & Co., Warren, Pa., 300-hp gas engine.

Starrett Company, The L. S., Athol, Mass, mechanical tools.

White Company, The O. C., Worcester, Mass., appliances for shop lighting.

Wilmarth & Morman Company, Grand Rapids, Mich., drill-grinding machine.

Warner & Swasey Company, The, Cleveland, Ohio, hollow hexagon turret lathe.

Washburn Shops, The, Worcester, Mass., drill grinders.

Worthington, Henry R., Brooklyn, N. Y., jet condenser.

Walworth Manufacturing Company, Boston, Mass., valves, fittings and tools.

SILVER MEDALS.

UNITED STATES.

American Steel & Wire Company, Chicago and New York City, cold-drawn shafting.

American Blower Company, Detroit, Mich., fans and blowers.

Ames Iron Works, Oswego, N. Y., automatic steam engines.

American Roller Bearing Company, Boston, Mass., roller bearings.

Ball Engine Company, Erie, Pa., steam engine.

Buffalo Forge Company, Buffalo, punches, shears and forges, induced draught, blacksmiths' drills.

Bradford Machine Tool Company, Cincinnati, Ohio, engine lathe with turret attachment.

Bement, Miles & Co., Philadelphia, vertical milling machines.

Burt Manufacturing Company, Akron, Ohio, oil filters.

Bliss Company, E. W., Brooklyn, N. Y., sheet-metal stamping and drawing machines.

Bickford Drill & Tool Company, Cincinnati, Ohio, radial and multiple drill.

Cameron Steam Pump Works, A. S., New York City, steam and air pumps.

Chicago Pneumatic Tool Company, Chicago, pneumatic tools and appliances.

Cincinnati Planer Company, Cincinnati, Ohio, spur-gear planers.

Foos Manufacturing Company, The, Springfield, Ohio, gas and gasoline engines.

Foos Manufacturing Company, The, Springfield, Ohio, attrition grinding mills and crushers.

Green Fuel Economizer Company, The, Matteawan, N. Y., fuel economizer.

Gisholt Machine Company, Madison, Wis., tool grinders.

Gisholt Machine Company, Madison, Wis., turret lathes.

Hazard Manufacturing Company, Wilkesbarre, Pa., wire rope.

Heald & Son, L. S., Barre, Mass., American lathe center grinder.

Heald & Son, L. S., Barre, Mass., sash trimmers.

Jenkins Brothers, New York City, Jenkins pump, valves and disk.

Lane & Bodley Company, The, Cincinnati, Ohio, Corliss steam engine.

Norton Emery Wheel Company, Worcester, Mass., "Bath" machine indicators.

Niles Tool Works Company, The, Hamilton, Ohio, radial drills.

Prentiss Tool & Supply Company, New York City, general arrangement of exhibit of machine tools.

Pratt & Whitney Company, Hartford, Conn., automatic turret lathes.

Pratt & Whitney Company, Hartford, Conn., compound boring machine.

Pratt & Whitney Company, Hartford, Conn., automatic toolmakers' lathe.

Standard Tool Company, The, Cleveland, Ohio, twist drills, reamers, milling cutters and taps.

Williams & Co., J. H., Brooklyn, N. Y., drop-forged wrenches and chain pipe wrenches.

Wheeler Condenser & Engineering Company, New York City, Admiralty Surface Condenser, with combined air and circulating pump.

Weber Gas & Gasoline Engine Company, Kansas City, Mo., gas and hoisting engines.

Warner & Swasey Company, Cleveland, Ohio, vertical boring and chucking machines.

BRONZE MEDALS.

UNITED STATES.

Abendroth & Root Manufacturing Company, New York City, improved Root water tube safety boiler.

American Blower Company, Detroit, Mich., blower engine.

American Tool Works Company, Cincinnati, Ohio, planers.

American Tool Works Company, Cincinnati, Ohio, shaper.

Becker-Brainard Milling Machine Company, Hyde Park, Mass., horizontal drill.

Barnes Company, B. F., Rockford, Ill., wet tool grinder.

Chicago Belting Company, Chicago, "Reliance" brand leather belting.

Cleveland Machine Screw Company, Cleveland, Ohio, brass work lathes.

Harrison Safety Boiler Works, Philadelphia, Pa., Cochrane steam and oil separator.

Harrison Safety Boiler Works, Philadelphia, Pa., drainage system for vacuum oil separator.

Keasbey, Robert A., Buffalo, magnesia covering.

Knowles Steam Pump Works, New York City, triplex electric pump.

Murray Iron Works, Burlington, Iowa, compound Corliss engine.

Monarch Manufacturing Company, Waterbury, Conn., safety engine stop valves.

Monarch Fire Appliance Company, New York City, "Kilfyre" dry powder fire extinguisher.

Neemes Brothers, Troy, N. Y., shaking grate.

Norton Emery Wheel Company, Worcester, Mass., bench and floor-grinding machinery.

Norton Emery Wheel Company, Worcester, Mass., Walker universal tool and cutter grinder.

National Pipe Bending Company, The, New Haven, Conn., coils of iron, brass and copper pipe.

Otto Gas Engine Works, The, Philadelphia, Otto railroad water crane.

Pratt & Whitney Company, Hartford, Conn., cock and key machine.

Pratt & Whitney Company, Hartford, Conn., centering machine.

Pond Machine Tool Company, Plainfield, N. J., lathe.

Replogle Governor Works, The, Akron, Ohio, waterwheel governors.

Skinner Engine Company, Erie, Pa., steam engine.

Snow Steam Pump Works, The, Buffalo, steam pumps.

Underfeed Stoker Company of America, Chicago, Jones underfeed stoker.

Wilmarth & Morman Company, Grand Rapids, Mich., friction countershaft.

Watertown Engine Company, Watertown, N. Y., Corliss engine.

HONORABLE MENTION.

UNITED STATES.

Abendroth & Root Manufacturing Company, New York City, Root's spiral riveted pipe.

American District Steam Company, Lockport, N. Y., underground system of steam heating from central station.

Bement, Miles & Co., Philadelphia, Pa., key-seat cutter.

Becker-Brainard Milling Machine Company, Hyde Park, Mass., grinding machine.

Cling-Surface Manufacturing Company, Buffalo, Cling-Surface belt dressing.

Cincinnati Milling Machine Company, The, Cincinnati, Ohio, universal cutter and reamer-grinder.

Harrison Safety Boiler Works, Philadelphia, Cochrane feed water heater and purifier.

Kennedy Valve Manufacturing Company, The, New York City, iron and brass valves.

Warner & Swasey Company, Cleveland, Ohio, special milling machines.

DIVISION X.—ELECTRICITY.

JURORS.

Carl Hering, chairman; Arthur V. Abbott, Henry S. Carhart, William S. Franklin, Winder Elwell Goldsborough, Dugald C. Jackson, A. E. Kennelly, William L. Puffer.

GOLD MEDALS.

UNITED STATES.

American Steel & Wire Company, Chicago, New York City, electric wires and cables.

Belding Brothers, New York City, electrical silk.

Delany, Patrick B., South Orange, N. J., apparatus for rapid telegraphy.

General Electric Company, Schenectady, N. Y., machinery and apparatus for generating and using electricity.

General Electric Company, Schenectady, N. Y., electric lighting apparatus.

General Electric Company, Schenectady, N. Y., electrical measuring instruments.

Holophane Glass Company, New York City, Holophane glass globe.

Johnson, Eldridge R., Camden, N. J., mechanical apparatus for reproducing sound.

Kellogg Switchboard & Supply Company, Chicago, telephone systems and apparatus.

National Carbon Company, Cleveland, Ohio, carbon products.

Niagara Falls Power Company, Niagara Falls, N. Y., electric transmission plant, as illustrated by model.

Pittsburg Reduction Company, Niagara Falls, N. Y., electrical conductors of aluminum.

Roebling's Sons Company, John A., Trenton, N. J., wires and cables.

Safety Ins. Wire & Cable Company, The, New York City, electric wires and cables.

Standard Underground Cable Company, Pittsburg, Pa., electric wires and cables.

Stanley Electric Manufacturing Company, Pittsfield, Mass., high-tension alternating-current apparatus.

Stanley Instrument Company, Great Barrington, Mass., electric wattmeters.

Stromberg-Carlson Telephone Manufacturing Company, Chicago, telephone exhibit and service.

SILVER MEDALS.

UNITED STATES.

American Clock Company, The, Chicago, electric clocks.

American Vitrified Conduit Company, New York City, vitrified clay conduits.

Bernard Company, The E. G., Troy, N. Y., motor-generator sets and accessories.

Bullock Electric Manufacturing Company, Cincinnati, Ohio, dynamos and motors.

Camp Company, H. B., Akron, Ohio, vitrified conduits.

Crocker-Wheeler Company, Ampere, N. J., dynamos and motors.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., motor starters and controllers.

D. & W. Fuse Company, Providence, R. I., fuses and fuse fittings.

Edison Manufacturing Company, Orange, N. J., mechanical apparatus for recording and reproducing sound.

Edison Manufacturing Company, Orange, N. J., Edison-Lalande battery.

Electric Storage Battery Company, Philadelphia, methods and appliances for the distribution of electric energy.

Electric Storage Battery Company, Philadelphia, storage batteries.

Eureka Tempered Copper Works, North East, Pa., tempered copper and cast copper.

Gould Storage Battery Company, New York City, storage battery.

Hazard Manufacturing Company, Wilkesbarre, Pa., insulated wire and cables.

Hydra Double Battery Company, New York City, dry battery.

Illuminating Appliance Company, New York City, prismatic reflectors.

McRoy Clay Works, Brazil, Ind., vitrified conduits.

National Gramophone Corporation, New York City, mechanical apparatus for reproducing sound.

Northern Electric Manufacturing Company, Madison, Wis., direct-current dynamos and motors.

Queen & Co., Philadelphia, self-regulating X-Ray tube.

Stanley Electric Manufacturing Company, Pittsfield, Mass., measuring instruments

Wagner & Co., R. V., Chicago, mica plate Holtz machine.

Wagner Electric Manufacturing Company, St. Louis, single-phase motors and transformers.

BRONZE MEDALS.

UNITED STATES.

American Electric Telephone Company, Chicago, telephone apparatus.

American Engine Company, Bound Brook, N. J., direct-connected dynamos.

Bettini, Lieutenant G., New York City, mechanical apparatus for recording and reproducing sounud.

Bossert Electric Const. Company, Utica, N. Y., switches.

Brown, Harold P., New York City, plastic amalgam joints.

Clark Auto. Tele. & Switchboard Company, Providence, R. I., automatic telephone switchboard.

Dicke Tool Company, The, Downers Grove, Ill., electric wiremen's tools.

Inc. Elec. Lt. Man. Company, Boston, Mass., lamp manipulator and attachments.

Jandus Electric Company, The, Cleveland, Ohio, enclosed arc lamp.

Jantz & Leist Electric Company, Cincinnati, Ohio, electroplating dynamos and driving motor.

Keystone Electric Company, Erie, Pa., direct-current generator.

Lincoln, P. M., Niagara Falls, N. Y., phase indicator.

Mason Monogram Company, New York City, illuminated sign.

Morris Electric Company, New York City, Morris rail bond and hydraulic splicing machine.

National Carbon Company, Cleveland, Ohio, primary cells.

Onondaga Dynamo Company, Syracuse, N. Y., direct-connected dynamo and electric motors.

Peru Electric Manufacturing Company, Peru, Ind., porcelain devices for electric purposes.

Porter Battery Company, Chicago, storage batteries.

Pyle National Electric Headlight Company, Chicago, electric headlight.

Roche, William, New York City, dry cells.

Standard Paint Company, New York City, P. & B. tape, insulating compound and armature and field-coil varnish.

Submerged Electric Motor Company, Menominee, Wis., submerged electric motor and propeller.

Toerring Company, C. J., Philadelphia, arc lamps.

Waite & Bartlett Manufacturing Company, New York City, X-Ray apparatus.

Wilhelm Telephone Manufacturing Company, Buffalo, telephone apparatus.

MEXICO.

Reyes, L., San Luis Potosi, State of San Luis Potosi, telephone.

HONORABLE MENTION.

UNITED STATES.

American Watchman's Time Detector Company, New York City, watchman's time detector.

Arnold Electric Power Station Company, Chicago, power station system and clutches, illustrated by models.

Bogue, Charles J., New York City, electric searchlight.

Buckeye Electric Company, The, Cleveland, Ohio, incandescent lamps.

Chicago Fuse Wire & Manufacturing Company, Chicago, fuse wires and links.

D'Olier Engineering Company, Philadelphia, dynamo switchboard.

Edison Manufacturing Company, Orange, N. J., nine-inch battery fan motor.

Hall, Alvah W., New York City, automatic advertiser,

Jandus Electric Company, The, Cleveland, Ohio, electric fan motor.

Lea Electric Manufacturing Company, Elwood, Ind., enclosed arc lamps.

Meyrowitz, E. B., New York City, eye magnet.

Parsell & Weed, New York City, model dynamo.

Robbins & Myers Company, The, Springfield, Ohio, dynamos and motors.

Rowell, C. B., Buffalo, static electric machines.

Sage & Bro., F. B., New York City, direct-reading ohmmeter.

Sprague Electric Company, New York City, electric motors.

Stow Manufacturing Company, Binghamton, N. Y., multi-speed motor and flexible shaft.

White Company, The, O. C., Worcester, Mass., adjustable lamp arm.

DIVISION XI.—TRANSPORTATION.

JURORS.

H. G. Prout, chairman; Arthur V. Abbott, William L. Aughinbaugh, Albert C. Bostwick, R. C. Carpenter, J. M. Carson, Jr., Frederic A. Delano, David Porter Heap, C. H. McLellan, Henry M. Paul, Cecil H. Peabody, George D. Shepardson, Ambrose Swasey, J. Elfreth Watkins.

GOLD MEDALS.

UNITED STATES.

Consolidated Railway, Electric Lighting & Equipment Company, New York City, car light by electric power from the axle.

De Dion-Bouton Motorette Company, Brooklyn, N. Y., motorettes, bicycles and quadricycles.

Electric Vehicle Company, New York City, electric vehicles (variety and completeness).

Electric Vehicle Company, New York City, electric automobiles.

General Electric Company, Schenectady, N. Y., electric traction apparatus and system.

Lidgerwood Manufacturing Company, New York City, electric ship's winch.

Roebling's Sons Company, John A., Trenton, N. J., general exhibit in transportation.

SILVER MEDALS.

UNITED STATES.

Gold Car Heating Company, New York City, car-heating apparatus.

McGuire Manufacturing Company, Chicago, trucks and appliances for electric cars.

BRONZE MEDALS.

UNITED STATES.

Continuous Rail Joint Company of America, Newark, N. J., rail joints for steam and street railroads.

Electric Vehicle Company, New York City, gasoline automobile.

HONORABLE MENTION.

UNITED STATES.

Palmer Brothers, Mianus, Conn., gasoline engines and launches.

DIVISION XII.—ORDNANCE AND MUNITIONS OF WAR.

JURORS.

George Eugene Belknap, chairman; Philip R. Alger, Peter C. Harris, Victor Hernandez, Richmond Pearson Hobson, C. F. Shoemaker, Thom Williamson, John P. Wisser.

GOLD MEDALS.

UNITED STATES.

American Bridge Company, New York City, steel structural material and steel buildings (ordnance).

Ritchie & Sons, E. S., Brookline, Mass., ships' compasses.

BRONZE MEDALS.

UNITED STATES.

Ferracute Machine Company, Bridgeton, N. J., brass cartridge cases.

DIVISION XIII.—MANUFACTURES.

JURORS.

Edmund A. Engler, chairman; Wm. L. Aughinbaugh, Marcus Benjamin, Morris Benson, A. H. Bottum, J. M. Carson, Jr., John L. Choyer, F. W. Clarke, George Coit, Stanley T. Cozzens, John G. Eppendorff, Alberto Falcon, M. L. Floyd, David Porter Heap, W. H. Holmes, John R. Kendrick, F. P. Machado, Edward S. More, Henry M. Paul, Frank H. Peabody, G. G. Pond, W. de C. Ravenel, John K. Rees, Edward Rovinson, Jose A. Saenz, Carlos Sellerier, George D. Shepardson, John Strootman, Ambrose Swasey, Evaldo Tirade, Juan P. Tomas, Charles H. Turner, Harry Walbridge, Mrs. Lester Wheeler, Miss Eugenie Hauenstein.

GOLD MEDALS.

UNITED STATES.

Pittsburg Reduction Company, The, Pittsburg, aluminum.

Roessler & Hasslacher Chemical Company, The, New York City, acetone and chloroform.

Standard Paint Company, The, New York City, ruberoid roofing and flooring.

Williams & Co., J. H., Brooklyn, drop forgings and special designs.

SILVER MEDALS.

UNITED STATES.

Cassidy & Son Manufacturing Company, New York City, electric fixtures.

Frink, I. P., New York City, reflectors.

Grant Tool Company, Franklin, Pa., brass and steel balls.

Grasselli Chemical Company, The, Cleveland, Ohio, chemicals.

Standard Paint Company, The, New York City, P. & B. rubberine paints and varnish.

United Indurated Fiber Company, Lockport, N. Y., indurated fiberware.

Union Carbide Company, Niagara Falls, N. Y., the Horry carbide furnace and products.

White Company, The O. C., Worcester, Mass., adjustable electroliers.

BRONZE MEDALS.

UNITED STATES.

Blickensderfer Manufacturing Company, The, Stamford, Conn., electrical typewriting machine.

Mygatt, O. A., New York City, new patent prism globes.

Norton Emery Wheel Company, Worcester, Mass., India oil stones.

Standard Paint Company, The, New York City, P. & B. waterproof case lining and wrapping paper.

Vosburgh Manufacturing Company, Limited, W. C., Brooklyn, electric and gas fixtures.

HONORABLE MENTION.

UNITED STATES.

Jenkins Brothers, New York City, electro-magnetic lamp holders.

DIVISION XIV.—GRAPHIC ARTS.

JURORS.

Theodore Low De Vinne, chairman; Marcus Benjamin, Julio Perez Canto, Stephen J. Kubel, D. B. Wainwright.

SILVER MEDALS.

UNITED STATES.

Jantz & Leist Electric Company, Cincinnati, Ohio, electrotyper's motor-generator.

HONORABLE MENTION.

UNITED STATES.

Charles J. Bogue, New York City, photo-engraving lamp.

Cutler-Hammer Manufacturing Company, The, New York City, printing press electric controller.

Edison, Thomas A., Orange, N. J., Edison numbering machine.

New England Motor Company, Lowell, Mass., 5-hp compound motor, type M. E.

DIVISION XV.—LIBERAL ARTS.

EXHIBITORS HORS CONCOURS.

Massachusetts Institute of Technology, Boston, Mass., president of Institute chairman of superior jury.

GOLD MEDALS.

Keuffel & Esser Company, New York City, surveying instruments and drawing materials.

Pratt Institute, Brooklyn, New York, Students' work, showing educational methods and results.

Rensselaer Polytechnic Institute, Troy, N. Y., students' work, showing educational methods and results.

Roebling's Sons Company, John A., Trenton, N. J., bridge engineering.

McGraw Publishing Company, New York City, Electrical World and Engineer, etc., technical books, etc.

Worcester Polytechnic Institute, Worcester, Mass., students' work, showing educational methods and results.

SILVER MEDALS.

The Western Electrician, Chicago, Ill., publication, *The Western Electrician.*

BRONZE MEDALS.

International Correspondence Schools, Scranton, Pa., photographs, courses of study, pupils' work.

INSTALLATION.—DIVISION X.

GOLD MEDALS.

Edison Manufacturing Company.

SILVER MEDALS.

General Electric Company.

BRONZE MEDALS.

The Safety Insulated Wire & Cable Company.

HONORABLE MENTION.

American Electric Telephone Company.

Buckeye Electric Company.

Kellogg Switchboard & Supply Company.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, OCTOBER 26, 1901. No. 17.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 26, 1901.

CONTENTS.

	PAGE
Editorial	671
Opening of the New York Electrical Society Season	674
Electrical Engineers of the Day—XVII; Harold W. Buck	674
Walla Walla, Wash., Electrical Transmission Plant	675
Gas vs. Electricity, by Alton D. Adams	676
The Zossen Polyphase Railway Installation for Experimental Trials, with Speeds up to 125 Miles an Hour—V, by Walter Reichel	678
The Theory of the Electrolytic Rectifier, by Dr. K. Norden	681
The Telephone as an Information Bureau	682
New Telephone Patents	683
Current News and Notes	684
LETTERS TO THE EDITORS:	
Wireless Telegraph Reports of the Yacht Races, by G. P. Gehring	686
Lighting at the Omaha and the Pan-American, by Luther Stieringer	686
Digest of Current Electrical Literature	687
New Books	692
The De Laval Steam Turbine	693
A Watch Demagnetizer	694
National Association of Automobile Manufacturers	695
Snap Cover Steel Conduit Moulding and Safety Switch	695
Automatic Door Switch	695
A Modern Printing Press Equipment	696
New Feed Water Heater	696
Milling Machines at Pan-American	696
The Kellogg Telephone and Switchboard Exhibit at the Pan-American	697
DEPARTMENTS:	
Financial Intelligence	699
Commercial Intelligence	700
General News	702
Trade Notes	707
Record of Electrical Patents	708

TELEPHONIC INTELLIGENCE.

In its endeavors to deal satisfactorily with the public, one of the largest independent telephone exchanges in the country, the Cuyahoga, of Cleveland, has organized a trouble and information bureau, at the head of which it has placed a young lady who has a reputation throughout the State of Ohio for the great success she has achieved in dealing with imbeciles. Probably in making this selection of Miss Ashley, the Cuyahoga Telephone Company had no intention of reflecting upon the average intelligence of the public of Cleveland, but the fact remains that a large percentage of the trouble in giving good service is due rather to the subscriber than to the system. It has been seriously suggested more than once by contributors to these columns that patrons of the telephone need to be educated in the use of the instruments; and it is amusing to note how this is resented by daily newspaper critics, who certainly never undertook to handle a bicycle or a typewriter without some preliminary drill; in fact, one of the marvels of telephonic work is the ignorance of such newspaper critics about it, as, for example, that of the man on the *New York Times* who keeps on talking editorially about the "regular subscriber with his unlimited service," after it has been laboriously and painfully explained to him time and again in these columns, and out of them, that that personage is a back number of years ago, there being now in all New York only some 1200 "unlimited" out of a total of nearly 60,000 "regular subscribers," all of at least 45,000 "paying for the exact amount of goods delivered." Possibly we may have to state that fact 50 times again, or get Miss Ashley to do it, before it is accepted in the silence that carries consent.

One marked novelty characterizes the new bureau in Cleveland, namely, the giving of information on moot points, as well as clearing out lines that are busy or in trouble. We print a brief list of the questions submitted to Miss Ashley for answer. Some of them betray a low order of intellect; others an absence of education, but it would not be fair to infer mental inferiority in Cleveland from them, any more than it would be to suppose that a newspaper is unduly dense because it "cannot get the real state of the case through its thick head," when it is stated by every telephone expert that, as in a great many other lines of work, the cost of giving service runs up as the bulk of business increases; so that the margin of profit on each transaction tends to decline. The attempt to use the telephone for other purposes than conversation is not new. Years ago, attempts were made in this country to send time over its lines, and it is still employed for fire alarm and early morning alarm purposes. At Budapest, it is part of a newspaper service, and in London the "electrophone" is said to be quite a success in connecting people with places of amusement. But the "information bureau" is something new, and should be valuable to a community thirsty for knowledge and too lazy to look it up for itself. There will be a check on sales of literature of the "Inquire Within" character, and a relief to the editors now plagued with requests for data of all kinds.

WIRELESS TELEGRAPHY.

We cannot refrain from directing attention to correspondence in this issue on the timely topic of wireless telegraphy at the recent international yacht races. The brief report which we made of the mingled success and failure of the system seems to have given umbrage in some quarters. While we cannot change the fact and record a complete success, we regard the work done as encouraging. The

fact remains, however, that the moment interference of rival signaling was set up, nothing could be done. This was true of the attempts at the races two years ago, and would imply that selective wireless telegraphy is still a thing of the future. Evidently, it was not feasible to send two messages at once, and it was evidently not less foolish to repeat the same news a minute after it had already gone in over some other etheric service. In brief, etheric telegraphy stands to-day a worse "monopoly" than anything else in the electric line, for whoever "does the trick" must have sole use of air, earth and sea.

Urban and Suburban Roads.

One of the most interesting features of the Street Railway Convention was the paper on and subsequent discussion of this most timely topic. The interurban road to-day is in a somewhat indeterminate position. It has in a measure outgrown its early association, and has not yet found a definite place in what one may call the major tactics of general transportation. It is steadily differentiating itself from purely urban traction, and is approximating, while it has not yet reached, the field of ordinary railway practice. The vital present question is this: How far can electric interurban service assume the functions of general railway service without incurring its inhibitions? Ordinary railways have to run over their own rights of way with well defined restrictions as to crossings and relations with other roads; they have to find unobjectionable stations or termini in the cities which they serve, and they stop for passengers and freight at rather long intervals. They are subject to sharp legal restrictions as to equipment and service, and come in their interstate relations under the control of the general government. Interurban roads for the most part have grown out of the necessities of urban service, and in the majority of instances operate wholly or in part over public streets and roads, with few express or implied limitations as to speed and no or few restrictions as to crossings. Originally they stopped on signal for passengers, or at short intervals, and furnished a part of the urban local service. These conditions have steadily been changing, and we now have admirable interurban lines running heavy cars at ordinary railway speeds, carrying both passengers and freight and having well defined stations. It is a small wonder that their relations to urban tramway systems have become somewhat confusing.

During the discussion, Mr. Crosby called attention most forcibly to the physical difference of equipment between these two classes of roads, and the inherent difficulties of coming to a common basis. The modern interurban car may be 50 ft. long and weigh 30 tons, while its running gear differs little from that of an ordinary steam passenger coach in dimensions and weight. Its normal economical speed may be 20 or even 30 miles per hour. Such a car calls up rather serious questions when it arrives at a city line. It is on the one hand physically unfitted for convenient operation under tramway conditions, and on the other hand it is a grave inconvenience to compel the passengers to change cars, and to tranship or distribute freight at that point. When the interurban cars are of a character more closely allied to the urban cars the solution of the difficulty is readily found in traffic arrangements that will give the outside line a terminus in the heart of the city, as is really necessary for the convenience of the passengers. But the limiting case arises with inconvenient frequency, and there is trouble ahead. Mr. Crosby leans strongly to a complete separation of service with a change of cars at the termini of the interurban road. This, however, is bad in point of convenience, as bad as it would be if the N. Y., N. H. & H. between New York and Boston had one terminus at Port Chester and the other at Readville, with surface cars the rest of the way. If not over surface lines, then over underground or elevated trucks, the cars should come to a convenient terminus. There is certainly a line between an interurban electric tramway and an electrically operated railway connecting two cities, albeit it may seem at first thought as shadowy as the distinction between chicken and fowl. When interurban cars by weight, dimensions and speed become physically unfitted for operation in the streets of a city, the system which operates them has definitively passed out of the tramway class. Nor could the New York Central properly be considered anything but what it is, even if the roadbed were capable of taking the Empire State Express clear down to the Battery. There is a distinction between the things in themselves which should be defined before there is further confusion.

Electricity vs. Gas.

The discussion of the relative growth of gas and electric service during the last decade by Mr. A. D. Adams in our columns this week opens a number of interesting questions as to the future. As to the past the issue is clear, for what is true in Massachusetts is *a fortiori* true in most of the other States. For the gas industry was as firmly intrenched physically and legally in that Commonwealth as anywhere in the country, yet by 1892 the bottom had been knocked out of the gas street-lighting business and the sales of electrical energy had risen to nearly $3,000,000 per year. But, as has many times been remarked, the advent of electric lighting actually served as a stimulus to the sale of gas. For example, from 1891 to 1892 the increase in gas sales was absolutely, although not relatively, larger than the gains in the sales of electricity, in spite of the fact that a considerable amount of street lighting had passed from the former to the latter. The same is true of the years 1894 and 1895, although these years of stress were years of relative depression in the gas industry, and again nearly in 1899 and 1900. Of course, the introduction of so brilliant an illuminant as electricity had the effect of putting general illumination at a higher pitch, and as gas, so far as mere candle-power is concerned, is usually cheaper than electricity, it, of course, got a material share of the increase. The very recent increase in gas sales is, however, probably due to the increasing use of gas stoves and of mantle burners. It would be interesting to trace the effect of both gas and electricity on the sales of kerosene, which we fancy has held its own pretty well. In other words, the sale of illuminants per capita has very greatly increased in the last ten years, both in public and private lighting.

Mr. Adams' figures give some interesting data on this point. In 1890 the total sales for public and private purposes were $6,668,731, while in 1900 they had risen to $12,155,676, though the population had only increased 25.2 per cent. A large part of this increase is in private lighting, for while in 1890 the total sales of gas and electricity were $1,104,424, in 1900 they were $1,847,448. So much for the stimulus given to artificial illumination by the introduction of electric lighting. If the result were reduced to candle-hours it would be still more striking, for in the last ten years the prices of both gas and electricity have fallen to a considerable degree. It is probably well within the truth to say that in the last ten years the consumption of illuminants per capita has more than doubled. As to the future, we think the experience of the past will be repeated. The oft-repeated prophecy that electricity would drive gas from the field is far from its fulfillment. In point of fact, gas seems intrinsically able to hold its own in the general market, and the effect of the electric competition at present is confined to limiting and defining the field of gas. In street lighting gas is likely to play year by year a less important part and may eventually become a negligible quantity. In general lighting, on the other hand, unless there are very great advances in the electrical art, gas is from an economic standpoint amply able to hold its own. Electricity will steadily make inroads on gas for general lighting, but if we mistake not for every dollar the latter loses it can

gain one as fuel. This is a field in which gas has not yet risen to its logical place. As electrical competition gets stiffer the price of gas will fall, and it has a long way to fall before it reaches bottom, until it can reach the domestic fuel market effectively. From that last stronghold it is not likely to be driven by any form of electric competition yet devised.

The competition of electricity with gas has assumed even a more acute stage in England than in this country, if we are to judge from a recent editorial in the British *Journal of Gas Lighting*, printed under the title "A Grave Situation." After referring to its own efforts in combating electricity by exhibiting its "seamy side," the confession is made that "although there are no fresh electric lighting companies of the old pattern started, those that are actually in the business hang on, and the disappointment of local authorities who have electric lighting undertakings does not prevent others following in their track." Gas investments, it says, are not held in the estimation they should command, primarily because electric lighting has made inroads upon the preserves of some big undertakings. "On the other hand, gas has not yet in a single instance definitely stopped the career of an electric lighting undertaking. The latter continue to grow; and although their capital grows also, and their state is not usually prosperous, still they often appear to hurt gas if they do not benefit themselves." The gravity of the situation is further emphasized by the fact that our British gas contemporary can suggest no broad line of defence against electrical competition, contenting itself by severely scolding gas company officials for indolence and neglect of duty.

The Voltaic Arc as a Telephone Transmitter.

A paper has recently been read before the International Society of Electricians in Paris on experiments with the voltaic arc as a transmitter. This subject is not only interesting from a technical standpoint, but it also offers hope to experimenters from a practical point of view. Very little improvement has been made in the carbon telephone transmitter since its first development in the hands of inventors some twenty years ago. It would seem that the possibilities of the carbon transmitter have been nearly exhausted. The energy of the electrical waves transmitted over a telephone circuit is only a fraction of the energy of the waves in the primary circuit of the transmitter, and this in turn is only a small fraction of the energy of the current supplied by the voltaic cell in the transmitter local circuit. If it were not for the marvelous sensibility of the receiving telephone, the carbon transmitter would remain an interesting scientific toy.

It is evident that it would not be practical to have a voltaic arc burning on the table of each person using the telephone, but if a voltaic arc transmitter possessed very great power, as compared with the ordinary carbon transmitter, it might be quite possible to employ the arc transmitter on special occasions, such as when a public speaker was addressing an audience, in order that his voice might be heard by telephone at a number of distant points. It ought to be possible to force a telephone to shout, when necessary, as loudly as does the gramophone, or even the megaphone or steam siren. The siren voice would probably be required very rarely, but the possibility of speaking in siren tones would be at least potentially valuable, and might be worth utilizing for occasional purposes, even at considerable trouble and expense in the transmitter. It would be necessary to liberate a relatively large amount of energy in the transmitter circuit, and to allow the relatively feeble energy of the vocal sound waves to modify and control the transmitter circuit energy in a very sensitive rhythmical manner. Every improvement in the power of the transmitting apparatus, and in the range of effective transmitting e. m. f., increases the range of telephonic transmission, or enables a smaller telephonic wire to be employed for the same range of telephonic transmission. While the experiments thus far described have not been very successful, yet it is to be hoped that more encouraging results are yet to come.

The Aluminum Electrolytic Rectifier.

Much interest has been recently directed to the aluminum rectifier. It is well known that if a plate of aluminum is substituted for one of the plates of lead in an ordinary storage cell, the apparatus so modified, will readily let current pass when the aluminum plate is a cathode, but will interpose a marked barrier itno the circuit when the aluminum plate is an anode. Consequently the apparatus forms a sort of artificial valve or filter for unidirectional currents when connected with the alternating-current circuit. Unfortunately, the efficiency of the cell has been found too defective hitherto to permit of its practical application; otherwise, it is quite possible that a battery of such cells might take the place of the converter.

Dr. Norden's article appearing in this issue throws light upon the nature of the actions which occur in the cell. It is shown that the action is not to introduce a unidirectional c. e. m. f., which would have to attain a magnitude of as much as 100 volts, but is to introduce a selective resistance residing in a very thin film of hydroxide formed upon the plate. This film is virtually an insulator, and seals up at each impulse of current leaving the plate for the electrolyte, but breaks down and becomes electrically pervious at each opposite impulse of current leaving the electrolyte for the plate. According to this theory, there should be an intermediate stage at each cycle of current, in which a very considerable resistance should be offered to the rising current strength in the favored direction, and during which interval a relatively considerable loss of energy should be developed as heat in the film. In other words, the door is not alternately shut closely and opened widely, but commences to open more or less gradually with objectionable intermediate resistance, corresponding to the wire-drawing of a valve in a steam engine. This may account for the inherently considerable losses of energy which have been hitherto encountered in the tentative use of this electrolytic rectifier.

It would be interesting to determine whether the very thin film of insulating material, which Dr. Norden says is the hydroxide of the metal, is similar in its properties to the oxide which forms in air with such great rapidity upon the surface of a freshly scraped aluminum plate. It is alleged that if this thin superficial coating of an oxide did not form upon a freshly exposed surface of the metal, the affinity between aluminum and oxygen is so great as to cause complete combustion to be started at ordinary temperatures. In fact, it is said that we never see pure aluminum, but always view the metal through a thin veil or film of oxide, and that the difficulty in soldering pieces of aluminum lies in the difficulty of dislodging this thin protective layer, and of bringing the two metallic surfaces into intimate contact in air without the reformation of a separating film.

According to the theory laid down, it would be reasonable to expect that the efficiency and effectiveness of the aluminum rectifier would be greater for low alternating frequencies than for high frequencies, other conditions remaining unchanged, and evidence upon this question would be of much interest. In fact, it would appear from some experiments of Professor Wilson that beyond a certain frequency, the formation of the film is not sufficiently complete to produce any practical rectifying effect.

Opening of the New York Electrical Society Season.

The 217th meeting of the society will be held at the College of the City of New York, corner of Lexington Avenue and Twenty-third Street, Wednesday, Oct. 30, at 8 p. m. Mr. F. W. Willcox, of the Edison Lamp Works of the General Electric Company, at Harrison, N. J., will deliver a lecture on "The Manufacture and Use of the Modern Incandescent Lamp." Mr. Willcox's lecture will be a review of one of the largest branches of the electrical industry, and will take up the subject of lamp manufacture, exemplifying the progressive changes which have been made in perfecting the lamp and in lowering its cost to the public. The various steps of the production of the lamp will be elaborately illustrated with slides. Mr. Willcox will also treat upon the uses of the lamp and discuss the part which it plays in the illumination of the present day, as well as various economic features of efficiency, life, etc.

As an appropriate supplement to this lecture, Mr. Luther Stieringer, consulting electrical engineer of the Pan-American Exposition, has kindly consented to deliver a brief address on "The Incandescent Lamp at the Pan-American Exposition." The magnificence and beauty of the night spectacle at the Exposition has excited the admiration of the world. Mr. Stieringer will describe how these effects were obtained solely with the aid of the incandescent lamp, and will outline the principles to be observed in the employment of light for artistic effects. Secretary Guy announces that ladies will be welcomed at this meeting.

American Railroad Data.

The advance sheets of *Poor's Manual* shows an increase in the railroad mileage of the United States for the fiscal year of 1900 of 4160 miles. The total mileage was 191,861 miles, and the total revenue from traffic aggregated $1,501,695,378. Operating expenses were $1,018,447,852, and net earnings were $483,247,546. The total available revenue was $551,020,469, and from this sum there was deducted for interest, rentals, dividends and similar purposes $458,460,571, leaving a surplus over all charges and miscellaneous payments of $92,559,889. The total assets of all railroads were $12,768,910,837. The stock capitalization was $5,804,346,250, and the bonded indebtedness $5,758,592,754. The stock, bonds and unfunded debt representing approximately cost of road and equipment, was $61,884 per mile. The average gross earnings per mile were $7,826, and net earnings $2,519. The average interest paid on the bonded debt was 4.24 per cent and the dividends paid on the combined capitalization aggregated 2.42 per cent.

Electrical Engineers of the Day—XVII.

HAROLD W. BUCK.

Harold Winthrop Buck, who now holds the position of electrical engineer of the Niagara Falls Power Company and its allied corporations, was born May 7, 1873, and is probably the youngest man in the electrical profession who has attained a position of such importance. His father is a distinguished surgeon and he is a grandson through his mother of Abbott, the well-known historian. During his brief career, Mr. Buck has, however, earned for himself exceptional opportunities for experience in the most important electrical work, and by thoroughness, courage and tact has gained the entire confidence of his associates.

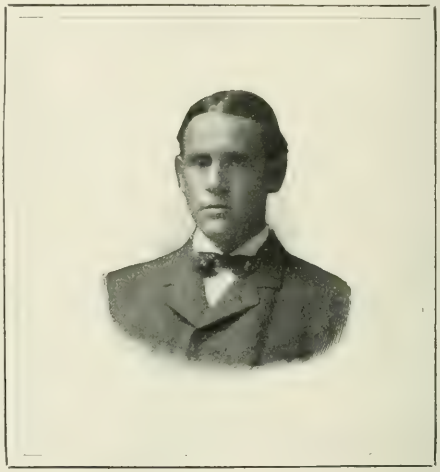
Mr. Buck has always been a great lover of hardy outdoor sports, and by the exercise of such tastes has built up a rugged frame and sound nerves, which have helped him to bear the strains of study and hard work, but have not deprived him of the enthusiastic interest which is necessary to successful study or work. Mr. Buck graduated from Yale University in 1894 and afterward took a postgraduate course at the Columbia School of Mines, receiving the degree of E. E. from Columbia in 1895.

Soon after leaving college he entered the employ of the General Electric Company, beginning work as a student in the Schenectady works. He very soon began to attract attention through a display of originality and inventivenes in connection with various matters. He devised a three-phase motor operating by static induction and explained its analogy to the induction motor. The device has never been put to any practical use, but it is entirely original and interesting from a scientific standpoint.

The motor is similar in construction to the electromagnetic induction motor except that electrostatic poles are substituted in the field for electromagnetic ones. The armature consists of a continuous cylinder of any high insulating material. When the motor field terminals are connected to any high-voltage, three-phase circuit, the armature rotates nearly at a synchronous speed, the torque being produced by the lag in the lines of polarization in the insulating material of the armature, behind the rotating lines of electrostatic force.

During the first two years of Mr. Buck's work at Schenectady he suggested a number of mechanical and electrical devices and took out several patents. During this time he did some work on electrical furnaces and with two associates devised and patented a process for making corundum in an electrical furnace. This process has been developed to a state of commercial soundness, and a plant is now being built at Niagara Falls which will manufacture 5000 tons a year of the finest corundum by this method and under the patents above mentioned.

During the latter part of Mr. Buck's service with the General Electric Company he acted as one of the assistants to the engineer of the lighting department, and in that position he had a variety of experience in connection with the development of new work in the



factory, and more particularly in connection with the starting and adjustment of many very important and novel installations which were made at that time. Serious problems arose in some of these installations calling for exhaustive and laborious experimenting in large operating plants in distant cities. Such work has to be done at all hours and under the most trying conditions. It can only be done successfully by a resourceful man who has tact and can inspire the confidence and obtain the support and assistance of the men who are responsible for the operation of the stations. Mr. Buck did this work with marked ability and success, with perfect loyalty to his superior and adhesion to his instructions combined with much independence and originality.

In September, 1900, Mr. Buck was appointed electrical engineer of the Niagara Falls Power Company, the Cataract Power & Conduit Company, of Buffalo; the Tonawanda Power Company and the Canadian Niagara Power Compny. Among his many duties in this position he has drawn the specifications and directed the selection of apparatus for the new power house now building at Niagara Falls, and also the large development which is now being made on the Canadian side.

Mr. Buck has always worked with good standards in view and has intelligently sought usefulness in all branches of his profession. He has acquired a sound theoretical knowledge and has learned how to handle machinery freely and with confidence. With his equipment and the start he has made and with the immense opportunities which electrical developments now produce Mr. Buck's career ought to be a useful one.

Mr. Buck is a member of the American Institute of Electrical Engineers.

Walla Walla, Wash., Electrical Transmission Plant.

In the spring of the present year the Walla Walla (Wash.) Gas & Electric Company completed a water power plant for the supply of electric current to Walla Walla. The plant is located on Mill Creek, about five miles from the city of Walla Walla, and is interesting from the fact that it employs the monocyclic system, and a rotary engine in its auxiliary steam equipment.

Mill Creek takes its rise in the Blue Mountains, in the State of Washington, not far from the Oregon line, and drains an area of many square miles, but on account of the denuded state of the watershed, the Creek is subject to rapid fluctuations. The average flow of water during the extreme dry season is 2800 cubic feet, but during the winter months the average is much higher.

The water is taken from the Creek at a point 5600 feet above the plant, where a concrete dam spans the stream and raises the water but a few feet above its natural bed, owing to the extraordinary fluctuations and locality. The water is conveyed to the plant through a 4-ft. stave pipe built of red wood, this giving an actual head at the power house of 82 ft. 6 inches. The pipe is buried the entire distance from the dam to the power house. It has been in use for seven years, and shows very small depreciation. The power house is built over a brick and concrete arch that spans the tail race and draft tube, which latter is 17 ft. 6 inches in length, and gives a vacuum of 20 inches.

The building is of brick 40 ft. by 40 ft., with truss roof. The floor is of concrete. At present the plant consists of one 450-hp McCormick turbine, built by the S. Morgan Smith Company, of York, Pa. The wheel is direct connected to a 300-kw General Electric revolving field monocyclic generator of 6600 volts, running at speed of 450 r. p. m. and giving a frequency of 60 cycles. The exciter is a 7½-kw multipolar machine driven from generator shaft. A 400-hp rotary engine of the Thomas & Brumagin type, is installed, and is the first of its kind of this size put on the market. The engine, which runs at 200 r. p. m., is belted to the generator shaft, which is provided with a Hill clutch, so that the generator can be handled either by water or steam, or both, as the occasion may demand.

The switchboard is of blue Vermont marble, fitted with both potential and current transformers, together with current, potential and exciting-current indicators, a three-phase electrostatic ground detector and oil switches for operating the high-potential current. The fuses are of the spring expulsion type. The line is protected from lightning by Wirt arresters enclosed in iron boxes and connected with ground wire. A good ground was made by digging in the earth down to wet gravel and bedding a coil of wire in powdered coke.

The transmission line from the power house to the city of Walla Walla, five miles distant, consists of cedar poles 35 ft. long with 8-inch tops. The pole line is designed to carry two circuits of three wires each, but at present there is only one circuit. The poles are placed 100 ft. apart and carry two No. 2/0 and one No. 8 hard drawn copper wires.

The sub-station is provided with one 75-light and one 25-light series constant-current transformers, oil cooled. Two 100-kw single-phase and two 50-kw "Teaser" transformers are connected by means of a cross connection on both primary and secondary sides, and step from 6600 to 2080 volts pressure. The sub-station is provided with a skeleton switchboard upon which are mounted current and potential indicators for the incandescent lighting and power load of two circuits. The constant-current circuits are each provided with current transformers and ammeters, and tubular plug switches on both primary and secondary currents.

The sub-station is protected from lightning in the same manner as the power house, and also with an oil switch, which will disconnect the entire sub-station from the primary lines. The secondary lines

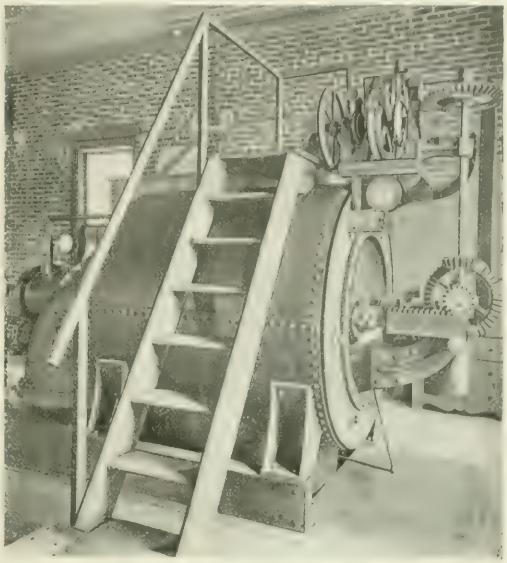


Fig. 2.—350-hp turbine.

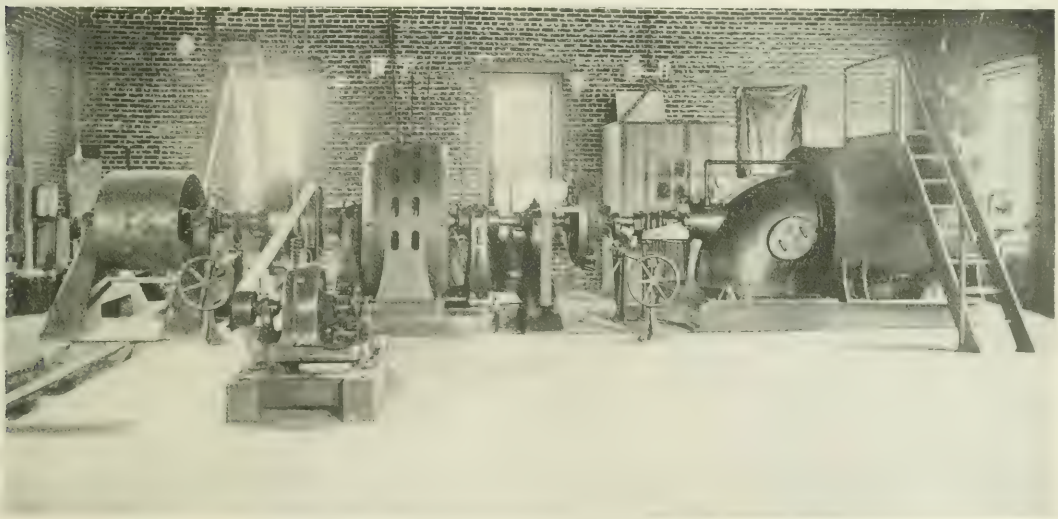


Fig. 1.—Interior View of Walla Walla Water Power Plant.

are equally well protected from lightning. The distribution of all secondary circuits is by the two and three-wire systems.

The Walla Walla Company also owns the gas works and distributes 6,000,000 ft. of gas per year. The patrons served by this company are well satisfied with the electrical service they receive. Mr. H. Wadsworth, of San Francisco, is president, and Mr. C. E. Burrows, of Walla Walla, is general manager. The plans for this plant were drawn by Mr. D. L. Huntington, C. E., of Spokane, Wash. The development was commenced in October of 1900, and carried out under the supervision of E. C. Morrow, superintendent of the electric department. The plant was put in operation in May, 1901, and has been in operation since that time without a single shut down or accident to mar the good service.

Gas Versus Electricity.

By ALTON D. ADAMS.

GAS and electric systems are competitors in general distribution for light, heat and power. A comparison of the incomes of these systems, on a large scale, is therefore of interest. Such a comparison may well be conducted on two distinct lines. First, to determine the changes in amount of the incomes of each system through the same series of years, and, second, to show the relative incomes of both systems through these years. The most important division to be made in the earnings of gas and electric plants is that between the incomes from public and private service. Public service usually takes the form of street lighting, and private service is the supply of individual consumers. It is thus desirable to separate from gas and electric incomes the parts received for street lighting.

The supply of gas through pipes laid in the public streets was on a business footing during some decades before the electric lamp was other than a scientific toy. For a comparison between gas and electric systems it is, however, only necessary to consider the operations of the former since electrical supply became a commercial factor. Some small beginnings, in the way of electric lighting stations, were made prior to 1880, but it is not possible here to present any comprehensive view of the earnings of either gas or electric systems at that early date.

The State of Massachusetts is selected as the field for the present comparison, because its public records of the operations of gas and electric plants are more complete than those in any other State. Moreover, both these classes of plants have been developed on a great scale in Massachusetts, from its many small towns to its one great city. From the public records of this State, the incomes of all its gas systems have been determined, for the years between the middle of 1885 and 1900. For all the electric lighting stations, records go back only to the years since the middle of 1889, and their incomes are given accordingly:

Incomes of all gas and electric systems engaged in general distribution in Massachusetts.

Year ending June 30.	Gas sold by meter.	Gas sold for public lamps.	All sales electrical energy.	Sales for electric street lamps.
1886	$3,678,206.06	$433,063.02		
1887	3,578,043.30	421,430.65		
1888	3,900,416.07	396,876.29		
1889	4,027,049.07	352,934.84		
1890	4,432,899.30	327,438.05	$1,908,394.00	$776,986.18
1891	5,040,438.78	292,544.62	2,432,869.15	
1892	5,308,118.06	262,777.00	2,947,199.64	
1893	5,439,302.81	262,309.09	3,427,576.84	
1894	4,500,605.49	211,727.83	3,623,056.92	
1895	4,779,821.60	187,874.48	3,794,060.41	
1896	5,517,061.62	181,006.85	4,148,681.71	1,422,020.76
1897	5,514,936.64	179,664.22	4,467,147.10	1,471,689.18
1898	5,669,060.07	182,662.56	4,775,316.07	1,567,379.97
1899	5,800,667.63	182,278.82	5,046,412.75	1,599,277.62
1900	6,357,368.00	175,752.26	5,622,556.43	1,671,696.13

Though figures cannot be given for the incomes of electric systems prior to the date named, the changes in the incomes of gas plants show that the competition of the former was an important factor after the middle of 1885. Incomes of gas systems are given for sales by meter, and for sales to public or street lamps, these two must be added to determine total incomes from gas sales. Other minor sources of income to gas and electric systems, such as the rental of stoves, are not considered here. The year ending at the middle of 1890, shows a gain of 20 per cent in the income from sales of gas by meter, over the year ending at the middle of 1886. During this same period the income from sales for public gas lamps declined 24 per cent. This reduction of gas income must have been due to electric street lighting, which was increasing rapidly at the time, and is the only known cause that could have produced the result.

From the middle of 1889 figures are given for total sales of electrical energy, of which the income from street lighting forms a part. The income from electric street lighting is given for the year ending June 30, 1890, but it is not possible to present it for other years before that ending at the middle of 1896.

As the record of incomes for both gas and electric systems is complete for the year ending June 30, 1890, a comparison of these systems is made to begin with that year. The income during the year last named from each class of service by gas and electric systems is taken as 100 per cent, and the number representing this income is used to divide the like income of each following year. In this way the per cent which the income of each class bears to the like income for the year ending at the middle of 1890 is determined.

To better illustrate the changes that have taken place in the four incomes, curves Nos. 1, 2, 3 and 4 are drawn. Each curve starts at 100 per cent for the year ending at the middle of 1890, and conforms to the corresponding per cent for the following years. Curve 1 represents the relative amounts of incomes from all sales of electrical energy during the 10 years named. The constantly upward course of this curve indicates an uninterrupted increase of electrical income.

Ratio of income for each year to the income for the year ending June 30, 1890.

Year ending June 30.	Income all gas sales. *Per cent.*	Income gas street lamps. *Per cent.*	Income all elec-tric. energy. *Per cent.*	Income electric street lamps. *Per cent.*
1890	100	100	100	100
1891	112.2	89.3	127.4	
1892	117.2	80.2	154.4	
1893	119.7	80.1	179.6	
1894	98.9	64.6	189.7	
1895	104.3	57.3	198.0	
1896	119.6	55.2	217.3	183.0
1897	119.5	54.8	234.7	189.4
1898	122.8	55.7	250.2	201.7
1899	125.5	55.6	264.4	205.8
1900	137.2	53.6	294.6	215.1

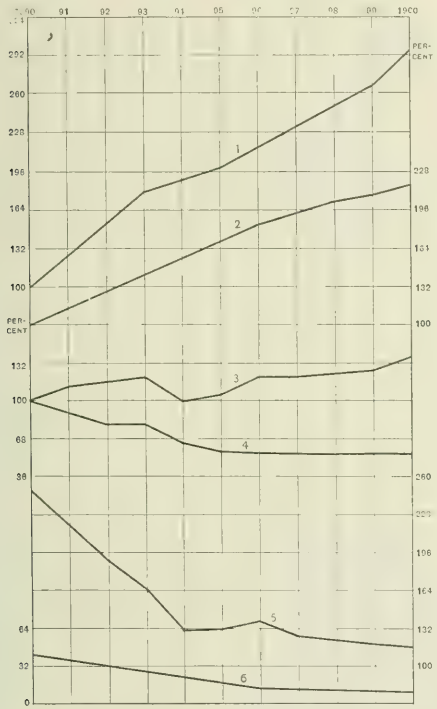
During the 10 years represented by the curve, the yearly income increased 194.6 per cent beyond that of 1890. This growth nearly equals 20 per cent a year for the entire period, or an addition to the income of an amount corresponding to the income of 1890, every five years.

Curve 2, drawn to the same scale as curve 1, represents the per cent of increase in income from electric street lighting during the period. Like the curve of total income, that for electric street lighting shows a steady ascent from the middle of 1890 to the like date in 1900. As may be seen from the table, no data is available for the income from electric street lighting between 1890 and 1896. The income for the year ending at the middle of 1890 is taken at 100 per cent as in the previous case, and the relative incomes of the years ending at the like date in 1896 and thereafter are calculatd accordingly. For 1896 the income from electric street lighting was 183 per cent of that in 1890, and from this point on the rate of increase, though not quite so rapid as before, was sufficient to reach 215.1 per cent in 1900. The added income for the last year over the first of the period was thus 115.1 per cent, and the yearly average 11.5 per cent, or a little more than one-half of the annual per cent of gain for the entire electric income.

Curves 3 and 4 for the gas incomes are drawn to the same scale as those just described, and therefore indicate at a glance the general tendency of these incomes compared with the two former. The movement of the total gas income is indicated by curve 3. This curve shows an increase of receipts up to the middle of 1893, but here comes a decline for the dull period after the panic of 1893, and

the loss is not regained until 1896. The effects of industrial depression during this same period are shown by the changed direction of curve 1 from the middle of 1893 to the middle of 1895. Electrical income, however, did not decline, but only slackened in its upward movement. Gas income, on the other hand, went back for the year ending June 30, 1894, to 98.9 per cent of what it was for 1890. Since 1897 there has been a moderate yearly increase in the volume of gas business, and at the middle of 1900 the yearly income stood at 137.2 per cent of what it was for 1890.

This increase of 37.2 per cent during 10 years corresponds to 3.7 per cent each year, on an average, or less than one-fifth of the like average for the total electric income. Unlike either of the curves just considered, curve 4, illustrating the changes in income from gas street lamps, takes a downward course from the start, indicating an almost constant though not uniform decline in the amount of yearly income. Most of this decrease took place before the middle of 1895, the annual income for gas street lamps at the middle of that year



CURVES ILLUSTRATING CHANGES IN INCOMES.

being only 57.3 per cent of the amount for the year ending in 1890. Since 1895 gas street lamps have yielded a nearly constant income yearly, the amount for 1900 being 53.6 per cent of that for the first year of the period.

The corresponding decline of 46.4 per cent in the receipts from gas street lamps amounts to an annual average of 4.6 per cent during the 10 years. This figure is in striking contrast with the yearly gain of 11.5 per cent noted for the incomes from electric street lamps.

Thus far gas and electric incomes have been considered only as to the changes of each from year to year. The accompanying table, with curves 5 and 6, illustrate the relative amounts of incomes derived from gas and electric service, both as to the totals and as to that portion received for street lighting. Curve 5 shows the per cent of total gas income to total electric income for each year between the middle of 1890 and the like date of 1900.

For the year ending June 30, 1890, the entire income from the sale of gas was 249.9 per cent of the entire income from sales of electrical energy in the same year. From the date just named to the middle of 1894 there was a nearly uniform fall in the ratio of gas to electric incomes of 29.8 per cent yearly on an average, or 119.3 per cent for the four years. Between the middle of 1894 and the like date in 1896 the ratio of gas to electric income rose 6.7 per cent, standing at 137.3 per cent for the latter year. During the next four years the curve shows a further decline in the gas income to 116.1 per cent of the electric in 1900. The net result of these movements is a total fall in the ratio of the gas to electric incomes of 133.8 per cent, or 13.3 per cent yearly on an average.

In other words, the income from all sales of gas was 2.5 times the like electric income in 1890, but in 1900 the earnings from gas were

Ratio of incomes from sales of gas and electrical energy in each year.

Year ending June 30.	Total gas income as per cent of total electric income.	Income from gas street lamps as per cent of income from electric street lamps.
1890	249.9	42.1
1891	219.2	
1892	189.0	
1893	166.3	
1894	130.6	
1895	130.9	
1896	137.3	12.7
1897	125.2	12.2
1898	122.5	11.6
1899	118.5	11.3
1900	116.1	10.5

only 1.16 times those from electrical energy. Curve 6 illustrates the ratio of income from gas street lamps to income from electric street lamps for each year from 1890 to 1900. Unlike the income from total sales of gas, that from gas street lamps began the period in question much below the corresponding electric income. For the year ending at the middle of 1890 the income from gas street lamps was only 42.1 per cent of the receipts for electric street lighting. No other figures for electric street lamps are available until 1896, when the ratio of gas to electric income from street lamps had fallen to 12.7 per cent. This is at the rate of nearly 5 per cent yearly. Since 1896 the decline of the ratio for gas has been much more gradual, the figure for 1900 being 10.5 per cent of the earnings of electric street lamps. For the entire period of 10 years the gas income from street lamps lost 31.6 per cent compared with the electric, or more than 3 per cent yearly on an average.

Looking at the six curves, it may be seen that the first field of serious competition between gas and electrical energy was that of street lighting. The unrecorded rise of electric lamps to the commanding position in this field must have taken place in the decade from 1880 to 1890, for in the latter year the electrical was more than douple the gas income from street lamps. This struggle continued with somewhat less vigor until 1896, when the income from gas was only one-eighth of that from electrical street lamps. Since this last date gas has slowly moved toward a position of even less relative importance in street lighting. Not content with its conquest in the field of public service, electrical energy is rapidly moving toward the position of first importance in the supply of private consumers. This tendency is operating with renewed vigor since 1896, as may be seen by inspection of curve 5 since that year.

It may be thought that the falling ratio of gas to electric income is due entirely to the rapid rise of earnings with electrical energy, as illustrated in curve 1, but it seems certain that the change of this ratio is due in part to a smaller use of gas for illuminating purposes per unit of population. The number of inhabitants in Massachusetts increased 25.2 per cent during the decade from 1890 to 1900. During this same period the total income from sales of gas increased only 37.2 per cent. Meantime the number of gas stoves in use has increased several hundred per cent, and the number of gas engines by a large per cent.

To supply these stoves and engines it seems certain that much more than the gas represented by the 12 per cent increase of income over the increase of population must have been necessary.

It follows that the amount of gas income per capita, from its use for illumination, and probably the actual volume of gas per capita is now less than it was in 1890.

The foregoing facts point to the conclusion that electrical energy

is forcing gas from its former leading position in the field of artificial illumination, and to its more rational use for heating and the production of power in units of fairly large capacity.

For the distribution of power in small units, say, under 20 horsepower, gas engines have been hopelessly distanced by electric motors, as general observation amply proves.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.—V.

By Walter Reichel.
(*Chief Engineer Siemens & Halske Company.*)

HIGH-TENSION SWITCHES.

THESE switches, like those for the mean pressure circuits, are built on the tube principle, and have a double break on each of the three branches. They differ materially from the mean pressure type in that the contacts are not arranged in a circle, but in sets of three, and that one-half of the switch is above and the other half below the roof of the car. For this purpose the same type of hollow insulators, as those for the high-tension fuse device, is used. The current passes from the current collector (trolley) through these hollow insulators to the one contact piece; from this through a bridge to the other contact of the switch and then through the second hollow insulator back to the roof and then through the distributing circuits to the safety fuses.

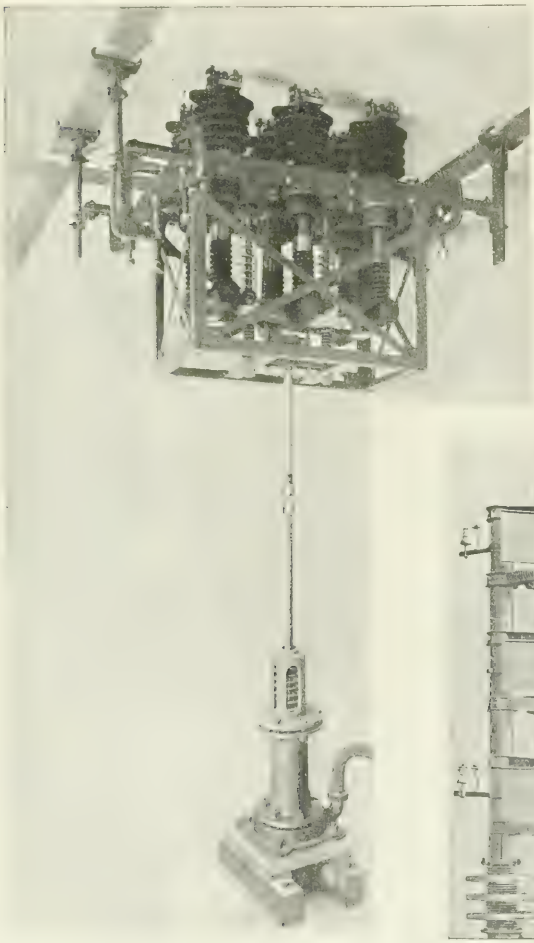


FIG. 25.—HIGH TENSION SWITCH COMPRESSED AIR MECHANISM

The switch is located in a sheet iron box next to the small transformer. To the cover of this box are fastened six insulators above referred to, two for each branch. The main contact consists of a ring, into which fits a split copper tube. An auxiliary contact consists of three horizontal circular segments of copper into which a plunger is pushed.

The split copper tube of the main contact and the plunger of the auxiliary contact are connected together. The above-mentioned bridge consists of a U-shaped hollow cast body, which is covered without and within by hard rubber, and through this passes the connecting wire for the two legs of the circuits.

The three bridges of the three branches are joined by a plate (Fig. 25), and are operated by a common compressed air cylinder, having a stroke of 10 inches, which is located toward the front of the car beneath the seats. The plate is guided by two vertical rods and the switch is closed by the plate being raised by the cylinder piston.

As in the mean pressure switch, two snap hooks hold the plate tightly after it has been pushed into place, and the plate can only be released by springs after the piston, having returned to its original position, has released the hooks. The lowering is therefore very rapid and assures the breaking of the sparks. The lift of the bridges is limited by buffer springs.

CURRENT COLLECTOR OR TROLLEY.

The current collectors, through which the current passes from the line to the high-pressure switches, are widely different from any type heretofore constructed. They are patterned after those used on the Siemens-Halske Lichterfelde experimental line. As it was deemed inadvisable to permit crossings over high-speed railways on account of the fact that the wires might possibly be touched from the bridges and because such crossings would necessitate a lowering of the current collectors which at such high speeds is not to be recommended, it was decided that the high-speed railway must always pass over other highways, even if the roadbed must be raised accordingly. This gave the designers unlimited space above the roof of the car, and admitted a design which would be efficient and certain. It consists of a heavy mast built into the car, which is movable about its vertical axis. The mast consists of two telescoped Mannesmann tubes 200 mm. (7.8 inches) in diameter. The mast is firmly fastened to the floor of the car and passes through a sleeve bearing in the roof of the car. By means of a hand brake operating a double set of gears the mast can be revolved by the motorman. It can be firmly held in its lower bearing by means of a wedge. There is a flange at the upper end of the lower part of the mast to which the tube carrying the collector rings is fastened. The flange is made of cast steel, and is surrounded by a hard rubber sleeve. Three contact springs press

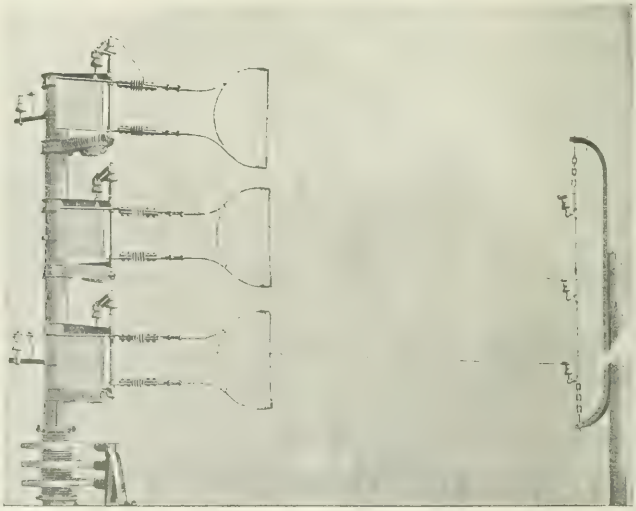


FIG. 26.—CURRENT COLLECTORS.

against the rings, which are fastened by means of hard rubber posts to a special block of iron, as shown in Fig. 26.

Into the insulating tube and partly also into the lower part of the current collector the upper tube is fitted, which can be easily taken off by the loosening of a few screws. This tube carries three revolving sleeves 1 m. (3.28 ft.) apart from center to center, which carry the actual collectors. On account of the enormous wind pressure occasioned by the high speed which might cause the collectors to leave the trolley wire, the collectors must not only be pressed against the

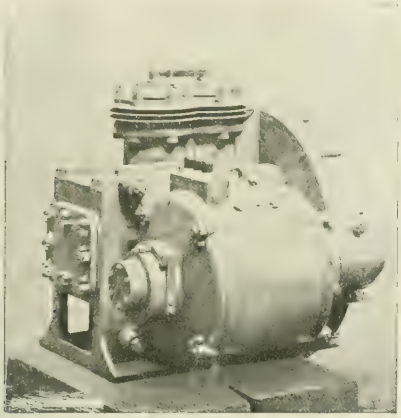


FIG. 27.—AIR PUMP, WITH MOTOR.

wire by springs, but the wind pressure against the collector must be equalized on the other side of the sleeve by a flat surface, as shown in Fig. 26. The collectors are made of steel tubing, as usual, and are detachable. To the upper points of the axis bell insulators are attached, the bronze caps of which are electrically connected with the collectors. From this bronze cap the current is collected by a contact spring, and from here goes to the lightning arresters and the collector rings. The lightning arresters are of the ordinary fork type. There are two current collectors on each car, so as to prevent the 200-ampere current from damaging the collectors and to eliminate the sparking at switches or section insulators on the line.

THE COMPRESSED AIR INSTALLATION.

The compressed air used for the operation of the brakes and the electric switches is supplied by two air pumps, driven by electric motors, which are located beneath the car directly below the platform. At a speed of 190 r. p. m. they compress 400 liters (88 gallons) of air at atmospheric pressure to eight atmospheres absolute. The pump is of the duplex type with two vertical cylinders in which the pistons are moved up and down by a crank-shaft. On the latter a large gear wheel is mounted, into which the small pinion of the motor meshes. The entire device is encased so that no dust or water can enter. The motor is supplied with current from a small trans-

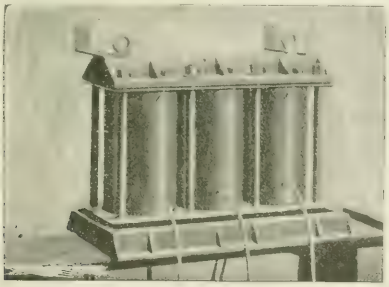


FIG. 28.—SMALL TRANSFORMER.

former (Fig. 28), which is constructed similar to the large transformer, and which is located on the roof of the car together with the high-tension switches. The high-tension winding is protected by three high-tension fuses.

The low-tension winding produces a pressure of 110 volts, and is connected by wires passing through iron pipes to the pump starting switch on the platform. The compressed air is stored in two tanks for the brakes and two tanks for the switches. The air pump is fastened to the iron frame of the car by means of U and angle irons.

APPARATUS FOR THE COMPRESSED AIR DISTRIBUTION.

The tanks above referred to are situated on the two platforms, one on each platform. The tank for the operation of the switches is

FIG. 29.—OPERATING TABLE.

fastened to the ceiling while the tank for the operation of the brakes is located at the left hand corner in the back of the platform. The pressure in this tank is 8 atm., in the other tank 4½ atm. Both tanks are connected by an equalizing pipe. The system is operated from a table located along the front of the platform. The table is connected with the various pipes in the car by heavy rubber tubes, which, of course, can be easily detached. The various cocks permit of three positions, as follows:

I. Connecting the switch cylinders with the atmosphere.

II. Cutting the switch cylinders off from the atmosphere and connecting them with the air tanks.

III. Switch cylinders connected with the atmosphere, but connection with the air tanks is cut off.

Onto the frame of the table are fastened one two-way cock for go-

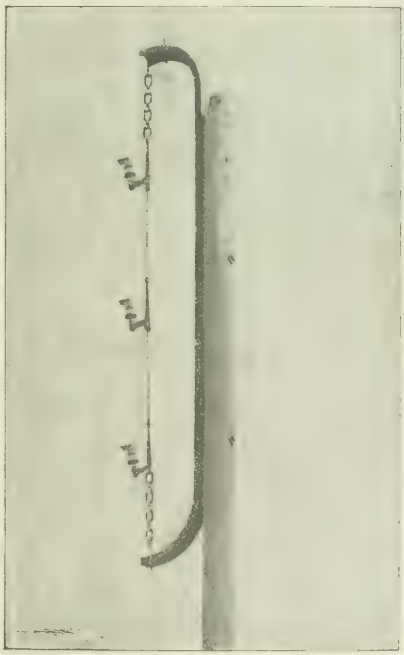


FIG. 30.—TROLLEY POLE, WIRE SUPPORTS, GROUND WIRE AND LOOPS.

ing backward and forward, and one, which is seldom used, for connecting the transformers in star and delta. Also a one-way cock for the motor switch and one for the controller. This is operated by the hand wheel on the motorman's table, which, as has been previously

explained, is connected by means of gearing with the main shaft of the controllers. The hand wheel moves around a scale with 29 divisions, and a pointer shows the exact position of the controller cylinders at any instant.

All cocks on the platforms are arranged directly beneath each other and are connected by rubber tubes and iron pipes with the starting cylinder which is located beneath the car floor.

Mounted above the table so that they can be read at a glance are two air-pressure gauges and three electrical instruments, a voltmeter, an ammeter and a voltmeter, indicating for kilometer-hours the pressure generated by a small dynamo coupled to the running axle. The voltmeter measure the secondary e. m. f. of the small transformer, but is so marked that it indicates in the transformation ratio of the transformer. In this way the actual line voltage can be read off. The ammeter measures the current of one phase of one of the four motors.

In the right corner of the platform, toward the rear, is the hand brake for braking the truck nearest to the platform. At the right side of the operating table is the air cock for operating the air brake. At the left side is an emergency cock, which is of the one-way type, but can be turned into two positions. When the car is running it connects the air tank with all the steering cocks; when placed in the emergency position, it shuts the air tank off from the switches and the atmosphere but opens the working cylinders of the switches into the atmosphere which causes the latter to open.

There is furthermore located on the platform a cock for the operation of the air pump. This is mechanically connected with the motor switch, and has three positions—"rest," "running," "pumps." In the "running" position the motor starts without a load, and after it is running the cock is set in position "pumps," when it is operated by the entire air pressure in the tank.

FIG. 31.—GENERAL VIEW OF POLE LINE.

FIG. 32.—TYPES OF POLES BETWEEN VARIOUS SECTIONS AND AT TERMINALS.

DETAILS OF LINE CONSTRUCTION.

Referring to Fig. 1, Part I., it will be seen that the line extends from Marienfelde to Zossen, a total distance of 23 km. (14.26 miles).

Parallel to the track and 2¼ m. (7.38 ft.) from the center, toward the right side in the direction of Zossen, wooden poles have been placed 35 m. apart. To these the U-shaped arms, shown in Figs. 30 and 31 are fastened by three bolts. The trolley line is not rigidly connected to these arms as the connection is made by means of links as shown in the figure. This enables a uniform contact between the three collectors and wires to be obtained at all times.

The trolley wires are doubly insulated from the earth, so that each insulation alone will stand the maximum pressure of 12,000 volts. The high-pressure insulators are made of hard rubber. A wrought iron conical bolt 200 mm. (7.8 inches) in length is surrounded by a hard-rubber sleeve 5 to 6 mm. (about 0.2 inch) in thickness. There is a thread, 50 mm. (1.95 inches) in length at the upper end, and onto this the insulator is screwed. This is also made of rubber. The second insulation is the chain at top and bottom, also made of hard rubber.

Each of the trolley wires has an area of 100 sq. mm. (.15 sq. in.), and they are made of hard-drawn copper, and a conductivity of at least 97 per cent of chemically pure copper. The horizontal distance of the wires from the center of the track is 1450 mm. (4.75 ft.). The three wires are placed vertically above each other 1 m. (3.28 ft.) apart; the lowest wires being hung 5.5 m. (18 ft.) above the top surface of the rails.

The total line of 23 km. (14.26 miles) is divided into several sections in such a way that at distances of 1 km. (.62 mile) the wires are anchored in the direction of their length. To serve as an anchorage between two sections, and at the terminal points of the line two wooden poles are connected together and are supported, as shown in Fig. 32. This method enables the system to withstand a horizontal pull of 3000 kg. (6600 lbs.) at a height of 6 m. (19.68 ft.) above the rails.

These anchorage points take the place of section switches. In order to connect the several sections electrically, connecting wires are attached at these points, which can be easily removed in case it is desired to cut the current off from any one section.

At the anchorage points the collectors pass without touching the wires for a distance of 10 m. (32.8 ft.). As the two collectors on the car are 17.64 m. (57.85 ft.) apart the car is never without a supply of current.

To the right and left at a distance of 5 m. (16.4 ft.) from the anchorage points a pole is placed. It is located 380 mm. (14.82 inches) behind the row of trolley poles. This will insure a smooth gradual passing over of the collector from one wire to the other. Each section is supplied with a lightning protective device, in the form of a lightning rod fastened to the wooden poles.

A precaution has also been adopted against danger from a broken wire in the form of a device which grounds the current-carrying wire. At each point of support of the trolley wires is a loop of an 8 mm. (.312 inch) copper wire, as shown in Fig. 30, which is connected with the trolley wire by means of a clamp at the wrought iron cap, the clamp being fastened to the cap by a brass bolt. In case the trolley wire breaks the pull will turn the clamp, which in turn will pull the copper loop against a grounded 8 mm. (.312 inch) copper wire. The latter is coiled into a spring at its upper end, and passes down the pole to the rail, to which it is connected.

The rails are connected together by rail bonds of copper cable. By a special wire the rails are connected to the zero point of the system and every kilometer (2.2 miles) they are connected to the earth by special ground plates.

The feeders between Marienfelde and the power station at Oberschonweide of the Allgemeine Elektricitats-Gesellschaft, three high-pressure wires and a neutral wire, are partly bare wires mounted on porcelain insulators fastened to wooden poles, partly cables, in case bare wires could not be used. These have a cross-section of 70 sq. mm. (.108 sq. in.), the bare wires of only 50 sq. mm. (.0775 sq. in.). Under the bare wires, where it was found necessary, nets were spread. At Marienfelde the line branches off to the car shed situated nearby.

The Theory of the Electrolytic Rectifier.

By Dr. K. Norden.

THE purpose of this article is to advance a complete theory of the modern electrolytic rectifier, which has been wanting up to date. The subject will be developed according to the researches made experimentally in this line.

Although the practical progress made in the production and application of the electrolytic rectifier has been laid down in various patents issued during the last few years, still the theory has never been fully explained and the results of theoretical researches, which have been made in this line, are scattered in a great number of scientific periodicals. The author for this reason believes that a paper treating briefly on the theoretical side of the question may be of interest and perhaps may give a basis for further investigations concerning this interesting subject, which, until now, has remained in an uncompleted state.

The phenomenon in question may first be briefly explained. An electrolytic cell with one electrode of aluminum and the other of lead, carbon or any other suitable conductor, permits an electric current to pass in one direction only, viz., from the lead to the aluminum. In the reverse direction the current is reduced practically to nothing, especially if the aluminum electrode has been subjected to a previous treatment, called formation, except when a certain voltage is exceeded. Hence, it is evident that if an alternating current is sent through this cell, only the waves making the aluminum a cathode will pass, so that the current is "filtered" and transformed into an interrupted current of uniform direction. By proper arrangement, it is possible to utilize both waves in the same direction after having separated them, thus obtaining a continuous direct current in the working part of the circuit.

After the aluminum electrode has been exposed to the action of an alternating or a direct current, which latter has to enter the cell at the aluminum pole, the aluminum is changed in its appearance and is now covered by a thin film, the thickness of which varies somewhat with the electrolyte used in the cell and the time of this action or "formation."

At first the film is so thin that it cannot be observed directly, but its presence is indicated by the colors of interference appearing on the surface of the electrode. After a certain lifetime this film is easily recognized as a gray, dull coating, traversed by dark lines according to the structure of the metal. This film is doubtless the seat of the asymmetric effect on the aluminum electrode and a thorough investigation of its formation and properties must lead directly to a theory of the rectifier.

The film, when cutting down the current sent through the cell, may offer to it either a counter e. m. f. or a high resistance. In the first instance, we have the conditions of an electrolytic polarization, and this may be considered as analogous to the well-known case of the lead accumulator, in which the positive plate is covered with a layer of lead peroxide, and does not permit a current to pass, if its voltage is below two volts. However, this explanation of the film was soon abandoned. For the e. m. f. of two volts of the accumulator cell, due to the presence of peroxide of lead on the positive lead plate, is retained after the charge as long as there remains any residue of the coating of peroxide, while the counter e. m. f. of the formed aluminum, which can be brought up to a hundred and more volts, drops down immediately after the charging current has been cut off, though the chemical condition of the film has not been at all changed. A very small amount of e. m. f., not exceeding about three volts at the highest, is still left, representing the true value of the electrolytic polarization, but this is too low to justify this explanation of the process.

On the other hand, the electric resistance of the film has been measured and found to be very high. Professor Wilson[1] observed values up to 10,000 ohms, which practically can be considered as an insulating resistance. This would suggest the explanation given by the early investigators, who wrote about this subject (Ducretet, Beetz and others). They state that a high resistance introduced by the anodic film may rapidly stop the current, and thus produce a unipolar effect. Although in accordance with the present facts, this theory is too narrow to explain the physical behavior of the cell in all cases.

More light was thrown upon this subject from a new point of view, introduced by F. Kohlrausch's discovery of the polarization capacity of metallic electrodes,[2] and applied to the aluminum cell by Streints (1888), Scott (1899) and others. According to this theory, a layer covering an electrode represents the dielectric of a condenser. The coating of the latter is formed on the one hand by the metallic plate, on the other by an opposite layer of electrically charged ions in the electrolyte. In the present case, after having formed the dielectric film on the aluminum anode, the e. m. f. of the circuit then charges the said condenser to the value of its own voltage. After the cell has been disconnected, the tension of this condenser drops down immediately through self-discharge.

By means of this theory, we are enabled to explain the behavior of the aluminum cell even in cases where the old theory of resistance mentioned above fails. When placed in the circuit of an alternating-current dynamo, the aluminum cell acts like a condenser, carrying a current leading the e. m. f. in phase, and many researches were made along this line some years ago by Professor Fessenden of this side of the Atlantic and others abroad. After all, in many practical cases the aluminum cell can replace the ordinary condenser and thus at once has a certain use in some scientific laboratories. Most of the patents granted in regard to the application of the rectifying cell refer also to its use as a capacity.[3]

The well-known phenomenon of the luminosity of aluminum cells has to be explained in accordance with the above. This phenomenon was discovered abroad by Dr. E. F. Polzeniusz and exhibited at the meeting of the German Chemical Society at Frankfort-on-the-Main some years ago; and also independently in this country by Mr. W. S. Andrews, who recently exhibited such luminous cells in the Conversazione of the American Institute of Electrical Engineers. If the voltage impressed on the cell is increased to a certain point, then the aluminum plates seem to glow with a faint phosphorescence, growing brighter as the voltage is increased. If we consider the film on the plates as a dielectric, then the phenomenon results from a silent discharge, like that of a current passing through a Geissler or Crookes tube. If the voltage is still further raised, the discharge turns disruptive, stars or scintillations appearing on the luminous surface. This occurs when the stage is reached where the insulating power of the layer is unable to stand the pressure of the voltage any longer, and the dielectric breaks down in its weak points. However, the phenomenon remains continuous, for, when any point of the film is destroyed by sparks, it is immediately renewed by the electrochemical action of the current.

Summing up, the theory of the aluminum cell as a condenser based upon the high resistance of the film seems to be out of question, and the physical side of the problem is thus cleared up. However, the working rectifier is not a mere physical, but also an electro-chemical problem, and we have also to discuss the chemical properties and the chemical behavior of the insulating film before a complete theory may be advanced.

Owing to the extreme thinness of the layer of film formed on the aluminum anode, it seems to be almost inaccessible to ordinary chemical methods of analysis for want of sufficient material. Therefore, the opinions about the chemical constitution and the formula of the substance have been rather divergent. The first discoverer of the phenomenon, Buff,[4] considered the film as silicon, which is always contained in commercial aluminum to a certain percentage, and might be accumulated on the surface of the aluminum electrode if some of this metal is dissolved by the current. Later on Professor Beetz disproved this conception by experiments, and with many others assumed that a suboxide of aluminum is formed by electrolytic action; the existence of this suboxide has, however, never been proved in a satisfactory manner.

As the only means of deciding this question, exact chemical analysis was resorted to by the author of this article two years ago, and the results were published in the *Zeitschrift fuer Elektrochemie* in 1899. The author paid attention to the fact that the film formed on the anodic aluminum, does not disappear when the current is reversed, though it becomes inactive. When, after a while, it is submitted again to the anodic action, then the film separates from the electrode and a new film is formed in place of the former one. By repeating this process, a sufficient quantity of films was obtained for analysis according to the most exact chemical methods. The results of numerous analysis made revealed the fact that the film consists

[1] London *Electrical Review*, 1898, Vol. XLXIII.

[2] Ueber die Polarisations kupazitat von Metallelektroden," *Wied. Annal.*, 1873 and 1874.

[3] U. S. Pat. No. 672,913, Electrolytic current rectifier and condenser, to C. Pollak, and other patents.

[4] *Liebig's Annal*, 1857.

of normal aluminum hydroxide, of the formula $Al_2(OH)_6$. Variations in the conditions of the experiment did not influence this result. As an electrolyte in these experiments dilute sulphuric acid was employed. The acid acts chemically on the aluminum hydroxide, forming the basic or neutral salt of aluminum sulphate. Consequently, there was found on the one hand a certain amount of sulphuric acid fixed by the film, and on the other a good deal of aluminum sulphate dissolved in the liquid. This action of the acid was ascertained to be a mere chemical one, accompanying the regular electrolytic formation of the hydroxide.

During these experiments, the effect of the electric current was continuously controlled by comparing the amount of gas set free at the aluminum with the weight of copper deposited in a copper voltameter placed in the same circuit. No reducing action at all was found to take place on the aluminum, when employed as the cathode, and the full theoretical cathode effect of the current was used up in developing hydrogen. This result was to be expected from the above stated chemical constitution of the film. For even nascent electrolytic hydrogen is not strong enough to reduce aluminum oxide or hydroxide, which, when formed out of its components, develops a heat of combustion greater than any other known substance.

The absence of any electro-chemical action on the aluminum cathode is a very important fact in the explanation of the working rectifying cell, and this must be remembered in considering any available theory. In the case of a real alternating current the alternations are apparently too fast to allow any separation of the film by subsequent cathodic and anodic action, nevertheless, the results of the writer's observations are applicable to the conditions of the working rectifier.

According to the facts above stated, one wave of the alternating current produces the insulating film, by converting the surface of the aluminum into hydroxide, while the opposite wave does not have any effect on the same. But the important question arises, How is it to be understood that in a circuit with aluminum as the cathode, the current can pass almost freely through the cell, if the high-resistance anodic film still remains unchanged?

Before answering this question, I wish to call attention to an observation which is familiar to every one who has studied the aluminum rectifier. If after the generation of the film, the forming current is disconnected and the cell left to itself, then the aluminum electrode loses its insulating power in a sort time. Introduced again in the forming circuit, it carries at once a considerable current depending on the length of the time it rested, as if the aluminum electrode were used as cathode and the insulating coating became inactive. On the surface of the aluminum anode the developing gas marks the points where the current enters the electrode, until complete formation is restored.

This observation, I believe, can easily be explained in accordance with the above described researches by pointing out that the film of aluminum hydroxide has a certain chemical solubility for all the usual electrolytes, due to its double reaction of a base as well as an acid. Hence, if the cell is left to itself, the liquid by mere chemical action, soon corrodes some weaker points of the coating, thus destroying the insulating power of the electrode. The current, when connected again, passes freely through these low-resistance points, at the same time touching up the coating by its electro-chemical effect. The chemical dissolution, however, must be imagined as a very slight one, as the layer or film itself is extremely thin.

Granting once that a certain dissolution takes place in the resting cell, then the same must be the case with the working cell. The aluminum anode, as a matter of fact, never stops the current entirely, as may be easily recognized by some bubbles of gas evolved from its surface. But, of course, this dissolution and, therefore, the reduction of resistance, never can exceed a certain stage, because the forming effect of the current continuously restores the weakened points of the coating in the same manner as the breaking down in points of the film in the luminous cell, above described, is kept continuous. If the current is reversed, so that the aluminum becomes the cathode, this restoring action is lacking. Dissolution and reduction of resistance is going on as in the resting cell, and in the same way it is easily understood how the current passes freely through the cell.

As a consequence of the explanation herewith given, the efficiency of the different electrolytes used in the rectifying cells ought to be very distinct, according to their respective dissolving power, and, in fact, practice shows conspicuous differences between the same. However, whether these differences are at the same time in exact proportion to the dissolving power of the electrolyte, as the theory would require, is a question which may not be decided at present. There are only a few chemicals which offer as great a variety of modifications physically as aluminum hydroxide. These modifications differ principally as to their solubility, and we are not yet able to say which of these different modifications of the aluminum hydroxide forms the film on the anode.

However, the theory advanced is not in conflict with any fact of chemistry, and explains the electro-chemical process in quite a satisfactory manner. It is based on chemical analysis and is in harmony with the practical and scientific knowledge of the present electrolytic rectifier.

The Telephone as An Information Bureau.

MISS BLANCHE ASHLEY.

One of the unique departures inaugurated by Mark Davis, until recently general manager of the Cuyahoga Telephone Company, Cleveland, in connection with the service of the company, is a public information bureau. Although the scheme has only been in operation for about six months, it has already become one of the most valuable features of the Cuyahoga system; one which has unquestionably done much toward popularizing the service with the general public. The bureau has a special number, and it averages more than double the number of calls of any line on the boards. It is utilized by all classes of people, and the variety of questions asked are almost as numerous as the stars in the heavens. Naturally, the person in charge has not only to be a walking encyclopedia, but must be well up on current affairs of all kinds. Such a person is hard to find, and it was months after Mr. Davis first developed the scheme in his mind that he finally found the right one. Miss Blanche Ashley, who has been in charge of the bureau since it was firmly established, is a young woman of more than ordinary attainments. She is well educated, well read, cultured and refined, and has had experience in a position where much learning, patience and perseverance were required—that of endeavoring to educate imbeciles at a State institution.

The information bureau now at the Cuyahoga exchange is fitted up expressly for the purpose. It is apart from the main exchange, and it is provided with a very complete reference library. There are encyclopedias, dictionaries, hand books, time tables, geographies, histories, works of law and medicine, religious reference books, directories of Cleveland, and many other cities; in fact, a list of books which might in any way contain the answer to any question likely or unlikely to be propounded. Questions are written out as they are asked with the telephone number, and address of the inquirer. Sometimes they can be answered at once, but frequently the reference books must be referred to. Often the operator is obliged to call up some one who is likely to be familiar with the matter in question, and frequently it is necessary to enter into the correspondence with parties in other cities before the information can be obtained. Sometimes questions are asked which are clearly outside the province of the bureau, and in such cases the inquirer is referred to some one who is likely to be able to furnish the desired information. Of course, the majority of questions are concerning matters of common occurrence. People want to locate parties in or out of town, to learn addresses of business houses or manufacturers of certain articles, time of arrival or departure of trains, best routes to given points, what the weather is likely to be, postal rates, etc. The location of fires is a frequent question, and the most common during the summer time is concerning the baseball score; in fact, this is sometimes asked a hundred times a day, and the operator never keeps any record of this question. Sometimes the questions are silly, and these are discouraged, sharply and sarcastically.

The bureau is for public information, but at first starting the funny man was much in evidence, asking such questions as "Can a man

marry his widow's sister," but a few sharp turn-downs were effective. The questions are now more reasonable, although many of them are extremely difficult. Among the questions asked in a single day recently were the following:

"Will money lost in a registered letter be refunded by Uncle Sam?"

"What is the average number of tons of coal consumed on a voyage by an ocean steamer?"

"In what county is Glastonbury, England?"

"What are the necessary preliminaries to become a notary?"

"Is there any law to prevent a President from holding a third term?"

"What is the greatest and average depth of Lake Erie?"

"How much does a cubic foot of gold weigh?"

"What is the cost of a copyright?"

"How old is Olga Nethersole?"

"Will the people of Cuba vote for the President of the United States?"

"What was the cost and displacement of the steamers 'Great Eastern' and 'Celtic'?"

"To what countries do Greenland and Iceland belong?"

"What is the total valuation of the world?"

"May a man shoot rabbits on his own farm?"

"How far is it to heaven?" (This is from a funny man.)

"Are stamps required on a letter to the White House?"

"Is there any clause in the Constitution permitting a woman to become President?"

Another scheme of inducing subscribers which has been worked by Mr. Davis with great success is that of calling attention to non-subscribers to the fact that they are losing business by not having the Cuyahoga connection. The "new number operator" at the exchange keeps a careful record of parties who are asked for but who do not subscribe to the service. Once a week a postal card is sent to the various parties stating the number of times they have been asked for, the opinion being presented that they are handicapped by the lack of service. A few days later a solicitor makes a personal call. The argument is one which counts for much, and it generally has the desired effect.

New Telephone Patents.

Among the telephone patents of last week are two granted to Frank B. Cook, of Chicago, one on a system including a new form of generator switch and a method of ringing without the use of ringing keys, and the other on a form of distributing board. In the Cook system the generator at the subscriber's station is normally out of circuit. When the crank is turned a friction wheel is put in action which pushes up a contact roller that acts on a set of contact springs, connecting to generator to the line and opening the contact that normally closes the line round the generator circuit. The arrangement is ingenious, but involves the use of no fewer than four spring contacts and practically does not appear to accoplish more than any of the standard devices for cutting the generator armature in and out of circuit.

The ringing device is especially adaptable to four-party lines equipped with polarized bells and operated from non-multiple boards. On inserting the plug in the appropriate jack and pushing the plug home, the tip of the plug, pressing against a projection of insulating material on the line spring, pushes the line spring upward against a contact spring connected to a generator. When pressure on the plug is released the plug is automatically pushed back by the line strip and then establishes the contacts required for talking. Two generators are supplied, one with the positive pole permanently connected to certain jacks, and the other with the negative pole connected. Mr. Cook also shows an arrangement, involving a rather more complicated form of jack, which enables one generator to be used for both positive and negative signals.

The other patent granted to Mr. Cook covers the detailed arrangements of a wooden distributing board with binding post terminals mounted on ebonite strips. The general adoption of metal distributing frames with clips for soldering all connections will naturally limit the field of application of this device.

To William S. Paca, of Erie, Pa., is granted a patent on a highly

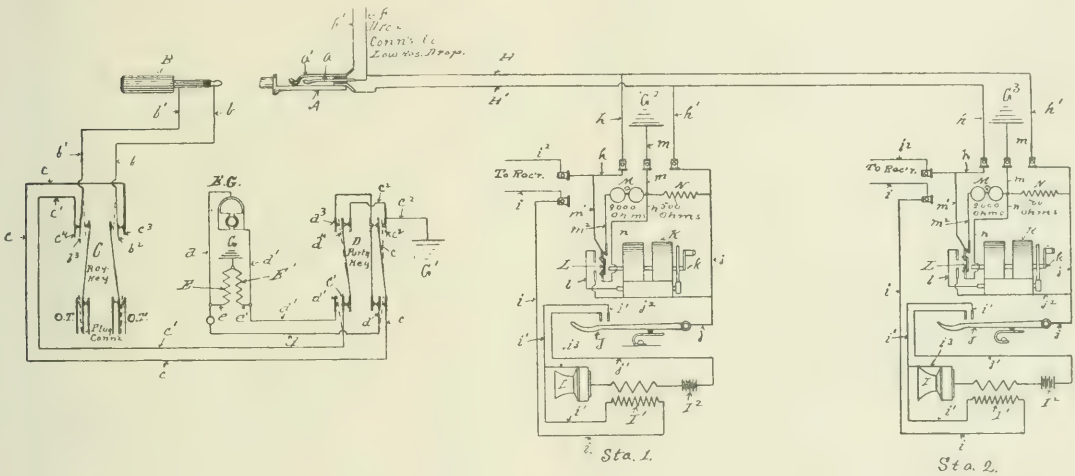


Diagram of Selective Paca Telephone Bell System.

ingenious selective bell system, involving somewhat complicated apparatus at subscribers' stations and central office, but avoiding the use of polarized bells—that is, of plus and minus bells. Referring to the accompanying diagram, it will be seen that the bell at Station No. 1 is permanently connected to line H of the metallic circuit, and the bell at Station No. 2 to line H^1, the bells being worked on a grounded circuit formed of one leg of the metallic circuit for each bell. At each station, interposed between the ground to which the bell is connected, and the opposite leg of the circuit is a resistance coil of preferably 500 ohms. These coils prevent the ground at either station from interfering with the operation of the other. In each case the coil N operates not only to resist the passage of currents from the line j to ground when the bell at the other station is operated, but also operates to prevent part of the current passing through the bell being rung from passing to the line j and then through its line connections to the bell magnets M at the other station.

The exchange generator is connected to ground through a split resistance coil; the party key D operates to put one generator lead to ground and to connect the other, through the ringing key C, to the tip of the plug for ringing Station No. 1 (by line spring a and line H), or to the sleeve of the plug for ringing Station No. 2 (by line spring a^1 and line H^1). In each case a ground G^1 is put on the line by the party key to prevent a false signal being transmitted to the other station in case the called subscriber takes down the receiver while the call is being made, which would throw a bridge across the line

and divert the generator current from H to H^1, or vice versa, as the case might be.

When either station calls the exchange, the circuit from the generator is through one lien and the exchange drop and back through the other line to ground at the station. The resistance coil N at the second station prevents the ground there from interfering. When the exchange desires to signal an ordinary metallic circuit station the party key D is moved so as to cut out the ground G^1, closing $c\ d$ and $c^1\ d^1$. Then coils $E\ E^1$ are interposed between the generator leads and the ground G, and the generator is in circuit in the usual way. While this arrangement effects an operative two-party selective bell system without recourse to bells of special polarity, the object is effected, as will be noted, at the expense of fairly complicated circuits and apparatus.

CURRENT NEWS AND NOTES.

YERKES IN LONDON.—A cable dispatch from London of Oct. 19 says: It is understood that the Brompton & Piccadilly and the Great Northern & Strand Tube railways will combine their interests. The construction of both roads has been authorized by Parliament, and Charles T. Yerkes has arranged the combination scheme.

FOUND BY WIRELESS TELEGRAPH.—During a recent fog, when the "Lucania" was due but did not show up at her New York dock, Mr. Vernon H. Brown, the Cunard agent, had the Marconi operator on the "Umbria," then lying there, try if he could "raise her." Sure enough, a wireless reply came at once through the fog, stating that the "Lucania" was anchored outside the bar, waiting to come up when the fog lifted. The test was a very pretty one, as there was a dense fog and the boats were miles apart.

PRESIDENT M'KINLEY'S CASE.—The doctors' report on President McKinley's treatment has just been issued in the *New York Medical Journal.* In regard to the reasons for not using the Röntgen rays, Dr. Mann says that at no time were there "any signs that the bullet was doing harm. To have used the X Ray simply to have satisfied our curiosity would not have been warrantable, as it would have greatly disturbed and annoyed the patient, and would have subjected him also to a certain risk. Had there been signs of abscess formation, then the X-Ray could and would have been used." It may be questioned whether Mr. McKinley would have been alarmed, and as to the "risk," we should greatly like to know what it was. The fact remains that the bullet was not located when it could have been easily.

PENNSYLVANIA RAILROAD TELEGRAPHS.—In regard to recent rumors anent Western Union and Pennsylvania Railroad, an official of the road is quoted as follows: "I do not say positively that we will discard the Western Union service, but I will say that we are installing the Delany system for commercial purposes, and that in two weeks it will be working between here and Altoona, with all probability of its extension to Jersey City, Chicago, Pittsburg, Baltimore, Washington, and, in fact, all the larger points along the Pennsylvania lines. Then, with our wire facilities, we will be more than able to serve the public. Mr. Delany has transmitted a readable code and made a record of 8000 words a minute. At the Buffalo Exposition he is every day sending 1000 words a minute. At this rate one wire would do the present Western Union work between here and Pittsburg, and we have from 8 to 10 of our own wires all the way."

SUBMARINE BOAT LAUNCHED.—At Elizabethport, N. J., on Oct. 19 the submarine boat "Shark" was successfully launched at the Crescent Shipyards before a distinguished company. The vessel was christened by Miss Wainwright, daughter of Commodore Richard Wainwright. She is one of five torpedo boats built by Lewis Nixon for the United States Government. The ones already launched are the "Adder," "Porpoise" and "Moccassin." She is 63 ft. 4 inches in length and 11 ft. 9 inches beam. The displacement submerged is 120 tons. She has a 160-hp gasoline engine for surface running and a 70-hp electric motor for driving her under water with storage batteries. She is expected to make a speed of 8 knots an hour on the surface and 7 knots when submerged. She is armed with five Whitehead torpedoes. The only exposed part of the boat when not submerged is the conning tower, which is made of harveyized steel 24 inches in diameter and 4 inches thick.

POLYPHASE CURRENTS IN ELECTRIC TRACTION.—In the discussion at the Street Railway Convention of the paper on "Alternating and Direct-Current Transmission on City Lines," which appeared in abstract in our convention report, the author, Mr. M. S. Hopkins, said that in Columbus, Ohio, it was found that the loss of energy in direct-current feeders as determined by wattmeter readings, ranged normally from 23 to 31.2 per cent, and reached 50 per cent during hours of heavy load. A rotary sub-station enabled copper to be taken down, having a market value of $27,000. The high-potential transmission line substituted only required copper to the value of $10,000, which left $17,000 to be credited to the sub-station. The loss in energy is now kept well within 15 per cent between the main sub-station and the sub-station bus-bars, even during periods of heavy travel, which results in a yearly saving of $3,804 in the cost of power, or equivalent to 12 per cent on the cost of the sub-station investment. In the discussion, Mr. Crosby said that if the city is a very compact one only in exceptional cases will the use of polyphase currents be justified. In some of the smaller cities, however, the use of alternating currents for railway service is desirable where power is also supplied to suburban and interurban roads.

A TELEPHONE REPEATER.—A curious solution of the telephone relay problem is offered in a patent granted Oct. 15 to one Bela Gati, of Temesvar, Austria-Hungary. The inventor connects one winding of each of two repeating coils by a circuit containing a generator and an arc lamp, which may be either in series or in parallel with the windings of the coils. The theory is that the weak telephone currents traversing the transmitting circuit, act by induction upon the lamp circuit and cause corresponding increase and decrease of current therein, which in turn will cause the carbons of the lamp to vary in their separation, thereby decreasing the resistance of the lamp circuit and increasing the supply of current from the lamp supply circuit. This amplified current will correspondingly reinforce an induction coil in circuit and send out to the receiving telephone much stronger impulses than were created by the voice in the speaking circuit. This is certainly a strikingly bold attempt at the telephonic relay problem, but it would require a delicacy in carbon feeding mechanism difficult to attain, to say the least, while in practice the arc lamp circuit, through its normal fluctuation, would have something to say for itself with rather a disturbing effect on telephone currents.

STORAGE BATTERY PATENTS.—Among the patents of Oct. 15 are six on storage batteries, three of which were granted to Robert McA. Lloyd, and three to Charles S. Kaufmann. The earliest in date of application of the Lloyd patents is on a storage battery for boats, and relates to means for insulating a battery from the machinery and hull, to details of a battery compartment, including its ventilation and drainage, and provision for an alarm to give notice when the battery solution is leaking. The two other patents are on applications filed the same date, and also relate to details of a battery compartment in a boat, and more especially a submarine boat of the "Holland" or similar type. They describe details of insulation and drainage of the battery compartment, and means for drawing off the gases set free in the charging. The Kaufmann patents describe the construction of a storage battery plate and of a separating insulator. The insulator is made of vulcanized rubber or other suitable material, and has the form of a hairpin, which is so shaped at the neck that when it is slipped over the head of a plate the legs are caused to be thrown outward. When the plates of an element are assembled the legs will be forced in contact with the surface, and this will lock the neck of the insulator on the head of the plate. In one of the other Kaufmann patents a plate is described, which is constructed by making a series of grooves in a flat lead plate, whereby ridges are produced at right angles to the plane of the plate. The plate is then subjected to a pressing or rolling operation, which causes the ridges to be pressed down flat upon one another so that their edges overlap. When the plate is being formed the peroxide of lead gradually presses the leaves apart, and at the same time is firmly held in place by the pressure of the leaves. By this means cavities are filled with peroxide without the addition of other means. The third patent describes a plateholder with provision for holding a plurality of plates. The advantage of such a holder is stated to be that if one of the plates be destroyed or injured it may easily be removed and a new one inserted, the loss, therefore, not including the holder as in the case of the usual form of plate.

WIRELESS TELEGRAPHY FOR LLOYDS.—A recent London dispatch states that the Marconi Wireless Telegraph Company and Lloyd's shipping agency have entered into an agreement whereby the stations of the agency throughout the world are to be equipped with wireless apparatus.

A REUTER JUBILEE.—In London on Oct. 19 Baron de Reuter gave a dinner in celebration of the jubilee of the establishment of Reuter's Agency, which his father founded in 1851. Sir John Hay, chairman of Reuter's Telegram Company, Limited; Baron George De Reuter, the Hon. Mark Napier, representatives of the Associated Press and the Havas and Wolff bureaus, the great agencies with which Reuter's company is allied, and many others were present. Telegrams of congratulation from all parts of the world were received during the dinner.

ENGLISH PACIFIC CABLE.—It is stated from Victoria, British Columbia, by Mr. James Wilson, superintendent of the Canadian Pacific, telegraphs that Mr. Lockwood, who has charge of the work of preparing the landing of the Pacific cable, and two engineers, have started for Banfield Creek, on the west coast of Vancouver Island, 104 miles from Victoria, to make arrangements for the site for the landing place. Wharves will be built, and houses to accommodate the staff, which will consist of about 40 men. The cable repair ship will not have its headquarters on this coast as previously announced, but at Fiji.

AMERICAN TROLLEYS IN ST. PETERSBURG.—Enterprising American street railway promoters have invaded St. Petersburg, and have, according to a dispatch to the London *Standard*, submitted a proposal to take over the entire tramway system of that city under a twenty-five years' contract, the lines to be relaid and extended in all directions, and horse cars to be replaced by electric cars. The scheme includes the building of a substantial bridge across the River Neva to replace the existing wooden structure. The capital, to be raised in the United States, will be 100,000,000 roubles, half of which will be in ordinary shares and the remainder in guaranteed.

ELECTRIC RAILWAY SYSTEM.—A railway patent which, if it had been granted within several months after the application was filed, would now be on the point of expiration (the application is dated Aug. 14, 1884), was issued Oct. 15 to Benson Bidwell, of Philadelphia. The patent relates to an electric railway system in which slotted tubular conductors are used. As illustrated, there are two slotted conductors supported between the rails. On a pair of arms attached to a car are mounted two collectors or trolleys, which enter the tube through a slot in its lower portion. The slotted tubes are in sections independently supported so that one may be removed without removing an adjoining section. The claims also refer to the details of the insulation of the tubes and to the collecting arrangement.

INSTITUTE MEETING.—As noted last week the subject for the New York meeting of the A. I. E. E. on Oct. 25 will be "Regulation in Prime Movers and Successful Operation of Alternators," with an introduction by President Steinmetz. The following papers will be presented: "Angular Variation in Steam Engines," by Mr. P. O. Keilholtz, of Baltimore; "Parallel Operation of Engine-Driven Alternators," by Mr. W. L. R. Emmet, of Schenectady; "Parallel Running of Alternators," by Mr. Ernst J. Berg, of Schenectady; "Angular Velocity in Steam Engines, in Relation to Paralleling of Alternators," by Mr. Walter I. Shlicter, of Schenectady. It is expected that other papers also specially prepared for this meeting will be presented, as many engineers in electrical, steam, gas and hydraulic interests have been invited.

A NOVEL TROLLEY SCHEME.—It is stated from Scranton, Pa., that abandoned subterranean mine workings converted into a subway will be utilized by the Pennsylvania Railroad to get into Scranton. For years this company has endeavored to extend its line from Wilkesbarre to Carbondale via Scranton, but until this novel plan was hit upon they were unable to do so. The company has purchased the immense tract of land formerly occupied by the Lackawanna Iron & Steel Company, which is removing to Buffalo. From this point access will be made to the heart of the city through old mine workings. It is also stated that the Westinghouse people are to erect a building on this newly acquired plot to put in an electrical equipment. The line between Wilkesbarre and Carbondale will be operated by electricity entirely.

BREMER ARC LAMP.—A number of details relating to the Bremen arc lamp form the subject of a patent issued Oct. 15. With the Bremer compounded electrode it is desirable that the carbon pencils shall not be vertically in line as in the usual form of arc lamp, but at an angle or parallel to each other. The patent relates to details of a chamber above the arc for reflecting the light downward, and to an arrangement whereby a magnetic field may be produced for the control of the arc; also means for priming the arc, this being necessary, owing to the disposition of the carbons and the fact that they cannot be brought into contact with certainty by simply moving the carbon points toward each other, on account of the slag deposited on their ends, this slag being due to material compounded with the carbon for the purpose of modifying the character of the light.

A BLIND TELEPHONE GIRL.—The following from Mattoon, Ill., is not without a pathetic interest: Miss Abbie Downing, a blind girl of 23, began as an operator of the Metcalf, Edgar County, telephone exchange three weeks ago. Now she is the most expert operator the company ever had. Miss Downing handles a board for 60 telephones; also takes charge of the toll station, and by an accurate system of bookkeeping makes a record of all toll charges. She locates a call on the board by the sound of the "drop," or, if busy and the warning call click has not been heard, extending her nimble fingers over the exchange board. She graduated from the Indianapolis School for the Blind in 1893, and can perform all household duties—cook, sew by hand or machine and do fancy work. Miss Downing is a splendid musician, and has taught music. She is the only blind telephone operator in the country.

BRITISH SUBMARINE BOATS.—The cable brings the news of the beginning of a series of tests of the first of the new British submarine boats. The vessel was launched about a week ago, in great privacy, and so far has received neither name nor number. She is 63 ft. long with 11 ft. 9 inches beam, and is specially designed on lines to minimize resistance when cruising on the surface, where she will be propelled by a gasoline type of main engine capable of maintaining a maximum speed of about nine knots on a run of about 400 knots. When she is submerged an electric motor will give a speed of seven knots for a four-hours' run. This motor will be worked by means of storage batteries. She is lighted by portable incandescent electric lamps. Stored compressed air secures the air supply and ventillation, and the gasoline vapors from the engine will be carefully excluded. In steering and diving, her movements can be regulated either by mechanical or hand appliances. Her four sister boats are all in an advanced stage of preparation, and will soon be afloat.

AUTOMOBILE RACES.—Twelve races, to establish, if possible, straightway mile records have been arranged by the Lond Island Automobile Club for Saturday, Nov. 16, on the Coney Island Boulevard. The first race will be called promptly at 1 o'clock, but the events will be preceded by an automobile parade, to form at 11.30 o'clock in the vicinity of the City Hall, Brooklyn, and to proceed via Prospect Park to a point near King's Highway, where the races will be started. As the course will be a straight one-mile road it is expected that new r cords will be established for the mile by several classes of machines. The events will be: First, motor bicycles; second, motor tricycles; third, gasoline vehicles 6 horse-power or under; fourth, gasoline vehicles over 6 horse-power, and including 9 horse-power; fifth, over 9 horse-power, including 15 horse-power (gasoline); sixth, over 15 horse-power, and including 20 horse-power (gasoline); seventh, over 20 horse-power (gasoline); eighth, steam vehicles (stock); ninth, steam vehicles (special racing); tenth, electric vehicles (stock); eleventh, electric vehicles (special racing); twelfth, open championship race, to be run in trials and a final. The winner in each class will be eligible to compete in the final, provided the time made for the mile is 1.30 or better. All events are to be run under the racing rules of the Automobile Club of America. The Long Island Automobile Club will award cups to the winner in each class, and a special cup, known as the Long Island Automobile Club Cup, will be given to the winner of the open championship. All contests against time to be with flying starts. Contestants will be given probably one mile in which to work their vehicles to top speed, one mile for the record, and about one-half mile for slowing down.

PNEUMATIC TUBE MAIL SERVICE.—The Postmaster-General recommends the reinstallation of the pneumatic tube service in all cities in which it was formerly in operation. He claims that the service was a mechanical success, and that no suitable substitute has been found. We venture to think that electrical methods would afford an excellent substitute.

CHICAGO ELECTRICAL ASSOCIATION.—Since the announcement previously made in these columns of the programme of the Chicago Electrical Association some changes have been made so that it now stands as follows: Nov. 1, 1901, "The Storage Battery in Telephone Work," by J. G. Wray, electrical engineer Chicago Telephone Company; Dec. 6, "Demonstration of High-Frequency Effects," by Arthur Vaughn Abbott; Jan. 3, 1902, "Proposed New Rating of Incandescent Lamps," by John D. Nies, instructor in electrical engineering Lewis Institute. Dec. 6, the evening of the lecture by Mr Abbott, the meeting will be held in the Auditorium of Lewis Institute instead of at the regular rooms in the Monadnock Block, and ladies will be invited.

LECTURE ON INDUCTION MOTORS AT CHICAGO.—Professor William Hand Browne, Jr., of the University of Illinois, delivered a lecture before the Chicago Electrical Association the evening of Oct. 18 on the induction motor. The lecture was illustrated with stereopticon views and diagrams. In introducing the subject, Professor Browne said that the induction motor combined the features of static transformers and shunt motors. He then gave a brief elementary review of the fundamental magnetic principles of the induction motor. Some of the early forms of the induction motor having solid iron armatures were described. The methods of starting by the use of an auto-converter and by the use of resistance in the circuit of the armature or rotor were discussed, and it was explained why such large quantities of current are taken by the auto-converter method, at starting; and also why the method of introducing resistance in the armature circuit requires much less starting current. In the latter case, the torque is larger in proportion to the current flowing and the total current is also less. Diagrams of the connections of most of the single-phase induction motors that have been actually in use were given with special reference to the Wagner single-phase type. The greatest mechanical objection to induction motors Mr. Browne considered to be the fact that in order to make the power factor low the clearance between the rotor and stator must be very small, so that very little bearing wear is allowable. If the clearance is increased, the power factor is necessarily lowered very perceptibly. In general, the induction motor was said to be suited to all places where the direct-current shunt motor would be used. In places where direct-current series motors are used the induction motor is not by any means as suitable in its present development, because the induction motor is essentially a constant speed motor. In the discussion which followed, Professor Woodworth, of Lewis Institute, was very enthusiastic in the support of the induction motor in every location where shunt direct-current motors are now used, but condemned it for places where the characteristics of a direct-current series motor are required.

LETTERS TO THE EDITORS.

Wireless Telegraph Reports of the Yacht Races.

To the Editors of Electrical World and Engineer:

Sirs.—Observing your articles on wireless telegraphy in connection with the International yacht races, I would say that this company reported the races successfully and accurately by wireless telegraphy every day of the races, without interference from the other system (Marconi). We furnished bulletins of the races to such papers as *New York World, New York Journal, Washington Evening Star, Denver News, Los Angeles Times, Philadelphia Inquirer, Philadelphia Record, Philadelphia Evening Bulletin, Philadelphia Telegraph, Philadelphia North American, Philadelphia Item,* and others. Besides, the Associated Press also used our service, and gave us due credit for the same. On Friday, October 4, the last day of the contest, 103 bulletins were received by wireless telegraphy at our station at Galilee, of which 98 were published as a matter of news. Another matter in your article incorrectly stated was the "'American system being used in connection with the Publishers' Press Association." Such was not the case. There was a third system (we are informed it was a Chicago party), that endeavored to report the races, but from all information we have received, it was an utter failure. From the fact that the Associated Press who used the Marconi system were very anxious to use this company's dispatches and bulletins and later were connected to our Galilee station by wire, we are led to infer that the Marconi people also were not successful, and were interfered with by us. We have on file letters from the leading newspapers, complimenting us in the highest terms of praise, for our excellent, accurate, prompt and superior service. So, therefore, we can positively state we suffered no interference, as our instruments were properly "tuned."

AMERICAN WIRELESS TELEPHONE & TELEGRAPH COMPANY,
G. P. GEHRING, *President.*

PHILADELPHIA, PA.

[In order that no injustice might be done by the report in our Oct. 12 issue to the American Wireless Telephone & Telegraph Company, we have taken particular pains to investigate the claims and statements made in the above letter. The general manager of the Associated Press informs us that the American Wireless Telephone & Telegraph Company furnished no bulletins whatever to it. The *New York Journal* informs us that the bulletins of the American Wireless Telephone & Telegraph Company were useless, as they always came in late, after the Associated Press bulletins, and were so nearly like the latter that nothing new was obtainable from them. The *Journal* has further stated to us that the Associated Press service was most accurate and prompt throughout all the races. The New York *Evening World* discarded the American Wireless Telephone & Telegraph Company's service almost entirely after the first day. "This was due to the fact that whoever was sending reports did not know his business. The service itself seemed to work well—at least, there was a continuous receipt of messages." Our reference to the system used by the Publishers' Press is correct. The system was that of the "American Wireless Telegraph Company," as stated, and not that of the American Wireless Telephone & Telegraph Company. Our correspondent has apparently confused the two titles, owing to their similarity.—EDS.]

Lighting at Omaha and the Pan-American.

To the Editors of Electrical World and Engineer:

Sirs.—I note your editorial reference to the list of Pan-American awards in your issue of Oct. 19, and your comment upon the fact that so far no recognition has been made by the authorities of the Exposition of the illumination, of which you have been kind enough from time to time to speak in the highest terms of praise.

Permit me to offer, what is not intended as a correction of your remarks, but as an elucidation of one or two points that may help to confer merit where the merit is due. My own share in the work at Buffalo is, I presume, too well known to the profession to need any further reference on my part, but I would like to point out that the Pan-American effects which have elicited such world-wide encomiums were in reality rehearsed some few years ago at the Omaha Exposition, so that any claim based on originality alone at Buffalo would fall to the ground. When, as consulting electrical engineer of the Omaha Exposition, I suggested that all the exterior illumination effects there and at the approaching Pan-American could be obtained solely with the incandescent lamp, there were many sceptics, but the plan received the utmost encouragemnt from Mr. Edison, and backed by the support of so great an authority I had no hesitation in going ahead and trying there what could be done later on a large scale at Buffalo. I believe it may be claimed that at Omaha the outline plan of the illumination, rising slowly from a minimum to a crescendo, first reached its highest effect. The display at the Pan-American can only be characterized as pushing to its logical limits the preliminary work thus carried out experimentally but successfully at Omaha. It may be noted, in proof of this, that the highest award possible was conferred at Omaha for the lighting effects.

As a matter of fact, the results secured at the Pan-American owe no small measure of their charm to accident rather than design, particularly in regard to the slow bringing-up of the illumination from its first faint glow until it reaches full splendor. The methods projected at first to attain this result, on previous lines, were found pro-

hibitive as to cost, but the result was attained in another direction. It will be remembered that the current has to be thrown on by means of a water rheostat, a specific device here employed on a scale of magnitude previously quite unknown in the art. The problems in connection with the rheostat were admirably solved by Mr. W. Le Roy Emmet, of whom I was glad to note an appreciative biographical sketch in your issue of Oct. 5. Back of the brilliant spectacle shown nightly at Buffalo has been this special engineering work of Mr. Emmet, which alone in reality has rendered it feasible; and the very conditions exacted by the manipulation of current in such volume from Niagara have been the means for furnishing those gradations which may be said to give dramatic touches to the effect that has so gratified every observer.

Personally, I can never forget that it was through the enterprise and public spirit of the authorities of the Omaha Exposition that we were enabled to rehearse the "glories which have crowned the Pan-American."

New York, N. Y. Luther Stieringer.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers

Phase Swinging.—Thornton.—The first part of an article giving "Notes on rotary converters and phase swinging." The name phase swinging has been given to the oscillations of the "current sheets" in synchronous motors or synchronous converters running under any load when this is suddenly changed. In its more general use it applies to the case when these oscillations have so disturbed other machines in the circuit that they exhibit the same effects, or when the generator is also affected. All risk of phase swinging being cumulative throughout the circuit, is prevented by the use of damping coils, consisting of high conductivity metal frames placed around the poles close to the faces, their action being as follows: There is a sudden change in the demagnetizing force due to the armature currents whenever the demand on the continuous side of the machine varies. This causes a change in the total flux through the pole, and during this change eddy currents are produced. This change of flux induces a voltage in the damping coil and, by reason of its very low resistance, a powerful current passes round the coil, reaching several thousand amperes for heavy loads. This current causes a strong wave of magnetic force parallel to the axis to pass radially into the core, where it sets up eddy currents, these being of much greater intensity than those due to the first changes of flux. The energy of the impulse given to the armature by the sudden load is dissipated as heat partly in the coil, but mostly in the core. The intensity of magnetic force when an alternating current is passed round a large solid iron core, is much greater at the circumference than the center. The heating effect is thus greater at the circumference, and the damping coil may be regarded as a device for concentrating the eddy currents in the outer layers of the core, increasing the rate of dissipation of energy. A simple mathematical theory of the damping coil is given. —Lond. *Elec.*, Sept. 27.

Self-Starting Single-Phase Motor Without Brushes.—Fischer-Hinnen.—A reply to the criticism, mentioned in the Digest, Sept. 7. He says that while the construction of his single-phase motor is similar to the Sahulka two-phase motor, the principles underlying both motors are essentially different.—*Zeit. f. Elek.*, Sept. 8.

References.

Short-Circuit Current of Three-Phase Machines.—Bauch.—A long mathematical article. At the start he remarks that the calculation of the short-circuit current of a three-phase machine always gives too small values. While this disagreement between calculation and measurement is often said to be due to straying, he says that while straying has certainly an important influence, there are other factors of importance. He describes in detail a method for calculating the field excitation for short circuit, the method being illustrated by many examples.—*Zeit. f. Elek.*, Aug. 4.

Generating Sets of Small Capacity.—An illustrated description of several small generating sets of French make; two generators of the Gramme Company, driven by gasoline engines and giving 18 amperes or 35 amperes at 110 volts; also similar generating sets of Dion and Bonton, etc.—*L'Ind. Elec.*, Aug. 25.

Dynamo Construction.—Schulz.—A review of improvements made in recent years in the method of construction of direct and alternating-current dynamos.—*Elek. Anz.*, Sept. 5, 8.

Generators.—Some important typographical errors in a former article on Oerlikon generators.—Lond. *Eng'ing*, Sept. 27.

Standardization of Electrical Apparatus.—Broderick.—A discussion of the advantages of standardization, from the point of view of the manufacturer. Quicker deliveries, less investment outlay, greater surety of satisfactory operation, lower cost of maintenance by reason of the readiness and cheapness with which renewal parts can be secured.—*Eng. Mag.*, Oct.

Lights and Lighting.

Direct-Current Arc.—Janet.—His long paper, read before the Internat. Soc. of Elec. in Paris, on an investigation of the direct-current electric arc, made in the Central Laboratory of Electricity by Laporte and Leonard. This investigation, which was a very extended one, dealt with the illumination obtained with different carbons under different electrical conditions. The apparatus used and the method of the measurements are described. The object was to separate the different influences which determine the resulting illumination. Carbons of a certain quality and of certain diameters were first experimented with under varying electrical conditions, the current being varied between 4 and 12 amperes and the pressure between 30 and 55 volts. After that the influence of varying the diameter first of the negative carbon and then of the positive carbon was investigated. After that the diameter of both carbons were varied together. Finally, carbons of different qualities were used. The results of their tests of the same carbons (cored 12 mm. and homogeneous 8 mm.) with varying current and voltage, are given in tables and diagrams. The curves obtained with constant current (4, 6, 8, 10, 12 amperes) show that the total luminous flux increases when the voltage is raised from 30 up, reaches a maximum at a voltage near 50 volts and then decreases again. The maximum total luminous flux for 12 amperes is about 8300 lumens (one lumen being evidently the flux in the unit solid angle emanating from one bougie or candle). They could not confirm Mrs. Ayrton's observation that the curve has a minimum after the maximum. The curves for lumens per watts, as function of the voltage, are also given. They are of the same general form, but reach the maximum at a lower voltage, about 41 volts. They also determined the consumption of the carbon and the form of the arc. Regarding the diameters of the carbons, they found that for an arc of given current, in order to get the maximum amount of light and the best efficiency, one should choose carbons of the smallest diameter which can be operated satisfactorily. The paper contains many tables and diagrams. It is concluded by some remarks on two arc lamps, and three arc lamps in series.—*Bull. Soc. Int. des Elec.*, June.

Arc Lamps.—Bochet.—A paper read before the Internat. Soc. of Elec. in Paris. Low-voltage arcs, i. e., for voltages between 35 and 38, give very good results with reference to steadiness and quantity of light, with specially prepared carbons. A current not lower than 2 amperes and not higher than 20 amperes should be used. For medium voltage arcs, i. e., for voltages between 38 and 50, it is convenient to increase the current together with the voltage. A French company uses 2 amperes for 36 to 40 volts, 8 amperes for 41 to 44 volts, 16 amperes for 44-47. For alternating-current lamps, a table is given, showing the system of French makers: 6-ampere, 27-volt, 9-mm. cored carbons; 16-ampere, 29-volt, 14-mm. carbons; 30-ampere, 30-volt, 20-mm. carbons. Enclosed arcs are said to be unsteady and to give no good light. The main advantage is the long life of the carbons. While it is much used in the United States, he thinks that Europe is justified in refusing the enclosed arc lamp on account of

the inferior quality of the light. The balance of the paper is a discussion of regulating devices. In the discussion which followed several speakers expressed an opinion in favor of the enclosed arc lamp.—*Bull. Soc. Int. des Elec.*, July.

Lighthouses in France.—De Rochemont.—A Glasgow Internat. Eng'ing Congress paper on "Recent improvements in the lighting and buoying of the coasts of France." The intrinsic brightness, in a horizontal direction, of various systems of lighting used in lighthouses, is given as follows, expressed in carcels per square centimeter of the mean horizontal focal plane of the luminous source: Burner with mineral oil and 1 to 6 wicks, 0.35 to 1.18 carcels; incandescent lighting with compressed oil gas, 2.00 carcels; incandescent lighting with patroleum vapor, 2.50 carcels; incandescent lighting with acetylene, 4.00 carcels; crater of the electric arc, 900 carcels; (one carcel equals 9.5 candles). A list of 13 French lighthouses is given, five are illuminated with oil, six with incandescent gas, petroleum or acetylene, five by the electric arc. Three of the latter have a single set of optical apparatus, two a double set. In those with a single set, three powers of light are used, produced by currents of 25, 50 and 100 amperes at 45 volts. In lighthouses with a double set of optical apparatus there are only two powers of light, produced by 25 and 50 amperes each. Twenty-five amperes are used only during very clear weather, while the two arcs of 50 amperes are almost in constant use, and absorb the whole power of the two dynamos employed. In order to have one machine in reserve and also to be able to couple up both machines and obtain two arcs of 100 amperes for use in thick weather, a new type of two-phase alternator of 5.5 kilowatts has been designed, the construction of which is described in detail. The old pattern of electric arc regulator which had only one rod for conveying the current, caused the carbons to burn unsymmetrically and to produce uneven shadows. To remedy this, a much lighter and more exact regulator with two symmetrical rods has been designed, which is described and illustrated.—Lond. *Engineering*, Sept. 20.

REFERENCE.

Street Lighting.—An experiment is described which shows that in comparing the light given out by lamps, one should not make an estimate from the apparent brilliancy, as it is very deceptive. Several accessories of street lighting, brought out by an English company, are described, especially a new device for raising and lowering arc lamps.—Lond. *Elec. Eng.*, Sept. 27.

Power.

Power Transmission in Coal Mines.—Habermann.—The first part of a paper read before the Electrotechnical Society, of Vienna. He remarks that the installation of electric power in coal mines should make good progress in the near future in Germany. In one district, that of Dortmund, there are at present 500 steam engines in operation, with a capacity of more than 500,000 horse-power, of which only about 20,000 horse-power are used for driving dynamos. While the direct-current system has been used in some special case and has been found quite satisfactory, the three-phase system is in general used for the larger plants, the three-phase induction motor being specially adapted for mines. He first discusses motors for driving pumps, the normal speed is given at 80 to 150 r. p. m. The squirrel cage type has not been found satisfactory. The use of slip rings for starting is no disadvantage. For low-speed motors he recommends a lower frequency than that which is generally used in Germany (50 per second) in order to make the motor cheaper and electrically better. He then discusses the electric driving of ventilators. Electric power should certainly be used for this purpose when a new mine is started. There is some difficulty with induction motors when the ventilator has to run at a higher speed in an emergency case. Electric drills have so far found no general application. He thinks the present commercial types are not yet sufficiently safe and convenient.—*Zeit. f. Elek.*, Aug. 25.

Power Plant.—A description of the power plant of a sugar refinery near Tangermuender. The three-wire direct-current system is used for lighting, while for power purposes the three-phase system at 200 volts is used. There are more than 70 induction motors, with capacities up to 40 horse-power. The plant furnishes current for lighting the city of Tangermuender, which is at a distance of a mile. For transmission, the voltage of the three-phase currents is raised to 2000. It is converted to 240 volts direct current in the city in a sub-station by motor-generators. There is also a storage battery.—*L'Elec.*, Aug. 24.

Traction.

New York.—Vreeland.—An article on the organization of the Metropolitan Street Railway Company, of New York. Twelve years ago the street railways in the boroughs of Manhattan and the Bronx were operated separately by some 18 different companies. They have gradually become consolidated until now the property consists of about 760 km. of track, and all are under one control. In 1893 4000 men were employed, now there are more than twice as many. The effect of the consolidation has not been to curtail the number of employes, but has largely reduced the number of higher officials. The writer then gives a diagram showing the division of authority among the officials of the company. Each of the officials has practically absolute control in the department under him.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Metropolitan Street Railway Power Plant.—Starrett.—An illustrated article on this plant in New York City, which is the largest polyphase electric railway power plant now in operation and also the largest electric railway power plant of any kind. The generators are also the largest yet put in operation. The evolution of power house construction in the United States in the past ten years is briefly reviewed. The use of polyphase current for railway distribution in the United States was for several years limited to location where power was furnished by a distant waterfall, and where polyphase current offered the only economical means of transmission. The first extensive use of polyphase distribution was in England, where the regulations as to drop in the ground return circuit were very strict. In the United States direct-current plants had already been erected in most of the large cities before polyphase machinery came into use. In New York, however, extensive electric railway construction was not begun until polyphase machinery had reached a high state of perfection. The various elements which go into construction of a direct-current power house as compared with a polyphase power house are then discussed. The ground space occupied by the Metropolitan power house is much less than that of any other electric railway power house in the United States per kilowatt of output. For example, the space required per kilowatt of capacity in this plant is .68 square feet in the engine room, and .56 square feet in the boiler room. There are very few power houses that do not take more than twice this engine room ground space, and five times this amount is not uncommon. This is due to the use of large 3500 kilowatt units, as much greater capacity can be put in a given ground space with a larger unit. The liability to interruption to the service through accident to any part of the power house or distribution system is guarded against by dividing the power house into a number of independent divisions. These are usually operated in connection with each other, but can be separated. The feeders from the power house also come in from several different directions. The operation of the power house is still in an experimental stage because of its newness. There are now 180 men employed in the power house, in which there are running eight 3500-kw generators. A list of these men is given in detail with the duties of each. They work in three shifts of eight hours each. In the seven sub-stations 60 men are employed. The coal consumption in actual practice is 2.65 lbs. per kilowatt-hour. The efficiency between the engine cylinders and the switchboard is above 90 per cent.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Brooklyn.—Roehl.—An illustrated article on the power stations and distribution system of the Brooklyn Rapid Transit Company. Owing to the great demands on the power supply, the Brooklyn Heights Railroad Company is about to double its generating capacity. An increase of 36,000 horse-power is to be made to the system. The general distribution of the initial power will be by high-tension polyphase feeders, a radical change from the present installation which is all of the direct-current, 550-volt type. The high-tension distribution is to be made by triplex, paper insulated, lead-covered cables placed in terra-cotta ducts under the streets of the city. The new station will contain at first six 4000-hp direct-connected generating units, two of which will be for supplying the district in the immediate vicinity of the station and will furnish direct current at 550 volts, the other four units will be 4000-hp, three-phase, 25-cycle revolving-field type generators. In one of the other stations now running will be installed a direct-current unit of the same size and type as that in the new station, and this will make, with two additional units for which space is left in the new station, a total capacity of 36,000 horse-power for the additions.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Third-Rail System.—Hoopes.—A paper read before the N. Y. State St. R'y Ass. on third-rail interurban railways. The third-rail sys-

tem is preferable to the overhead trolley on roads where its use is possible, for the following reasons: Lower cost of construction, very greatly lower maintenance cost, and more reliable operation due to the absence of delays caused by trolleys leaving the wire and wrecking sections of the line. He gives a table of comparative cost of 80-lb. third-rail and equivalent trolley construction for one mile of track. It is $3,410 for the third-rail system against $4,421 for the trolley system. The danger of the third rail is exaggerated. It is undesirable to install the third rail between the track rails, the best location for it is outside of one of the track rails and elevated several inches. The conductor rail should be of a special mixture, giving the highest possible electrical conductivity. In his experience the following composition of steel has proved satisfactory: Carbon, 0.09 per cent; manganese, 0.44 per cent; phosphorous, 0.088 per cent; sulphur, 0.08 per cent. This rail gave a resistance of 12.9 microhms per c. c., and was consequently of about 7.25 times the resistance of commercial copper. The mixture can be improved upon by further decreasing the carbon and other alloying elements. Although the operation of the third-rail system seems to be extremely satisfactory under nearly all conditions, it becomes very difficult in a sleet storm. There is as yet no approved method of removing the sleet from the rails.—*St. R'y Rev.*, Sept.; *St. R'y Jour.*, Sept. 14, and Int. Ed., Oct.

German Convention.—An account of the proceedings at the recent annual meeting of the Association of German Tramway and Light Railway Companies. An investigation had been made by the officials into alleged troubles with electrolysis in different cities. A list of questions was sent to 107 gas and water companies asking if there had been any damage caused by return circuits. The replies showed that his had occurred in only two or three out of 90 cities, and here the trouble had been slight. Fromm read a paper on brakes, an abstract of which is published. Poetz read a paper on safety appliances for electric railway cars, in which he discussed the value of fenders. He believed that the wheel guard which is from 7 to 8 cm. above the pavement to be the most desirable type of fender. A paper was read by Sieber describing economies effected on his line. He referred to the necessity of a well regulated storehouse and the issue of material from there should be only by requisition. Coal should be frequently tested and its heating value ascertained. The brick work of the boiler room should be inspected every three or four weeks. Shut downs in the boilers should not be caused too frequently, as it means a consumption of from 1000 to 1500 kg. of coal. The doors and windows of the engine and boiler rooms should be kept closed at night to avoid wasteful radiation of heat. The use of two voltages or the three-wire system is recommended. The cars should be tested to see that they operate easily. A single truck after receiving a slight push should travel over a level distance from 100 to 200 meters. Wheels should be properly mated and a pair of wheels should not differ in diameter more than 0.1 mm. A paper was read by Roehl on the training of motormen. He believed that former horse car drivers made the best motormen, and that a training of from 8 to 10 days was sufficient for this kind of employe. A considerable amount of theoretical knowledge is a bad thing, as the motorman will attempt to make repairs on his own car. Secretary Vollguth read a report on accidents, and showed that there had been a decrease in certain classes of accidents and an increase in others. He believed that the best fender was a wheel guard. He then presented some statistics on the German street railways compiled at the request and at the expense of the Government. The next meeting will be held in 1902 at Duesseldorf.—*St. R'y Jour.*, Int. Ed., Oct.

REFERENCES.

Jungfrau Three-Phase Railway.—A very long and profusely illustrated article on the electric equipment of the Jungfrau Railway.—*L'Ind. Elec.*, Sept. 25.

Chicago—Joliet.—An illustrated description of this new interurban road. Current is supplied from a motor power plant in Joliet. High-tension three-phase currents are transmitted, the transmission line being of aluminum. There are three converter sub-stations for converting to 550-volt direct current. They are provided with storage batteries.—*West. Elec.*, Oct. 5.

Surface Contact System.—Bainville.—An illustrated description of the Schuckert contact system which is in use in Munich, as has been noticed before in the Digest.—*L'Elec.*, Sept. 7.

High-Speed Electric Railways.—Reynold-Schiller.—The continuation and conclusion of his long serial, in which he gives the following final result: "There is no doubt that the problem, how to build high-speed electric railways, can be solved in the most economical way by the broad gauge of 4500 mm." (14.76 ft.).—*Zeit. f. Elek.*, Aug. 11, 18.

N. Y. St. R'y Assoc.—The papers, read before the New York State St. R'y Ass. are published in *St. R'y Jour.*, Sept. 14, 21, 28.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Efficiency of Alternating-Current Plants.—Weyde.—A very long article in the problem of improving the efficiency of alternating-current plant, the efficiency being defined as the ratio of the energy used by the consumers to the energy generated in the station. From statistics of German central stations it appears that 65 per cent of the direct-current stations have an efficiency of more than 75 per cent, while only 10 per cent of the alternating-current plants have the same efficiency. For the other 90 per cent of plants the efficiency is between 75 and 50 per cent, and average 65 per cent. It is to be considered, however, that distances are generally much larger in alternating-current systems. It has been tried to improve the comparatively low efficiency of alternating-current plants by giving up the "house-to-house" system with transformers in the consumers' premises, and by introducing instead the "bank" system with transformer sub-stations supplying low-tension networks, as in the latter system the no-load loss in transformers is smaller and less kilowatts of transformer capacity is required. He shows, however, from statistical data that no great improvement of efficiency of the system is obtained by introducing the bank system for the house-to-house system, and that in those cases where a marked improvement has really been accomplished, it has been due to the fact that in these cases unloaded transformers were disconnected from the network. He concludes that the only effective way of improving the efficiency of a plant is to use automatic switches for disconnecting the transformers. He discusses the following types of switches: Mueller, Electric Selector & Signal Company, Walton, Schlatter. He believes that only the Schlatter system is of commercial value. It is described in detail and illustrated by several diagrams.—*Zeit. f. Elek.*, Sept. 15, 22.

Pilot Wires.—Picou.—An illustrated article on "Pilot wires and the regulation of the voltage in central stations." All the pairs of pilot wires are connected in parallel across a pair of bus-bars. An electrometer on a high resistance electromagnetic voltmeter, connected across these bus-bars, gives directly the average voltage of the various pairs of pilot wires. A hot-wire voltmeter having a relatively low resistance is not suitable for this purpose. The voltage for each pair of pilot wires is most conveniently measured by means of ammeters inserted in the pilot wires as from their indications the excesses of the single voltages above or the amount below the average is easily found.—*L'Ind. Elec.*, July 10.

REFERENCES.

High-Tension Switches.—Abstracts of the papers presented to the Pac. Coast Elec. Transmiss. Ass'n by Masson, Van Norden, Lee, McFarland, Currie, Hebgen, on electric switches and fuses for high-voltage currents, and of the discussion which followed. The subject is also discussed editorially.—*Eng. News*, Oct. 3.

Walthamstard.—An illustrated description of this British municipal electric station, which is of interest as gas engines are used for driving the dynamos. There are three 66-kw direct-current dynamos and a battery of 284 cells.—Lond. *Elec.*, Sept. 27.

British Plant.—An illustrated article on the Battersea electricity supply work. The three-wire system with 2 by 230 volts is used. The capacity of the plant is 900 kilowatts.—Lond. *Elec.*, Sept. 27.

WIRES, WIRING AND CONDUITS.

Aluminum.—Wilson.—A British Ass'n paper on "The commercial importance of aluminum." He discusses the progress in manufacture, the construction of the Heroult cell, the properties of aluminum alloys, light alloys and heavy alloys, the use of aluminum for electric conductors, aluminum wires under wind pressure, the skin effect, electric glow, joints for aluminum wires, melting and casting, the addition of aluminum to iron and steel, rolling and forging, hardening and annealing, drawing and stamping, and the use of aluminum for various commercial purposes. Aluminum containing .31 per cent Fe and .14 per cent Si has a specific resistance of 0.00000259 legal ohms at 0 deg. C. (evidently referring to one cubic centimeter) and 0.000002762 legal ohm at 15 degs. C., a temperature coefficient 0.00393 and linear coefficient of expansion 0.000023 between 16 degs. and 100 degs. C. When in the form of wire .126 inch (3.2 mm.) in

diameter, it has a breaking load of 28,200 lbs. (12.6 tons) per square inch, a limit of elasticity 19,376 lbs. (8.65 tons) per square inch, and percentage extension 0.19 within the limits of elasticity with an applied force of 16,250 lbs. (7.2 tons) per square inch. Alloying this aluminum with copper, zinc, nickel, or iron in varying proportions to the extent of about 2 per cent, increases the tensile strength at the expense of conductivity. It is therefore important to know what the tensile properties have to be in particular cases. Some data are given regarding the aluminum wires used by the Standard Elec. Co., of California. The tensile properties of aluminum are increased by rolling, hammering or drawing. In testing wires, therefore, different results may be obtained from the same meterial by varying the amount of drawing down. Mechanical joints have been used for aluminum wires with success in practice; but, with proper precaution, aluminum wires can be welded either by the use of the blow-lamp or electrically. The results of a test are given in which the original trolley wire (8 section) had an aera of 0.135 square inch and a breaking load of 1.6 tons on that section, with 11.3 per cent extension. The welded joint gave 1.2 tons breaking load, with 8 per cent extension, the joint not being broken. An aluminum wire, 0.516 inch in diameter, having a breaking load of 3449 lbs. with 14 per cent extension, gave 2912 lbs. breaking load, when welded with 20 per cent extension. Hard and soft solders are said to be supplied by the Brit. Al. Co. It is necessary to break up the oxide which forms on the surface of the aluminum, and with care aluminum soldering is rendered easy. In the discussion which followed, Preece said that if all the merits claimed for aluminum were well founded, it would be of immense service for extending telegraphs through new countries, as the saving of weight in transportation is of the greatest importance; but up to the present, trials with telegraph wires of aluminum have not been successful as the thin wire, commercially made, was not uniform in its texture and did not withstand the strain of air pressure like iron or copper, but he regards this to be entirely a defect of the manufacture.—Lond. *Eng'ing*, Sept. 27.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Tests of Iron.—GUMLICH and SCHMIDT.—A long account with tables and diagrams of an extended series of magnetic tests, made in the German Reichsanstalt, of different kinds of iron. They first investigated the influence of annealing upon the magnetic properties. The maximum temperature was 950 degs., the time of heating and cooling three days. The magnetic properties of soft wrought iron are not changed greatly by annealing. The magntic properties of cast iron are improved by the first annealing, while repeated annealing seems to deteriorate them again slightly. By the first annealing, the coercive force (i. e., half the width of the hysteresis loop on the X axis) is reduced to one-third, the hysteresis loss to less than one-half, the remanence (i. e., half the height of the hysteresis loop on the Y axis) increases by 10 per cent. The results of annealing upon the magnetic properties of cast steel depend largely upon the individual constituion of the material. In general, annealing gives good results. While the values of the remanence vary in an irregular manner, sometimes increasing and sometimes decreasing, the coercive force diminishes and the maximum permeability increases, both values reaching a limit after the second or third process of annealing. The hysteresis loop also decreases with repeated annealing and is reduced to one-half with some materials. Other results were obtained with dynamo sheet iron for armatures which has been generally annealed before. Two kinds were tested, both were improvd in all their magnetic properties by the first process of annealing while the second process deteriorated these properties again. This deterioration was found to be due not to the formation of an oxyde layer on the surface, but to molecular changes. Such sheets for dynamo armatures were found to be very sensitive against mechanical treatment, as grinding or rubbing, so that the authors doubt whether the magnetic properties determined by tests of the sheets before they are made up in the armature, are still valid afterwards in the armature. Solid iron rods were not sensible to mechanical treatment. They investigated whether the process of annealing is best done with the iron sample in iron filings, sand or charcoal, or in air. Great differences were not found, but the cover of sand was found impractical on account of the formation of clinker. The cover of iron filings seems to give the best results. They further investigated the influence of the process of annealing upon the electric conductivity. As the eddy current loss increases with the conductivity, the best iron would be that which has a minimum hysteresis loss and a maximum electric resistance. It was found that in general annealing increases the conductivity, but not to such a degree that this disadvantage would balance the advantage due to the improvement of the magnetic properties. By comparison of a great many tests, it was found that in general the greater the hysteresis loss the greater the electric resistance, the greater the remanence the greater the coercive force and the smaller the maximum permeability. But this rule holds good only in general, while several materials greatly differed from this rule. One special material which compared with the other materials tested, had relatively very good magnetic properties, and was found to have an electric resistance of about three times the average resistance of all other samples. The chemical constitution of this material is not given, as it was communicated confidentially to the Reichsanstalt. But this shows that it is possible to obtain iron with very good magnetic properties, and at the same high electric resistance. Further experiments of the authors deal with the determination of the coercive force and with the maximum permeability. They found the following empirical formula for all values in c. g. s. units. The maximum permeability is equal to the ratio of remanence and coercive force, multiplid with a factor which is in general a linear function of the coercive force, but is approximately 0.5 for soft iron and cast iron.—*Elek. Zeit.*, Aug. 29.

Electrolysis of Alkali Salt Vapors.—WILSON.—A brief abstract of a Brit. Ass'n Adv. Sc. paper, giving the result of experiments which show that Faraday's laws of the electrolysis of liquids are applicable to the vapors of alkaline salts. Experimenting with a large number of salts, and injecting the aqueous solutions of the salts into a blast of air between the two electrodes, he found that the product of the electro-chemical equivalent of the ions into the maximum current which could be passed at any voltage whatever through the vapor was always a constant equal to 0.0276.—Lond. *Elec.*, Sept 20.

REFERENCE.

Speaking Arc.—JANET.—A brief illustrated paper, read before the Int. Soc. of Elec. in Paris, on experiments made by Leonard with the speaking arc, and especially with the arc used as telephonic transmitter.—*Bull. Soc. Int. des Elec.*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Calcium Carbide Manufacture.—PRADON.—An article on "The influence of the nature of the electric current on the manufacture of calcium carbide." Under precisely similar conditions of the furnace, and with the identical charges, direct-current carbide is of lower quality than that prepared with alternating current. Direct current yields a compact carbide which is very difficult to break; alternating current produces a crystalline carbide which breaks more readily. The furnace charge should be absolutely homogeneous in composition when direct currents are used. With alternating currents a rough mixing is quite sufficient. With alternating currents the influence of the phase difference must be taken into account. The power factor of the furnace may be 0.8. Pradon has designed a furnace built according to the idea which underlies the use of concentric cables for alternating currents. The hearth of the furnace is, as usual, a track running on wheels, and its sides are constructed of metallic walls. When in position, the truck stands under a metallic chimney, through which the gases ultimately pass off, and in the middle of which hangs the vertical electrode. One lead for the current is attached to the top end of the furnace sides. The other is fastened to the lower end of the chimney. The current is thus compelled to pass downwards through the metallic sides of the furnace, into the central hearth, up through the mixture of lime and coke, up through the second electrode, down through the walls of the chimney, and then to the main, so that in every position the central current is opposed by an "annular" current always traveling in the opposite direction. He claims that considerable economy can thus be effected in the generating plant, as an alternator may be safely used, the dimensions of which have been calculated for a power factor of 0.85. If, however, the lag of the furnace has not been eliminated, it is necessary to use in calculation a power factor of 0.70. If the proportion of lime is increased, the production of gas is diminished and the output of carbide is raised. It seems possible that there are advantages in producing a lower grade of calcium carbide than is made at present, a material yielding only 250 litres of gas per k. gr. for in which the manufacturing costs, and therefore the selling costs, might be more than proportionately reduced. He thinks that a "resistance" furnace cannot be used for making calcium carbide.—*Zeit. f. Calciumcarbid Fab.*; abstracted at some length in Lond. *Elec. Rev.*, Sept. 20.

Platinum Electrode.—A description of a new platinum electrode, made by Heraeus. A vertical glass tube, closed at the bottom, contains copper wires which are connected at the top to a lug of copper. Several horizontal thin platinum wires are fused through the walls of the glass tube; inside the glass tube they are soldered to the vertical copper wire; outside the glass tube very thin sheets of platinum, of only 0.0075 millimeter (slightly less than 0.3 mil) thickness and generally of 20 mm. (0.8 inch) breadth, are fused to the horizontal platinum wires. It is claimed that the latter give an unexpectedly strong rigidity to the thin platinum sheets. One square decimeter platinum electrode, i. e., 2 square decimeter of surface, weighs only 2 grams, hence 1 square meter surface weighs 100 grams (1 square inch surface weighs 0.0023 ounce). The arrangement of the platinum electrode causes an equal distribution of the current over the surface. The whole platinum electrode is somewhat like a combination of several electrodes which receive their current through the horizontal platinum wires from the thicker copper wires inside the glass tube. It is claimed that the glass tube with the platinum wires fused through the walls can be made strong and durable, even for use in hot solutions. It is believed that the new electrodes can compete with carbon electrodes in price, so that platinum may be used in electrolytic processes for which it has so far been assumed to be too expensive.—*Fly-leaf in Elektrochem. Zeit.*, Sept.

Nickel Plating.—An illustrated article on the process of nickel plating in which the objects to be plated are placed in a revolving drum. A device of Delval and Pescalis is described, by which the radial conductors in the drum which connect the objects to be plated to the negative pole of the source of current, are connected to this pole only as long as they are in contact with the objects to be plated, and otherwise are disconnected. This is accomplished by a special commutator which connects only a part of radial conductors at one time to the negative pole.—*L'Elec.*, Aug. 17.

Zinc Lead Cell.—A note on the regeneration of the lead electrode of a discharged zinc, sulphuric acid, peroxyde of lead cell. It is suggested by Hofmann to regenerate (oxidize) the discharged lead plate chemically by means of hypochlorous acid, which is said to be preferable to other oxidizing agents.—*L'Ind. Elec.*, Aug. 25.

REFERENCES.

Union Storage Battery.—A. Z.—An illustrated description of the Union storage battery which is made by a French company. The negative plates are made of the Faure type, the positive plates of the Plante type. The manufacture of the positive plates is described in detail. It is built up of a large number of laminæ by means of a special machine. No numerical data are given regarding the operation of the cell.—*L'Ind. Elec.*, Sept. 10.

Electro-Chemistry.—Jones.—The conclusion of his serial on selected chapters in electro-chemistry, in which he gives a review of the principal views of the electrolytic dissociation theory. The concluding part deals with Nernst's theory of calculation of the e. m. f. of cells.—*Elec. Rev.*, Oct. 5.

Electro-Chemical Micrscopy.—R. Kohn.—He suggests a new method of research, specially applicable to plant physiology. "He proves that all vegetable cells show p. d.'s which regularly appear in the course of the cellular activity." All plants are pervaded by a connected system of electric—probably electrolytic—conductors.—*Pamphlet*, Mercy, Pray; abstracted in Lond. *Elec.*, Sept. 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Plotting Alternating-Current Waves.—Hospitalier.—His illustrated paper in full, read before the Int. Soc. of Elec. in Paris on some applications of the stroboscopic method to the study of alternating currents, on the arcoscope and ondograph. Besides the ondograph (Digest, Aug. 31), and his special device for registering instruments (Digest, Oct. 5), he describes the following instrument which is called the arcoscope and is to be used for studying the variations of brightness which an alternating-current arc undergoes during a period. Upon the axle of a small induction motor, supplied by the same current as the arc, an opaque disk is mounted, provided with a number of small slits, equal in number to the pole pairs of the motor. For a four-pole motor the disk has two slits. The light of the arc is sent through the slits of the disk and is projected through a lens on a screen. The picture of the arc is thus taken for one instant in each period, and as the induction motor has a small slip, the picture is taken in consecutive periods at slightly different phases.—*Bull. Soc. Int. des Elec.*, July.

Silver Voltameter.—Skinner.—An abstract of a paper, read before the Brit. Ass'n Adv. Sc., on a "Comparison of the deposits in silver voltameters with different solvents. He experimented with two voltameters, one containing the usual aqueous solution of silver nitrate, and the other a solution of this salt in piridin. He found that the electro-chemical equivalent of silver as obtained from the aqueous solution differed from the piridin solution about the same amount as the difference obtained between electrolyzing under atmospheric pressure or in vacuum. In effect, the true electro-chemical equivalent of silver has to be raised from 0.1118 to 0.1119. In the discussion which followed, Griffiths regarded piridin to be a better solvent on account of the smaller risk of removing any of the deposit by subsequent washing, the deposit being harder and more consistent. Threlfall advocated the use of fused salts in preference to solutions. Schuster pointed out that the voltameter is intended to give, not an absolutely accurate standard but a sufficiently close approximation to the values obtained by absolute measurements. Lord Kelvin advocates the use of copper in place of silver, employing Gray's method and formula, with a current density of 0.02 amperes per square centimeter. Murray spoke of having used zinc with satisfactory results, and Quincke said that in Germany the copper voltameter is extensively used and is found to be satisfactory.—Lond. *Elec.*, Sept. 20.

Measuring the Resistance of an Electrolyte.—Duddell.—At the end of his paper on the resistance and e. m. f. of an electric arc (see the abstract above under Lights and Lighting) he deals with Kohlrausch method of measuring the resistance of an electrolyte. While it is often assumed that the errors due to polarization are avoided if the frequency of the alternating or interrupted current used is as high as a few hundred p. p. s., he found experimentally with a sulphuric acid cell that it was not until the frequency exceeded 10,000 p. p. s. that the electrolyte behaved as a dead resistance, and the errors due to the polarization were avoided. If the resistance of this cell were tested in the ordinary way at a frequency of 100 p. p. s., the value obtained would be over twice its true resistance. It is concluded that unless other methods are adopted to eliminate the effects of polarization, it must not be assumed that the use of alternating currents of ordinary frequencies of a few hundred p. p. s. eliminates the possibility of errors due to polarization.—Lond. *Elec. Rev.*, Sept. 20.

Interrupter.—Soulier.—An illustrated description of a new high-speed interrupter for Ruhmkorff coils. In principle the apparatus is a commutator of two copper segments, with two carbon brushes. The current enters through one brush and leaves through the other. The circuit is broken as long as both brushes are not sliding on the same segment. One of the brushes can be displaced at will, which enables one to adjust the time during which contact is made, in relation to the time during which the circuit is broken. The construction of the apparatus for practical uses is described in detail and illustrated.—*L'Ind. Elec.*, Sept. 10.

REFERENCES.

Meters.—Illustrated descriptions of two new French energy meters, one for alternating current, the other for direct current. The Blathy-Japy alternating-current meter is of the rotary field type. All parts of the meter through which currents flow, are fixed; the movable part is a simple homogeneous disk. The Japy direct-current meter consists essentially of an electrodynamic motor, the field coils of which are supplied with the main current, while the movable coils are shunted across the line wires.—*L'Ind. Elec.*, Aug. 10.

Prepayment Electric Meter.—Bainville.—An illustrated description of a prepayment device, brought out by a French company, to be used in combination with any type of electric meter.—*L'Elec.*, Sept. 14.

Meters.—Turner.—An Ohio Elec. Light Ass'n paper on the selection and maintenance of meters.—*West. Elec.*, Sept. 28.

Motor Meter.—An illustrated description of the Raschke motor meter for direct current.—*Zeit. f. Beleucht*, Sept. 20; *Elek. Anz.*, Sept. 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Lines.—Medina.—Long-distance telegraph lines consist of component circuits added together through repeaters. Where the parallel wires are few and far apart on the cross-arms the compound circuits work well with few repeaters. When new wires are added on the same poles, the mutual induction becomes more and more troublesome. He discusses the nature of mutual induction and distinguishes between that which takes place between the primary

and secondary coils of a transformer, and that which occurs between the two plates of a plane condenser. The former is electromagnetic induction, the latter electrostatic induction. He gives reasons why he believes that in telegraph lines the electromagnetic effect is usually negligible compared with the electrostatic effect. Being statical in its nature, the mutual induction effect is a function of the e. m. f., and not of the current, so when it becomes necessary to decrease it, it has to be done by decreasing the e. m. f. This may be done by using larger or shorter wires. The latter course requires the introduction of more repeaters, which he advocates. He calls attention to the importance of the time of movement of the relay lever. This is cut down by using shorter circuits. In certain classes of multiple telegraphy, relays with extra heavy levers and armatures are used, which can only increase that movement-time of the relay levers to the detriment of the signals.—*Jour. of Elec.*, Aug.

REFERENCES.

Statistical.—Long statistical tables on telephony in 1899, for nearly all countries of the earth. The United States, however, is not included.—*Jour. Tel.*, July 25.

Statistical articles on telegraphy and telephony in Sweden in 1900, on telephony in Brazil in 1898, and on telegraphy and telephony in the Netherlands in 1899.—*Jour. Tel.*, Aug. 25.

Statistical articles on telegraphy and telephony in Switzerland in 1901; in British India during 1899-1900; in Dutch Indies in 1899, and in Great Britain during the year from April, 1900, to March, 1901. —*Jour. Tel.*, Sept. 25.

MISCELLANEOUS.

Lightning Rods.—HEDGES.—A Brit. Ass'n paper on protection from lightning. He gives an account of his rearrangement of the system used at the St. Paul's Cathedral. The number of ordinary conductors from air to earth has been greatly increased, and, besides these, horizontal cables are run on the ridges of the roofs and in other prominent positions so as to encircle the building, being interconnected to the vertical conductors wherever they cross one another. The horizontal cables are furnished at intervals with aigrettes or spikes, which are invisible from the ground level and designed to give many points of discharge.—Lond. *Elec. Eng.*, Sept. 27; abstracted in *Eng'ing*, Sept. 27.

Association of German Electrical Engineers.—A full account of the proceeding at the recent annual meeting of this society in Dresden. (The papers read there have been noticed in the Digest as far as published.) The following values were adopted provisionally for one year and will be voted on again definitely next year: Standards for rating and testing electric machines and transformers (Digest, July 13, Sept. 28), rules for determining the magnetic properties of sheet iron (Digest, July 20). The following regulations were definitely adopted; safety regulations for electric railway installations, standards for rubber insulated wires, and rules for the protection of buildings against lightning flashes. All these regulations are reprinted in full. The president of the association is Professor Hartmann, of the firm of Hartmann & Braun, Frankfort.—*Elek. Zeit.*, Sept. 12, 19.

REFERENCE.

Electric Heating Apparatus.—HAERDEN.—An illustrated article in which he gives practical hints on making, with simple means, heating and drying apparatus for laboratory uses.—*Elek. Anz.*, Sept. 5.

New Books.

INTRODUCTION TO PHYSICAL CHEMISTRY. By James Walker, D. Sc., Ph.D. London: Macmillan & Co. 335 pages, 47 illustrations. Price, $3.

This book is intended to be an introduction to physical chemistry for students of chemistry. As the author remarks in the preface, his book makes no pretension to give a complete or even systematic survey of physical chemistry—its main object is to be explanatory. He has found in the course of 10 years' experience in teaching the subject, that the average student derives little real benefit from reading the larger works; that he keeps his everyday chemistry and his physical chemistry strictly apart, with the result that instead of obtaining any help from the new discipline in the comprehension of his systematic or practical work, he merely finds himself encumbered with an additional burden on the memory, which is to all intents and purposes utterly useless. This state of affairs the author has endeavored to remedy in the present volume by selecting certain chapters of physical chemistry and treating the subjects contained in them at some length, with a constant view to their practical application.

It must be conceded that the purpose and the general idea of the book are excellent, that the chapters treated by him are well selected, and that, in general, the treatment is extensive enough to give the student a good general idea of the theory, and at the same time interesting enough to excite the student to further studies. The contents of the 27 chapters are as follows: Units and standards of measurement; the atomic theory and atomic weights; chemical equations; the simple gas laws; specific heats; the periodic law; solubility; fusion and solidification; vaporization and condensation; the kinetic theory and Van der Waals's equation; the phase rule; thermo-chemical change; variation of physical properties in homologous series; relations of physical properties to composition and constitution; the properties of dissolved substances; osmotic pressure and the gas laws for dilute solution; deductions from the gas laws for dilute solutions; methods of molecular weight determination; molecular complexity; electrolytes and electrolysis; electrolytic dissociation; balanced actions; rate of chemical transformation; relative strengths of acids and bases; equilibrium between electrolytes; application of the dissociation theory; thermo-dynamical proofs.

It will be seen that the greater part of the book is of interest chiefly to chemists rather than to electricians. For the electrician, however, those chapters which deal with the principle of modern electro-chemistry and with the theory of the electrolytic dissociation are of special interest. It is therefore to be regretted that the author has not been very successful in the very chapter in which he discusses the fundamental researches on the processes occurring in the electrolytes during electrolysis, namely the work of Faraday, Hittorf, and Kohlrausch (Chapter 20). While the purely chemical points are very well brought out, this is not the case to the same degree with the electric phenomena. In the discussion of Faraday's law it would have been well to have shown clearly how the expression of Faraday's law as generally found in textbooks agrees with the assumption of charged ions. The textbooks generally state Faraday's law in the form, that the quantity of electrolyte decomposed in milligrams is 0.0104 times the number of ampere-seconds, times the chemical equivalent. The theory of ions says that a monovalent gram ion is charged with 96,500 coulombs of positive or negative electricity. The author of the present book starts at once with the latter statement, without mentioning the former. The student who makes an experimen in electrolysis will prefer the former statement, as given in the ordinary textbooks, because he can apply it at once to his experiment; he will be liable to regard the assumption of charged ions as something entirely different or as an irrelevant term of theorists. Such a book as the present one is intended to be, should show clearly that those two statements are in reality only different expressions of exactly the same thing. This can be done in a few lines, and should be done, as it is just in a book of this kind that the student looks for such explanations. Nor would it be too much to claim, too, that in this connection it should have been repeated that a coulomb is only another name for an ampere-second, for the book is for beginners and for chemists.

After the exposition of Faraday's law, the author discusses on a little more than four pages Hittorf researches on transport numbers, the discussion being clear, concise and to the point. After this follow some remarks on Kohlrausch's researches on the migration velocity of ions, which are very brief and not at all clear. He gives a table of the absolute velocities of migration with speeds in centimeters per hour, "when the difference of potential between the electrodes is one volt"; this is, of course, quite wrong. It would be easy to improve this chapter in a subsequent edition.

The last chapter of the book, which is on thermo-dynamical proofs, is of special interest. He there gives in concise and clear form some of the more important applications of the second principle of thermo-dynamics to the theory of solutions. The chapter is concluded by some remarks on electrical and chemical energy. By a simple cyclic process—which is a good example of the application of the entropy principle to chemical systems—he develops Helmholtz's formula for the relation between the e. m. f. of a cell, the heat equivalent of the chemical action in it, and the temperature coefficient of the e. m. f., i. e., the modified Thomson's rule. As is well-

known, Helmholtz has developed this formula as a consequence of his theory of the "free energy" of a system; it may also be easily obtained from other general statements of the entropy principle. But, in the opinion of the reviewer, the only proper way to dvelop it in a form intelligible and convincing to the beginner, is the way which the author of this book has used, to devise a special cyclical process and to apply to this process the old Carnot-Clausius principle, in the same way as it is applied to the heat engine. While improvements in details are very desirable, it may be said again that, as a whole, the book accomplishes its purpose, and can be highly recommended.

Dental Electricity. By Levitt E. Custer, B. S., D. D. S. Dayton, Ohio: U. B. Publishing House. 531 pages, 208 illustrations. Price, $4.

This is a book written by a dentist for dentists who seek to become acquainted with the nature and use of electric appliances used in dentistry. It is entirely practical in its style, and simple in its treatment. The book is well illustrated, and the subject is well covered. The first chapter is devoted to an outline of the theory of electricity. Then follows a chapter on electric terms. Next a chapter on magnetism. Chapter IV. deals with sources of electricity. The remaining eight chapters deal with practical applications of the current and are entitled, respectively, "The Rheostat," "Power," "Heat," "Light," "Electrolysis," "Cataphoresis," "X-Ray" and "An Independent Plant." Dentists employ small motors for driving their machines and tools, electric heaters for ovens and cauteries, electric lamps for illumination, electrolytic devices for therapeutical treatment, plating and cataphoresis, besides Röntgen ray apparatus. This represents a large and varied assortment of electric apparatus.

From a purely electrical standpoint the book is not without errors; for example, a dynamotor is described as a motor-dynamo, a totally different piece of machinery. But considering the necessarily popular treatment of the subject, and that the theory is properly subordinated to the practice, it would be unreasonable to expect the same degree of electro-technical accuracy that a college text-book should possess. The book will undoubtedly be of great value to dental surgeons.

De Laval Steam Turbine.

The De Laval steam turbine is now being introduced into this country, an American company having been formed for that purpose under the name of the De Laval Steam Turbine Company. A factory for the construction of turbines has just been finished at Trenton, N. J., and offices of the company have been opened at 74 Liberty Street, New York.

As is quite well known, the De Laval type of steam turbine was the first steam turbine to enter into the practical stage, the first machine having been put in use in 1883. At present thousands of these machines are at work in Europe, varying in size from 3 to 300 horsepower.

This turbine is, briefly, a steam impact wheel very similar in principle to the well-known Pelton waterwheel so largely used in the West under great heads. The steam impact wheel was first proposed by Branca, but its advantages were not practically realized until De Laval applied his diverging nozzle and mounted the wheel on a flexible shaft. By the use of the diverging nozzle it is claimed that a complete adiabatic expansion of the steam is obtained, and its entire static energy converted into kinetic energy. The flexible shaft overcomes the impossibility of producing a wheel accurately enough balanced to revolve about its center gravity at a velocity sometimes of as high as 1550 ft. per second.

By the use of the De Laval nozzle a volume of steam of a maximum pressure is accurately and adiabatically expanded to a minimum pressure, the steam at the point of discharge issuing as a solid jet without a tendency of its particles to divert in any direction. A characteristic feature of this type of turbine is that none of its running parts are subject to the full pressure of the steam, since the steam is fully expanded in the nozzles before it reaches the turbine wheel. As a consquence, the steam pressure that can be used is only limited by the strength of boilers. Moreover, a further and considerably increased economy can be obtained by using superheated steam, which this type of turbine is particularly well adapted for, having no rubbing parts requiring lubrication nor packing glands in contact with superheated steam.

A perspective view of the wheel and nozzles is given in Fig. 2. Fig. 1 shows a turbine direct connected to a dynamo, which arrangement is shown in sectional plan and elevation in Figs. 3 and 4. Fig. 1 shows the wheel with its steel flexible shaft, and Fig. 3 the same in its casing.

The steam after passing through the governor valve enters the steam chamber *D* (Fig. 3), whence it is distributed to the various nozzles. These, according to the size of machine, range in number from 1 to 12. They are generally fitted with shutting off valves, by which one or more nozzles can be cut out when the turbine is not loaded to its full capacity. This allows steam of boiler pressure to be almost always used, and adds to the economy on light loads.

After passing through the nozzles, the steam, as above explained, is completely expanded, and in blowing through the buckets its kinetic energy is transferred to the turbine wheel. After performing its work the steam passes into the chamber *G*, and out through the exhaust opening *H*. The wheel and case covers are so shaped as to form a safety arrangement around the hub of the wheel for the purpose of checking its speed in case of an accident to the shaft.

The velocity of the trubine wheel and shaft, in most cases too great for practical utilization, is considerably reduced by means of gearing, which is usually made 10 to 1. The gear is mounted and enclosed in the gear case *I*. *J* is the pinion made solid with the flexible shaft and engaging the gear wheel *K*. This latter is forced upon the shaft *L*, which, with couplings *M*, connects to the dynamo or is extended for a pulley. *O* is the governor held with a taper-shank in the end of shaft *L*, and by means of the bell-crank *P* operates the governor valve.

The flexible shaft is supported in three bearings. *Q* and *R* are the pinion bearings and *S* is the main shaft bearing, and carries the

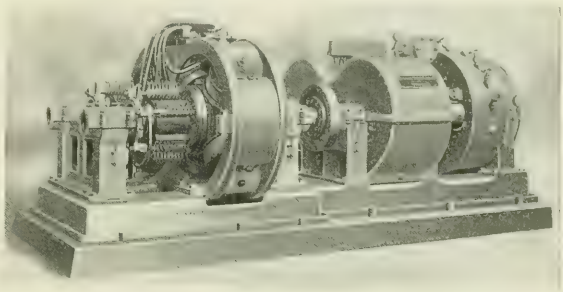


FIG. 1.—DIRECT-CONNECTED TURBINE.

greater part of the weight of the wheel. This latter bearing is self-aligning, and is held to its seat by the spring and cap shown. *T* is the flexible bearing. This bearing is entirely free to oscillate with the shaft, and its only purpose is to prevent escape of steam when running non-condensing, or air from entering the wheel case when the turbine is running condensing. All the bearings of the flexible shaft, as well as the gear wheel, are lubricated from a central oil reservoir *U*, mounted upon the gear case; all other bearings are self-oiling. The bearings are plain and simple in construction, and made in two halves, so as to easily be taken out and examined. They are lined with anti-friction metal, are reamed true and to exact size, and have the outside surface ground to insure perfect fitting and alignment. The bearings even in the largest sizes are removed and replaced without moving or raising the shaft from its seat.

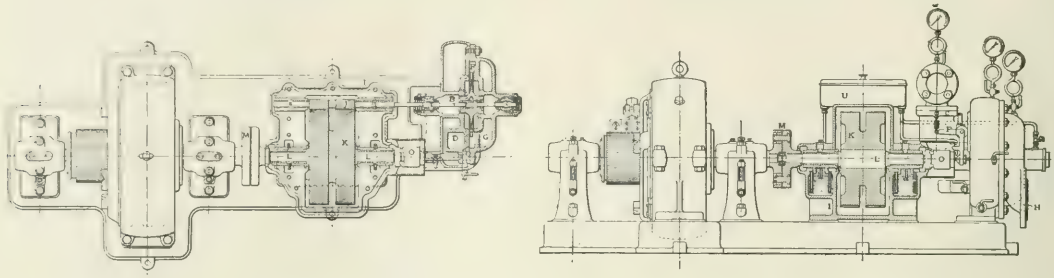
The flexible shaft is mainly supported on each side of the pinion by main bearings *Q* and *R*, which bearings are placed a considerable distance apart. The shaft is at the same time made very slender, which gives it a certain amount of flexibility and allows the turbine wheel, when the so-called critical speed is reached, to revolve around its true center of gravity. This critical speed, dependant upon the flexibility of the shaft, occurs well below the normal speed of the turbine and marks the disappearance of all vibrations.

The turbine wheel is made of forged nickel-steel, and will withstand more than double the normal speed before showing any signs of distress. In the smaller sizes the wheels have a hole through the center and are forced upon a taper sleeve shrunk on to the shaft. The larger wheels are made solid, with the shaft in two pieces screwed to the flanges of the wheel. The buckets are drop forged and made with a bulb shank fitted in slots milled in the rim of the wheel. By this

method the buckets can easily be taken out and new ones inserted, should occasion require, without damage to the wheel.

With the high speed used in the De Laval Steam Turbine a governor of small dimensions, and yet very effective, can be used. The governor is compact and simple in construction. The two weights are pivoted on a knife edge with hardened pins bearing on a spring seat. The governor body is fitted in the end of the gear wheel shaft *K*, and has seats milled for the knife edges. It is afterwards reduced in diameter to pass inside of the weights, and in its outer end is threaded for adjusting butt, by means of which the spring and eventually the speed of the turbine is adjusted. When the speed exceeds the normal, the weights, affected by the centrifugal force, spread apart and pressing on the spring seat *D*, push the governor pin forward, thereby cutting off part of the flow of steam.

Many authoritative tests have been made in Europe on the De Laval steam turbine, and these show that it is a very efficient heat engine. In a test by Professor Cedarblom, of the Royal Polytechnic College, of Stockholm, a 50-hp wheel was operated for eight hours and the load determined by the friction brake method. The boiler pressure was 122 lbs. per square inch, and 26-inch vacuum was maintained by a Korting ejector condenser. The steam consumption was found to be at the rate of 19.73 lbs. per brake horse-power-hour. A test of a 150-hp turbine was also conducted by Professor Cedarblom. This showed a steam consumption varying from 17.35 to 22 lbs. per brake horse-power-hour, the former corresponding to a brake load of 160 horse-power, and the latter to a brake load of 38 horse-power. A 300-hp turbine gave on test a steam consumption varying from 13.96 lbs. per horse-power-hour at 307 brake horse-power, to 21.3 lbs. per horse-power-hour for 31.9 brake horse-power. In the latter test, throwing off the maximum load (307 lbs.) caused the speed to increase but 4 per cent.



FIGS. 3 AND 4.—SECTIONAL PLAN AND SECTIONAL ELEVATION OF TURBINE.

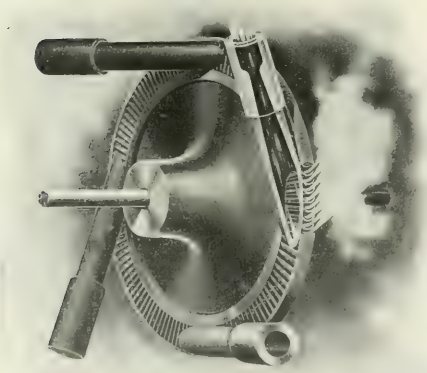
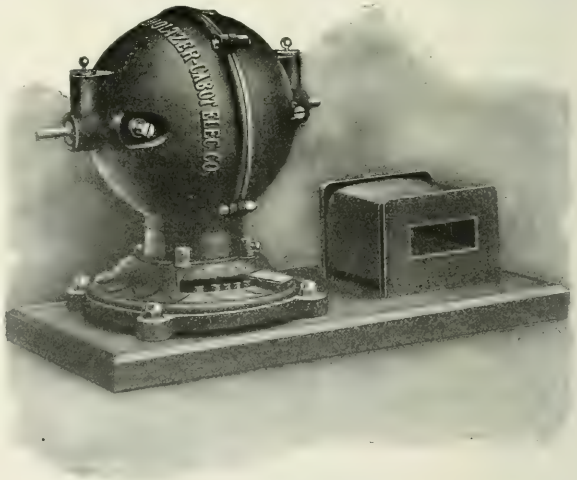


FIG. 2.—PERSPECTIVE VIEW OF STEAM TURBINE.

A Watch Demagnetizer.

The accompanying cut shows a special demagnetizing appliance, which is being manufactured by the Holtzer-Cabot Electric Company, of Boston, Mass. It relies for its principle upon the demagnetizing or reversal properties of the alternating current. The machine shown is a special form of dynamotor or rotary transformer, the primary of which may be wound for any direct current up to 250 volts. The secondary half of the armature delivers an alternating current of a convenient voltage, and a frequency that has been found thoroughly effective for the work. The current from the secondary is introduced directly into the coil shown, thus creating in the region in the center of the coil an intense magnetic field whose polarity reverses with each reversal of the current. The watch, or article to be demagnetized, is introduced into the orifice. It is, of course, instantly demagnetized and remagnetized with the opposite polarity, demagnetization and remagnetization following each other with a rapidity depending upon the frequency of alternation of the current. If the article be slowly withdrawn it is evident that each half cycle of magnetization will be of a lesser degree than the one preceding, until the piece is entirely withdrawn from the influence of the field, when the magnetism will be practically all removed. Obviously, the higher the frequency of alternation of the demagnetizing current, the more complete will be the demagnetization. The ordinary appliances, as is well known, aim to accomplish their purpose by revolving the watch rapidly before the poles of a horseshoe magnet, or reversing a battery current through a demagnetizing coil at a comparatively low frequency, by means of a hand gear. If it is attempted by these methods to approach the high rapidity of alternation which is easily obtained with the dynamotor, prohibitive mechanical difficulties are soon encountered. Furthermore, it is not possible to produce the high intensity of magnetization with the permanent magnet, which is readily obtainable with the electric current.



WATCH DEMAGNETIZER.

The National Association of Automobile Manufacturers.

The first annual convention of the National Association of Automobile Manufacturers for the discussion of trade topics will be held in the Assembly Room of the Madison Square Garden during the week of the Automobile Show on the forenoons of Tuesday and Wednesday, Nov. 5 and 6, 10 to 12 o'clock. The committee in charge of the programme and arrangements have mapped out an interesting meeting, which will be open to the public. Among the subjects to be discussed are: The National Association, protective tariff and undervaluations, legislation, transportaion, commercial gasoline, wheels, steel tubing, tires, races, good roads, prices and discounts. Men of special ability as speakers and writers on these different subjects have been selected, among whom will be: Samuel T. Davis, Jr., Messrs. Schwarzkopf, of *Automobile Topics;* Goodman, of the *Motor World;* W. W. Niles, George F. Chamberlin, Edward W. Adams, John Brisben Walker, Charles E. Duryea, E. P. Wells, Albert T. Otto, Kirk Brown, Alexander Winton, T. C. Martin, of Electrical World and Engineer; W. P. Stevens, of the *Motor Review*, and representatives of the Goodrich, Diamond, Hartford, Standard Oil and Shelby Tube companies.

The annual meeting of the association for the election of executive committeemen will be held in the same place at 8.30 p. m. on Thursday, Nov. 7, upon the termination of which there will be a dinner, with post-prandial oratory. It is hoped to be able to secure as one of the bright particular stars for this event ex-President Eddy, of the Chicago Automobile Club, who made such a witty and brilliant speech at the Garden dinner last year. Mr. E. D. Knappen is the active assistant secretary of the organization.

Snap Cover Steel Conduit Moulding and Safety Switch.

The accompanying illustrations refer to a new type of safety switch and a new type of steel conduit and moulding that are being brought out by E. E. Clock, of Passaic, N. J. The switch is designed to overcome the annoyance and sometimes danger in fusing a main line cutout on a live line. As will be noted, the fuse is attached to a switch having a fiber blade. When a fuse blows it is withdrawn from the circuit upon pulling the switch, and after re-fusing the switch is closed.

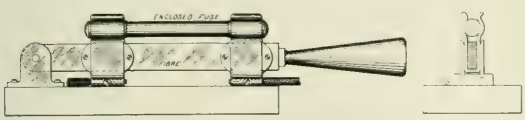


FIG. 1.—SAFETY SWITCH.

The conduit illustrated unites, as will be seen, the convenience of a capped moulding with the security of a metallic tube. It consists of a portion easily attachable in installation, and a cover for making the conduit entirely enclosed, which cover is snapped in place. The illustration shows two forms in which the conduit is made, one being cylindrical and the other having more the shape of an ordinary wood moulding.

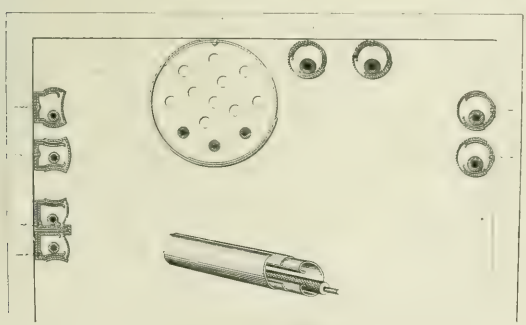


FIG. 2.—STEEL CONDUIT.

Automatic Door Switch.

The automatic door switch, illustrated herewith in Figs. 1, 2, 3 and 4, is enclosed in a steel case with semi-circular ends. This form of case facilitates letting the switch into the door jamb, as, after three 1-inch holes are bored, it is only necessary to cut out the wood between them to admit the case, and it is not necessary to square up the ends of the oblong opening.

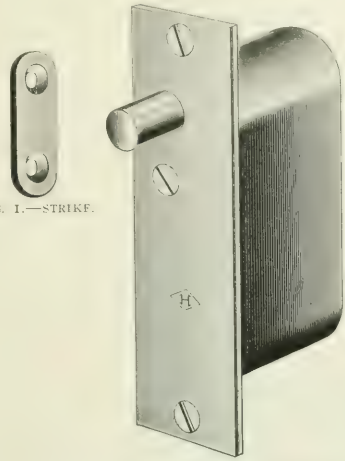


FIG. 1.—STRIKE.

FIG. 2.—DOOR SWITCH COMPLETE.

The insulation of the current-carrying parts from the mechanism, as in all switches of this type by the same maker, the Hart Manufacturing Company, of Hartford, Conn., is effected by the use of sheet mica. The spring bronze contacts are carried by a porcelain block, which is screwed to the bottom of the case, and extends through the bottom at the end where the wires enter. The binding screws on the face of this block are accessible from the front.

The parts of the switch most subjected to wear are made of nickeled steel. The springs are of the best music wire, nickeled, are helical in form and of large diameter.

The action of the switch is smooth and easy. The break is 1¼ inches in length, and is sufficient for 3 amperes at 250 volts. A steel template is furnished, which, when placed against the door jamb and tapped with a hammer, gives the location of the centers of the two screw holes at the ends of the face plate, and also of the three 1-inch holes to be bored for the case. It also gives the outline of the face-plate.

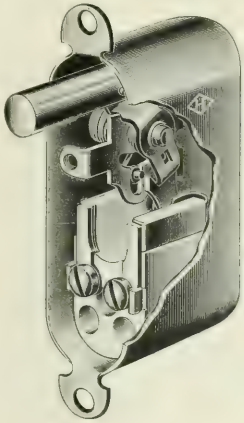


FIG. 3.—SWITCH "ON."

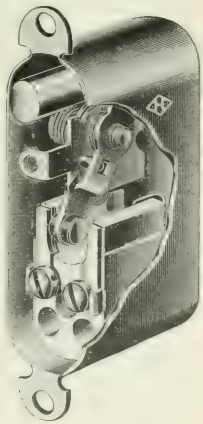
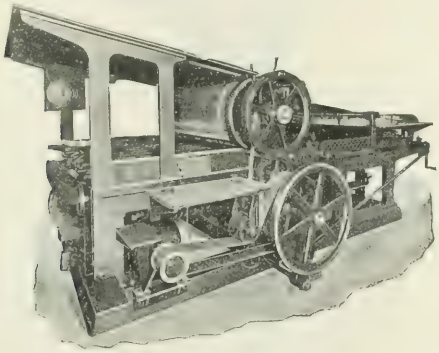


FIG. 4.—SWITCH "OFF."

These switches have been given tests equivalent to years of actual service, and it is stated that not one has given out or shown weakness.

A Modern Printing Press Equipment.

Electrically driven printing presses have been in operation long enough to demonstrate beyond question their superiority over all other kinds. The individual equipment of each press is also conceded to be the most satisfactory, but it is sometimes a question which method—belted, geared or direct connected—gives the best results. One of the most successful is a belted equipment recently perfected by the Sprague Electric Company, and shown in the accompanying illustration. It consists of a Lundell 4-hp, standard speed, compound-wound motor, belted to a flat-bed press. The motor is controlled by one of the Sprague Company's standard rheostatic rotary controllers, used in connection with armature and shunt field regulating resistances. The pulley on the motor is 4½-inch diameter and 6-inch face, and the pulley on the main driving shaft of the press is 22-inch diameter, 6-inch face. The transmission of the power from the motor to the press is obtained with a medium thickness perforated endless belt 5½-inch wide, which insures noiseless operation and reduces slippage to a minimum. An idler or belt tightener is used, which, together with the motor brackets, are furnished and attached by the press manufacturer. This method of equipment has merit, owing to the possibility of sudden strains being put on the gears of the press or the motor by the rapid manipulation of the controller.



ELECTRICALLY DRIVEN PRESS.

With this equipment, if the controller suddenly throws the full power upon the motor, it causes a slight slippage of the belt until the press has attained its speed.

The motor is attached to a removable bed plate, which permits the motor, in case of accident, to be withdrawn and another substituted while repairs are being made. This equipment has the additional advantage of being an economical installation.

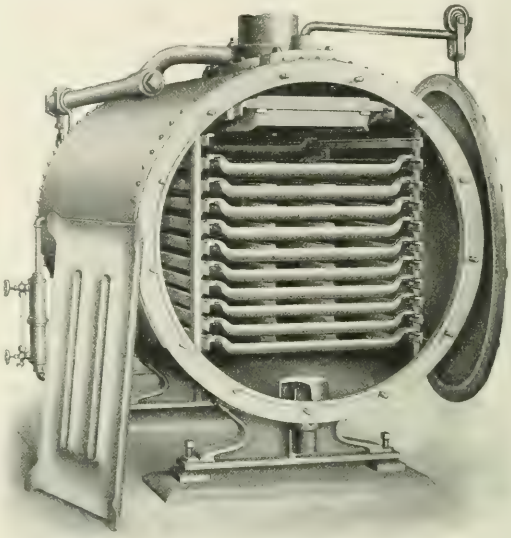
New Feed Water Heater.

We illustrate a new form of feed water heater recently brought out by the Hoppes Manufacturing Company, of Springfield, Ohio, intended to be used where the water contains acids or other corrosives, but not to take the place of the company's regular form of heaters with steel pans, where the water is neutral or contains large quantities of lime and other solids. The illustration clearly shows this heater, and it is only necessary to say that the pans and all parts with which the feed water comes in contact are made from cast iron and where bolts are used they are bronze. In designing this heater, use was made of the well-known Hoppes system of flowing water along the underside of the pan in thin films in such a manner that the exhaust passing through the heater would come into direct contact with the water.

The pans in this heater are cast in one piece and are in form a multiple of trough shape sections, joined at each end by a section of the same form and provided at each corner with lugs for supporting the pan on the ways in the heater. The pan shown beside the heater in the cut will give a good idea of the shape used in this construction. It will be noticed that the water will flow over the edges of the pans and also through the slots. The water flowing over the sides of the pans or edges will follow the underside of the pan to the lowest point before dropping into the next pan below, and so on over each pan until it reaches the reservoir at bottom. The exhaust steam passing through the heater comes into direct contact with the water flowing over the pans and therefore can impart its heat to the water without heating through the metal of the pans or lime deposited thereon.

The comparatively flat form of this pan permits of about twice the amount of surface being put into a heater of a given size as compared with the original form, and as a smaller shell can be used much saving of space is effected. This heater is provided with a hooded outlet for the pump suction which acts as a skimmer, and when desired a filter is also provided.

A large and efficient oil catcher is located in the back of the heater and a float and balanced valve is provided for regulating the feed water inlet. It will be noticed that the entire head of the heater is



FEED WATER HEATER.

removable so that access may be easy to all parts of the heater for cleaning or examination; and a crane is provided for removing this head as shown in the engraving. A trap is also provided for the oil drips from overflow when the heater is used in connection with a heating system.

Heaters of this construction have been manufactured by the Hoppes Company for a little less than one year, but it has now in use machines ranging in size from 150 horse-power to 7000 horse-power, all of which are giving excellent results. The large reservoir at the bottom of this heater makes it well adapted to be used as a heater and receiver where installed with a heater system.

Milling Machines at the Pan-American.

The Cincinnati Milling Machine Company has on exhibition at Buffalo a full line of milling machines and attachments for such machines. Their No. 2 Universal and No. 3 Plain machine are both shown in operation. A No. 0 Plain and No. 4 Plain, which are respectively the smallest and largest machines made by this company, are also shown. The chief new feature embodied is the positively driven geared feed mechanism, supplying 16 changes on the larger and 12 feed changes on the smaller machines. This mechanism is a bold departure from past practice in milling machine design, there being an entire absence of chains and friction devices. The entire train of feed gearing is carefully designed and the machines have been in use long enough to prove it amply strong for the heaviest duty that can be imposed on it by the main driving belt of the machine. The attachments shown cover the entire range of milling operations. Notable among these are a special spiral milling head for heavy work, and a vertical spindle milling head, which, when attached to either the No. 3 or No. 4 machines, converts them into vertical millers. There is also a universal cutter and reamer grinder in constant operation, as part of this company's exhibit, which, as already noted, won the highest award possible.

The Kellogg Telephone and Switchboard Exhibit at the Pan-American Exposition.

One of the most attractive and conveniently arranged booths in the Electricity Building is that of the Kellogg Switchboard & Supply Company. The display made by this company is very elaborate, and the illustrations of which are shown in this issue, will clearly emphasize this statement. In order to exhibit to best advantage the systems and apparatus manufactured by this company, it was found necessary to provide two booths. The main booth, Section R, contains a general display of its different apparatus, while its branch

FIG. 1.—VIEW OF MAIN EXHIBIT.

booth, Section F, is used to display and demonstrate the practical working of subscriber's telephone apparatus.

One of the first things to attract attention upon entering the main booth is a single section of what is stated to be the largest centralized energy multiple switchboard ever built. The ultimate capacity of the complete switchboard is 12,000 subscribers' lines. A board of this type fully equipped would require about 40 of these sections. It is provided with line lamp signals and double-lamp supervisory signals in the cord circuits. One of the unique features of this board is the simplicity of the spring jacks, which are provided with only two terminals, and are mounted 40 per strip on ⅜-inch centers, thus greatly reducing the area occupied by the multiple jacks on the face of the section, and making the cabling so simple as to be easily wired and maintained. The cabinet is of a rich, solid mahogany, and is provided with a plate glass panel in the end, which enables one to observe the complete arrangement of the multiple cabling. The back of the cabinet is provided with a roller curtain constructed so as to make the board practically dust proof.

At the front of the open space is a plate glass display show case, which contains an interesting exhibit of small telephone apparatus used in the construction of switchboards and subscribers' outfits. Several important pieces of this apparatus are shown unassembled. A duplicate of this show case in the rear of the 12,000 line board contains a complete line of samples of fine magnet wire, switchboard and telephone cords, and switchboard cable, all of which form a part of this company's product.

Supported on elaborate show boards conveniently arranged in this space is shown a complete line of subscribers' wall sets comprising over 36 different types and finishes. These instruments are all connected to switchboards for demonstrating purposes. A sound-proof booth, located in the rear of the space contains magneto and centralized battery subscribers' sets for testing the quality and strength of transmission and comparison of systems.

The section of a 3000-line centralized battery switchboard shown is called by this company a "minor" board to distinguish it from their "major" board, an example of which is the 12,000 line switchboard described above. This board has several distinctive features besides being provided with full lamp signals. It has all of its operating apparatus conveniently located in the cabinet. This is made possible by the compact construction of the relays. Strips of ten relays are made in a cast-iron case, so as to be mounted on the structural steel frame in the rear of the switchboard. Only one relay is necessary for each line, and there are no contacts to open or close in the talking circuit from the subscriber's instrument to the line jack. Several instruments are connected to this switchboard for demonstrating purposes.

Another switchboard shown in this space which is particularly interesting is a two-division centralized battery lamp signal switchboard. With this type of board, the subscriber is provided with two push buttons which enable him to make direct connection with either division of a two-division multiple switchboard, thus making it possible to connect directly with the subscriber desired, without the use of trunk lines.

A combination centralized battery and magneto switchboard is also exhibited in this main floor space. This switchboard is intended for use in small towns where it is desired to give the town subscribers the advantage of the latest designs of telephone apparatus and to make it possible to directly connect magneto lines, such as toll lines and long farmers' lines, with the centralized battery town subscribers. This board has a capacity of 160 centralized battery lines and 30 magneto lines.

A wall-type switchboard which is also shown, has a capacity of 20 magneto lines, provided with apparatus for four-party line selective signaling. This particular type of switchboard is largely used for connecting farmers and toll lines, and its construction is nearly as simple as the regular subscribers' wall set, so that it requires no experience to operate it.

Besides the instruments and apparatus described above, the main exhibition space contains four "express" switchboards ranging from 50 to 200 lines capacity. These switchboards are provided with mechanically self-restoring drops, and a very substantial and convenient arrangement of cord equipment. This type of board represents the simplest forms of telephone exchange equipment for use in small towns where an efficient and rapid means of inter-communication is desired.

At the rear of this main exhibition room just described is an "exchange room," in which is located a centralized battery "major" switchboard of 3000 ultimate capacity with a present equipment of 980 lines. All the apparatus necessary to make this a complete working exchange is located either in this room or in the basement under

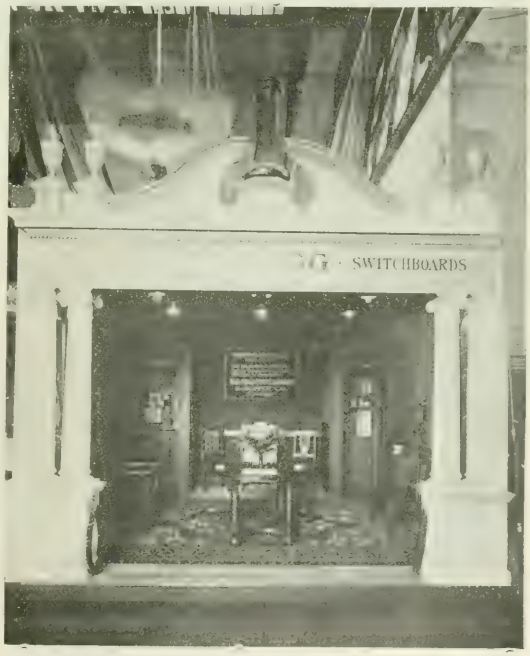


FIG. 2.—BRANCH BOOTH.

the booth. A large number of subscribers' instruments of different designs, located in Sections F and R, are connected to this board to show its operation.

The arrangement of the switchboard in the "exchange room" is the same as that of an operating exchange. There are three sections of three operators' positions each, the two end positions being left

blank. This gives each operator 140 lines, each of which terminate in an answering jack with its associated line lamp signal. The answering jacks and lamps are arranged 20 per strip, and are located just bove the key shelf in the face of the board. Above the answering jacks and lamps, but separated by white holly strips, are the multiple jack arranged 20 per strip, and above these are the spaces for the multiple jacks required by future growth. These latter spaces are fitted with black ebonized panels. The multiple jacks are divided by white holly strips in banks of five strips, thus making 100 jacks for each bank. Each section of the board is divided by vertical style strips into six panels, thus giving two panels for each operator's position. The key shelf contains a complete equipment of 15-cord circuits for each operator. These cord circuits are provided with ringing and listening keys and double-lamp supervisory signals, there being one lamp signal for each half of the cord circuit.

A rear view of this switchboard brings out a most striking feature in connection with this "model exchange," that is, its simplicity and the small amount of cabling used in its construction. This is due to the fact that it is operated on what is known as the two-wire multiple system. The circuits of this board have been so perfected that none of the answering or multiple jacks require more than two contacts. Thus the cabling and general construction of all the apparatus is very much simplified over other systems. The frame of this board, as in the 12,000 line "Major" switchboard, mentioned above, is constructed of structural steel. The cabient is of solid mahogany, and the opening of the back of the board is closed by roller curtains.

The storage batteries for supplying all direct current for the exchange are installed in a room located in the rear of the basement. This room is provided with ample ventilation and a concrete floor sloping to a drain. Each battery consists of 10 chloride cells, 240 ampere-hour capacity, this being sufficient for the present equipment of the exchange. The elements are contained in tanks of 480 ampere-hour capacity, which are large enough for the ultimate capacity of the exchange. The "discharge leads" from the battery lead directly to

FIG. 3.—ROOF GARDEN, TOP OF MAIN EXHIBIT.

the fuse board located just outside the battery room. From the fuse board wires are lead to the individual cord circuits at each section of the main switchboard.

The power switchboard used for handling all heavy currents required in the exchange, such as the currents for the charging and ringing machines, and the charging and discharging circuits of the storage batteries, is located next to the wall of the storage battery room. It consists of two slate panels mounted on an iron framework. On the first panel are mounted all the switches, starting boxes and other apparatus necessary for controlling the current delivered to the motor side of the machine. The second panel contains all of the switches, underload and overload circuit breakers, ammeter, shunts and rheostats for controlling the generator current in charging the storage batteries. At the top of these slabs are mounted a flush round pattern Weston ammeter, and a voltmeter and switches for connecting them to any of the direct-current circuits terminating in the power switchboard.

A duplicate set of charging and ringing machines are used in connection with this exchange as an extra precaution against breakdown or the failure of current supplied from an outside source. The

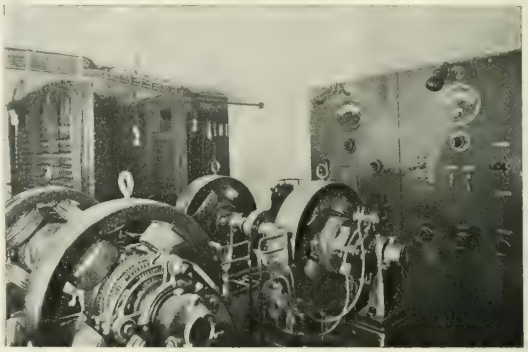


FIG. 4.—POWER EQUIPMENT.

machines are of the Holtzer-Cabot type and of the following sizes: The two generators provided for charging the storage batteries from 110 volts direct current are Holtzer-Cabot type M. P. D., 1850 watts output. There are two ringing machines, Holtzer-Cabot type B, ¼ horse-power. One runs from 110 volts direct and the other from 10 cells of storage battery. These ringing machines deliver 75 volts alternating and pulsating current from their secondary windings.

The power apparatus is mounted on power tables constructed of masonry, the sides are covered with white tile brick, the whole being capped by a heavy slate top. All slate used in both power boards and tables was obtained from the famous Monson Maine quarries, and is especially adapted for this purpose. All the power wiring in this "model exchange" is of the most substantial character, and is protected by being drawn into "Richmondt" steel conduit.

The roof garden, located over the "Exchange Room," of the main exhibit, is reached by a flight of winding stairs similar to those commonly used in telephone exchanges. Suspended over this roof garden from the girders of electrical building, is an elaborate double-faced electric sign nearly 22 ft. long, and about 7 ft. high, built by the A. & W. Electric Sign Company, Cleveland, Ohio. Each letter of this sign is connected to a "flasher" located in the basement of the booth, so that the word "Kellogg" can be flashed in any combination.

In order to demonstrate the operation of the Kellogg systems, and especially the transmission and receiving qualities of their subscribers' instruments, it was found necessary to isolate a part of their exhibit so as to give more nearly the actual condition of the subscriber with relation to the exchange. Thus the branch booth in Section F was designed solely for this purpose. This space is provided with two sound-proof telephone booths, same as used for long-distance transmission work. These booths are both supplied with centralized battery and magneto subscribers' instruments, which are connected by artificial lines to the switchboards located in the main exhibit, Section R.

The architectural design and arrangements of these booths are well balanced, and with the extensive exhibit they go to make up one of the largest and most interesting collections of telephone apparatus ever shown to the public.

The Kellogg Switchboard & Supply Company's industry is claimed to be one of the largest in Chicago. The factory has a capacity of 2000 telephones a week. It has 89,000 square feet of floor space, and employs nearly 1000 men. The company has one of the largest and the most perfectly equipped telephone laboratories for expert study, testing and experimenting in the world. The engineers employed are leading men in their profession, and all of them have had a broad and varied experience in electricity and telephony. As noted last week, the company has been awarded gold medals for its apparatus shown at the Pan-American.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 3 per cent nominal; time money, which was easy throughout the week, closed at 4¼@4½ per cent for high-grade loans; 4¾@5 on mixed collateral. The stock market lacked public support and transactions were narrow, industrials, including United States Steel stocks, being neglected. Some pressure was noted in the traction stocks, Metropolitan selling off on reports of a possible dividend reduction, which were, however, denied. Notwithstanding the adverse influences this stock closed at 158⅛, which is a net gain of 1⅝ points on the week's transactions, and only ⅞ below the highest quotation for the week. The sales aggregated 21,350 shares. Brooklyn Rapid Transit closed at 60⅞, a net gain of ¾ of a point. General Electric fluctuated between 255 and 259, closing at 257, a net gain of 2 points, the total sales being 2400 shares. Western Union Telegraph gained ⅛ point, quotations keeping within a narrow margin.

NEW YORK.

	Oct. 15.	Oct. 22.		Oct. 15.	Oct. 22.
American Tel. & Cable..	—	—	General Carriage.....	⅞	¾
American Dist. Tel.....	—	—	Hudson River Tel.....	112	112
Brooklyn Rapid Transit.	59⅝	61½	Illinois Elec. Veh. Trans.	—	½
Commercial Cable.....	—	—	Metropolitan Street Ry..	158	157¾
Electric Boat.....	22	18	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	45	45	N. Y. Elec. Veh. Tran...	7	6¾
Electric Lead Reduc'n...	2	2½	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	1¾	1½	Tel. & Tel. Co. of Am...	5	—
Electric Vehicle pfd.....	3	3½	Western Union Tel.....	91½	91½
General Electric.....	258½	258			

BOSTON.

	Oct. 15.	Oct. 22.		Oct. 15.	Oct. 22.
Am. Tel. & Tel.....	157	158¾	Mexican Telephone.....	2⅛	2
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light...	—	—	Westinghouse Elec.....	71½	—
Erie Telephone.....	38	36	Westinghouse Elec. pfd..	—	78*
General Electric pfd.....	—	—			

PHILADELPHIA.

	Oct. 15.	Oct. 22.		Oct. 15.	Oct. 22.
American Railways.....	40½	40	Phila. Traction.....	95⅞	95¾
Electric Storage Battery..	64	60	Philadelphia Electric.....	5¼	5⅛
Elec. Storage Batt'y pfd..	64	60	Pa. Electric Vehicle.....	½	½
Elec. Co. of America....	6⅞	6⅝	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Oct. 15.	Oct. 22.		Oct. 15.	Oct. 22.
Central Union Telephone.	—	—	National Carbon pfd....	83	84
Chicago Edison.....	160	165	Northwest Elev. com.....	40	39
Chicago City Ry.....	201	201	Union Traction.....	17⅜	17
Chicago Telep. Co.....	225	250*	Union Traction pfd.....	58	58½
National Carbon.....	18	19⅝			

*Asked.

DIVIDENDS.—Directors of the Allis-Chalmers Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock. The directors of Henry R. Worthington, Incorporated, have declared the regular semi-annual dividend of 3½ per cent on the preferred stock, payable Nov. 1. The directors of the Columbus Railway have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Nov. 1. The Grand Rapids Railway Company directors have declared the regular quarterly dividend of 1¼ per cent upon the preferred stock, payable Nov. 1. The Coney Island & Brooklyn Railway directors have declared a quarterly dividend of 4 per cent. The Albany (N. Y.) United Traction Company has declared the regular quarterly dividend of 1¼ per cent, payable Nov. 1. The Cleveland City Railway Company has declared a quarterly dividend of 1¼ per cent. The Pittsburg Traction Company has declared a dividend of 3½ per cent, payable Oct. 29. The Duquesne Traction Company, Pittsburg, has declared a dividend of 2 per cent, payable Oct. 29. The Central Traction Company, of Pittsburg, has declared a dividend of 1½ per cent, payable Oct. 29. The Consolidated Traction Company, of Pittsburg, has declared a dividend of 3 per cent upon the preferred stock for the first half of the earnings of the past six months, payable Oct. 25. The Milwaukee Electric Railway & Light Company has declared a regular quarterly dividend of 1½ per cent on its preferred stock, payable Nov. 1.

TELEGRAPH, TELEPHONE & CABLE COMPANY.—It is stated by an official of the Telegraph, Telephone & Cable Company of America that the company will enter into active competition against the Bell Company throughout the East, and the work of building lines from New York to Albany and Boston will begin at once. It is stated that wires are being run in all sections of New York City and conduits built. The new board of directors which was elected on Oct. 15 is as follows: C. W. Morse, James M. Thomas, J. A. McDonald, R. R. Moore, R. L. Edwards, J. T. Sproull, John D. Crimmins, Daniel O'Day, James T. Morse, Oakes Ames, Samuel Thomas, E. R. Chapman and Francis M. Jenks. All of the old officers of the company were re-elected. President Thomas states that all of the independent companies throughout Massachusetts will be merged and connections made from point to point. The Boston line will be run throughout New York State and a system of connecting all the cities, towns and villages has been perfected. The Albany line will tap the Boston line. After establishing the system in New York and Massachusetts, attention will be directed to other Eastern States.

THE STATUS OF INDUSTRIALS.—The *Wall Street Journal* had an interesting editorial comment last week on the weakness of industrial stocks, or, rather, their wide fluctuations as compared with "rails." It is encouraging to note that its bright stars in the industrial firmament are electrical chiefly, and it might have added Westinghouse and Bell telephone: "We do not wish to be understood as saying that all industrials are alike and that all have receivers awaiting them. Nothing of the kind. There is no taint in the word industrial. Some of the best stocks are industrials. Look at Western Union, with its long dividend record; at Commercial Cable, with its high credit; at Pullman, with the yield of a bond; at Standard Oil, with its wonderful record; at General Electric, and the way it has come out of its difficulties; at the long list of gas stocks and water stocks and private manufacturing stocks, securities which have afforded security, indeed, to those who have trusted in them."

GENERAL ELECTRIC SURPLUS.—The surplus of the company at the present time is said to amount of $14,000,000, a gain of over $7,000,000 since Jan. 1. To make full restitution to stockholders for the stock taken from them at the time the company's capital was impaired, it will be necessary that the company have a surplus of $18,000,000. It is the belief of General Electric directors that the company will be able to accumulate such a surplus by April 1. Some of the directors are desirious of restoring part of the capital stock this fall or early winter and the remainder next year, but it is said the Morgan interests think it better policy to wait until the company's surplus will permit of a complete capital restoration, and this opinion may prevail. The earnings of the General Electric Company continue large. September net earnings were between $800,000 and $900,000.

ERIE TELEPHONE.—It is said to be the idea of leading interests in the company to do away with the Erie Telephone Company as a parent company and organize a new company to take over the business of the sub-companies and operate the properties. Such a company could be formed and succeed to the business of the Erie sub-companies through the retirement of the Erie Company's bonds and the releasing thereby of the stock of the sub-companies held as collateral. It would require $14,000,000 to meet the notes of the Erie Company and retire sufficient bonds to get control of the sub-companies.

TORONTO STREET RAILWAY.—The directors of the Toronto Street Railway will increase the stock of the company $1,000,000 for the purpose of purchasing the Metropolitan & Toronto Suburban Electric Railways, 30 miles in length, extending from Toronto to Newmarket, and which will connect with the Schomberg & Aurora Electric Railway, now building. The Toronto Suburban Street Railway is 12 miles long, and connects with the Toronto Street Railway by transfer at Toronto Junction.

CENTRAL UNION TELEPHONE.—Suit has been filed in the Circuit Court against the Central Union Telephone by ten shareholders owning $129,000 worth of the company's stock. It is alleged that the action reducing and then increasing the capital occasioned a loss to complainants of half their capital. The bill says assets exceed fifteen millions; indebtedness, seven. By unanimous vote last week the stockholders of the Central Union Telephone Company, of Chicago, increased the capital stock from $3,481,500 to $10,000,000.

KEYSTONE TELEPHONE.—The Keystone Telephone Company, of Philadelphia, is offering $5,000,000 cumulative 6 per cent preferred stock, par $50 full paid, with bonus of 25 per cent in common stock. No allotment to one person of more than 50 nor less than 4 shares will be made. The company is putting into operation a large system with which to fight the Bell system in Philadelphia.

CUMBERLAND TELEPHONE.—The statement is made that Mr. Charles W. Morse, who has acquired control of the Telephone, Telegraph & Cable Company of America, has purchased the Cumberland Valley Telephone Company, of Pennsylvania, which was recently organized with a capital of $10,000,000.

NORTH AMERICAN.—The plan of the North American Company to absorb the Omaha Traction Company and many other local plants, involving a capital of $6,000,000, has been declared off.

MASSACHUSETTS TROLLEYS.—Negotiations are understood to be on for the consolidation of the Commonwealth Avenue, Newton & Boston, Lexington & Boston, and several other suburban lines operating west of Boston and within a radius of 20 miles. Considerable progress has been made in the direction of a union, and the proposition under consideration is said to contemplate the organization of one large company which shall control the entire system with a capital sufficiently large to admit of certain important extensions, and a material improvement in the existing service.

B. R. T. STOCK.—The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to have its $45,000,000 stock regularly listed. The stock has heretofore been traded in in the unlisted department.

Commercial Intelligence.

THE WEEK IN TRADE.—Dispatches to the mercantile agencies brought reports of stimulated retail trade, due to cooler, settled weather and advices of continued activity in all leading industrial lines, notably iron and steel. Consumption in the latter continues equal to, and in some cases, exceeds, the production. Orders for fully 1,000,000 tons of rails for next year's delivery have been booked at higher rates, and railroads are in the market for cars, one Western system having bought 2000 during the week. Despite predictions of a heavy cut in copper prices, the fact remains that lake copper supplies are small, and prices were actually higher last week at New York than those of the week previous, although they were lower in London. The market was quiet but steady ,and there was more confidence shown. The quotations are 16½@16¾c. for Lake; 16¼c. for electrolytic in cakes, wire bars and ingots; 16c. for cathodes and 15⅞c. for casting stock. The business failures for the week, as reported by *Bradstreet's*, aggregated 198, as against 183 the week previous, and 233 the same week last year.

THE BANKRUPTCY LAW.—A special committee on revision of the Bankruptcy Act, has just been appointed by Mr. De Le Roy Dresser, president of the Merchants' Association of New York, pursuant to a request made by a number of its prominent members at a conference recently held with United States Assistant Attorney-General E. C. Brandenburg in reference to this matter. The purpose of this committee is to make a study of the present act, to point out its defects, and to suggest amendments to remedy the same. The committee will report to the Board of Directors of the Merchants' Association of New York. It is expected that this work will be completed in time to be effective during the next session of Congress, at which time amendments to the present act will be sought. The committee in full is as follows: George F. Vietor, of Frederick Vietor & Achelis, chairman; Ora Howard, of Oelbermann, Dommerich & Co.; W. T. Evans, of Mills & Gibb; M. E. Baunin, of Converse, Stanton & Co.; Ewald Fleitmann, of Fleitmann & Co.; B. F. Shores, of Austin, Nichols & Co.; E. D. Page, of Faulkner, Page & Co.; C. N. Bliss, Jr., of Bliss, Fabyan & Co.; Charles E. Meek, of the National Lead Company; A. H. Watson, of Passavant & Co.; Carl Schefer, of Schefer, Schramm & Vogel; C. H. Webb, of J. H. Dunham & Co.; W. S. Mersereau, of Schieffelin & Co.; R. B. Hirsch, of William Openhym & Sons; William F. King, of Calhoun, Robbins & Co.; Benno Neuberger, of E. Rosenwald & Co.; John C. Eames, of the H. B. Claflin Company; George H. McNeir, of W. & J. Sloane; Chester A. Braman, of A. D. Juilliard & Co.; E. W. Riker, of Yale & Towne Manufacturing Company.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Oct. 16: Antwerp—23 packages, $1,181; 2 packages electrical machinery, $582. Argentine Republic—107 packages, $4,757; 2 bundles of copper wire, $62. Bilbao—1 package electrical machinery, $7. British Australia—1563 packages electrical machinery, $240,684; 131 packages, $3,852. Berlin—6 packages, $2,233. Bremen—9 packages, $330. British Guiana—9 packages, $225. British East Indies—1 package electrical machinery, $30. Brazil—21 packages, $942. British Possessions in Africa—33 packages, $3,055; 64 packages electrical machinery, $2,883. British West Indies—25 cases, $359. Copenhagen—1 case, $80. Cuba—79 packages, $1,278. Dutch West Indies—15 cases, $300. Glasgow—21 cases, $210; 6 cases electrical machinery, $1,082. Genoa—4 cases, $580. Havre—20 packages, $3,438. Hayti—18 packages, $201. Haarlem—1 case electrical machinery, $21. Hamburg—56 packages, $2,500; 77 cases, $3,113; 11 packages, $1,440. Japan—1 case, $40. London—257 cases electrical machinery, $6,445; 106 cases, $4,127. Liverpool—75 packages, $16,692; 147 packages, $6,099. Milan—2 cases, $500. Manchester—14 cases, $1,794. Mexico—133 cases electrical machinery, $9,846. Newcastle—20 packages electrical machinery, $7,805. Peru—10 packages, $550; 4 packages, $288. Rotterdam—4 packages, $55. Southampton—14 packages, $441. Santo Domingo—1 case electrical machinery, $14; 16 packages, $1,004. Tasmania—4 packages electrical machinery, $1,299. U. S. Colombia—24 packages, $1,026. Venezuela—47 packages, $1,480.

VARIOUS ORDERS FOR RONEY STOKERS.—Westinghouse, Church, Kerr & Co., of New York City, report a number of substantial orders received within the last ten days or so calling for the installation of Roney mechanical stoker equipments in various steam plants throughout the country. One of the principal contracts recently received was from the Rhode Island Suburban Company, of Providence, R. I., for an 8000-hp plant. The New York Glucose Company's plant at Shadyside is being fitted with a 4000-hp stoker equipment. The new plant in connection with the shops of the department of steam engineering of the Brooklyn Navy Yard is to have a 1500-hp equipment. The boiler contract for this plant has been allotted to the Babcock & Wilcox Company. The New Perth Amboy, N. J., works of the De Lamar Copper Company is to be equipped with Roney stokers for a 1000-hp plant, and the American Bridge Company, of New York, has called for a similar equipment to be installed in its Post & McCord plant, in Brooklyn. Smaller contracts lately obtained include one for a 500-hp outfit for Pingree & Smith, Detroit, Mich.

THE ARGENTINE REPUBLIC.—Mr. Simon W. Hanauer, deputy United States Consul-General at Frankfort, Germany, writes us: "The electrical industry is making rapid progress in Argentina, especially in Buenos Ayres. Several factories are already existing there which turn out small dynamo machines, etc. The importation of electrical supplies during 1900 amounted to more than $1,000,000, composed of dynamo machines valued at $80,025; cables, etc., $511,709; lamps, $101,112; telephone materials, $20,143; telegraphic materials, $36,993, and other supplies for electrical purposes worth $341,034. These supplies were mainly furnished by Germany, Belgium, England, France and the United States. A small part came from Italy and Holland. It were well if the Monroe Doctrine in a commercial way, devoid of coercive or warlike spirit, could be extended over our sister republics on our continent. In the natural course we, the progressive manufacturing and agricultural nation in the world, should supply all their wants in foreign products."

DEMAND FOR ELECTRIC PLANT IN GREECE.—Consul McGinley reports from Athens, Sept. 12, 1901, that the Mayor of Karpenesion, a village in the province of Evrytania, wishes to have that place lighted by electricity, and has requested the Consulate to publish the fact in the United States, hoping to induce some American company to sell him a suitable plant. There is a stream near the village that can be utilized to furnish the necessary power for the plant. There are 400 houses in the village, and the Mayor estimates that about that number of incandescent lights will be required. He does not mention the number of arc lights required. Karpenesion is the village which the heroic Greek chieftain, Marco Bozzaris, was defending when, in 1823, he fell in a midnight sortie against the Turks, an event made famous by Fitz Greene Halleck's stirring poem. This is but one of several electrical opportunities recently suggested from Greece.

MORE AMERICAN CABLE FOR GLASGOW TRAMWAYS.—The National Conduit & Cable Company, whose New York offices are in the Times Building, Park Row, is to furnish nearly $250,000 worth of cable for an extension of the Glasgow Corporation Tramways. The cable will be manufactured at the company's plant at Hastings-on-Hudson. It will be recalled that the National Conduit people were awarded the contract—valued at over $1,000,000—for the supplying and laying of the conduits in connection with the original electric traction system of the Scotch city, fully 90 per cent of the entire equipment for which was purchased in the United States.

WESTINGHOUSE ENGLISH FACTORY.—A contract has been closed by the London office of the Buffalo Forge Company with the British Westinghouse Electric & Manufacturing Company, Trafford Park, Manchester, for apparatus to be used for heating and ventilating the machine shop, foundry stores, the carpenters' shop and box factory of the new works. The machine shop is 900 ft. long, 420 ft. wide and 59 ft. high. To heat and ventilate this area eight steel plate fans, each capable of delivering 60,000 cubic feet of air per minute, and driven by a separate induction motor, will be provided.

ELECTRICAL EQUIPMENT FOR CHINA.—Mr. T. Philip Terry, of Shanghai, who represents the interests of a number of American manufacturers of various machinery in the Chinese markets, is at present in the United States, partly with a view to placing some fair-sized contracts for electrical equipment, etc. Mr. Terry can be reached through Mr. George W. Neff, New York representative of the Stilwell-Bierce & Smith-Vaile Company, Washington Life Building, Liberty Street.

THE NEW NIAGARA POWER HOUSE.—The Buffalo contractors, Mosier & Sons, have begun work on a new power house for the Niagara Falls Power Company at Niagara Falls. The new building will be located across the street from the present house, and will cost $250,000. The building will be of Queenston limestone, 570 ft. long, with a capacity of 50,000 horse-power.

THE INTERNATIONAL POWER COMPANY has secured control in this country of the manufacture of the Diesel oil engine. The Diesel rights for the United States are owned by a syndicate connected with International Power, the American Locomotive Company, and allied interests. The International Power Company intends to manufacture Diesel engines at South Worcester.

ORDERS FOR HARRISBURG ENGINES received at the New York offices include two 200-hp standard engines for the new plant of the American Consolidated Pine Fibre Company, of Cronly, N. C., to be direct connected to 160-kw generators furnished by the General Electric Company. This outfit will be utilized for both light and power purposes. The De Lamar Copper Company's new works at Perth Amboy, N. J., are to be equipped with one 160-hp and one 80-hp Harrisburg standard engine direct connected to 100-kw and 50-kw generators built by the Crocker-Wheeler Company. The Augur & Simon Silk Dyeing Company, of Paterson, N. J., has ordered a 40-hp standard engine, to be direct connected to an Ellwell-Parker generator for lighting. The large hotel building under construction at 124th Street and Seventh Avenue is to be equipped with one 80-hp and one 45-hp standard engine, direct connected to 50-kw and 30-kw generators of Sprague make. These machines are intended for lighting purposes. Another lighting outfit is to be supplied R. Neumann & Co., Hoboken, who have requisitioned for an 80-hp standard engine direct connected to a Westinghouse 50-kw generator. Further domestic contracts now on hand include two tandem compound Ideal engines of 40 horse-power each, direct connected to 25-kw General Electric generators for lighting purposes on board the new Pennsylvania Railroad ferryboat now being constructed. The Morse Building, 140 Nassau Street, is to be furnished with a 90-hp and a 45-hp power standard engine direct connected to 60-kw and 30-kw Westinghouse generators for a lighting plant. The State Normal School at Stroutsburg, Pa., is to have a 40-hp standard engine, direct connected to a 25-kw Eddy generator. The Hall Building, 130th Street and Park Avenue, is to be equipped with a 60-hp standard engine direct connected to a 40-kw Westinghouse generator. The Wilkesbarre & Bethlehem Railway has ordered a 40-hp standard engine, direct connected to a 25-kw Westinghouse generator. This outfit will be utilized for driving exciters. The Herald Square Hotel people have ordered a 150-hp standard engine to be direct connected to a 100-kw Sprague generator for lighting the large addition now being built.

TELEPHONY IN WASHINGTON.—Secretary T. W. Tyrer, of the Telephone Company of America, announced last evening that his company will endeavor to secure from Congress this winter a franchise for an additional telephone system in Washington. If constructed it will cost $3,500,000, and will furnish employment to 1500 people. It is the intention of the company to establish 100,000 telephones in the city of Washington. No charge will be made for the installation, and no contracts for specific periods will be made. Each time the telephone is used, however, it will cost 2 cents. Telephones will be put in rooms in the hotels, and the houses of the poor will be furnished as well as the houses of the wealthy. In addition to the above important announcement the Telephone Company of America also announced that it had decided to establish the factory for making its instruments in Washington. A deal was closed last week whereby at the end of four months from that date, the telephone company will come into possession of the property belonging to the Metropolitan Railway Company at the western end of the P Street Bridge over Rock Creek. It is understood the consideration was $200,000, and that the telephone company has made one payment and will make another before taking possession of the building as a factory. The company's board of directors is composed of Messrs. John F. Betz, of Philadelphia, president of the Betz Brewing Company; William C. Kean, business manager for the Betz Brewing Company; S. B. Rinehart, president of the Frick Manufacturing Company and of the Citizens' National Bank of Waynesboro, La.; Daniel Shockey, also of the Frick Manufacturing Company; J. P. Andree Mottu, of Mottu, De Witt & Co., bankers, of Norfolk, Va.; H. J. Van Hammert, of Colorado Springs, Colo.; C. W. Vanderhoogt, Ellis F. Frost, and T. W. Tyrer, of Washington, and David F. Marvell, of Wilmington, Del. The officers of the company are: President, Mr. Rinehart; first vice-president, Mr. Vanderhoogt; second vice-president, Mr. Shockey; treasurer, Mr. R. H. Mottu; secretary, Colonel Tyrer; general counsel, Mr. Leon O. Bailey. The chief electrician, Mr. U. H. Balschey, and the chief engineer, Mr. Ellis F. Frost, were with the Bell Telephone Company for several years.

NEW ENGLAND TELEPHONE EXTENSION.—As already announced the Southern New England Telephone Company directors will, at the annual meeting of the stockholders next January, ask for authority to increase to $5,000,000 the present stock, which amounts, with the recent issue of $230,000, to $2,990,000. The new stock presumptively will be issued from time to time in such amounts and ratios as the directors see fit. The company, which occupies all Connecticut except the town of Greenwich, has the legal right by vote of the stockholders to increase stock up to $5,000,000. The Bell Company owns 34 per cent of the stock outstanding. The new stock, when issued, will be used in extending the plant. The plans for extension which are officially given out include the building of a new line between Hartford and New London, about 50 miles, to cost about $35,000; the stringing of 12 new wires between New Haven and Hartford; new buildings for exchanges in New Haven, Bridgeport, Derby, Putnam, Simsbury and Enfield; and a general increase of toll-line wires, nearly doubling the facilities for that business in the State.

POWER AT SAULT STE. MARIE.—Mr. F. H. Clergue, of Sault Ste. Marie, who is at the head of a dozen or more mammoth commercial enterprises, has practically decided upon the construction of another water power canal to cost upward of $2,000,000. Associated with Mr. Clergue in the work are Messrs. Widener and Elkins, the Philadelphia capitalists, who, it is understood, will finance half the project. The canal is intended to develop about 20,000 horse-power electrically in the rapids or falls of St. Mary's River, opposite the ship canal. The St. Mary's Falls Power Company has been organized for the purpose, and it has applied to the Board of Supervisors for permission to divert the waters of the river for the project. The plans contemplate the construction of two parallel dikes on the bed of the rapids, 150 ft. west of the line of the international bridge, which crosses the falls. The dikes will be 3100 ft. long and the lateral distance between them 480 ft. The fall of water will be about 18 ft. The water power developments now made and projected at the Canadian Sault will furnish 125,000 horse-power.

THE COPPER SITUATION.—In spite of much talk, the copper market remains about the same. On the Stock Exchange, reports were circulated that it is intended to reduce the schedule price of copper to 12 cents per pound this week; but the circles where these rumors originated were two weeks ago positive that the price would then be reduced at once to 11 cents. None of the Wall Street statements agree with either the trade reports or the statements made by the managers of different copper companies. These interests united in stating that the copper situation was materially improved. One copper firm stated last Saturday that the output is being steadily taken at the selling agents' fixed price, and that urgent inquiries continue from the General Electric Company and the Ansonia district, but that these consumers have been unable to obtain a concession of even ⅛ cent per pound. The president of one of the independent copper companies flatly asserted that fully one-half the stock on hand could be placed at once if the agents agreed to that concession.

BALL ENGINE SALES.—The Pacific Coast Company, Seattle, Wash., are installing an engine furnished by the Ball Engine Company, Erie, Pa. The Cleveland Macaroni Company, Cleveland, Ohio, have purchased an engine for electric lighting from the Ball Company. The Driskill Hotel, of Austin, Texas, has ordered from the Ball Engine Company a direct-connected engine for its electric plant. The College of Physicians and Surgeons, Chicago, will have an electric plant. The power will be furnished by a Ball engine.

ELECTRIC HEADLIGHTS.—Contracts have been let for the equipment with electricity for headlights of all the passenger engines of the Chicago & Alton Railway. The power will be derived from a small dynamo placed on top of the engine behind the smokestack. The new headlight, it is claimed, will throw a light clear enough to distinguish any object 2000 ft. ahead of the locomotive. The present oil lights do not reach further than 700 ft.

ELECTRIC AUTOMOBILE RECORD.—A cable dispatch from Paris of Oct. 19 states that the record for long distance accomplished without recharging the accumulators of an electric automobile was beaten on the 16th by Mr. Krieger with a machine of his own well-known manufacture. He went from Paris nearly to Chateau l'Erault, a distance of 307 kilometres, with one charge of the batteries. The previous best is 262 kilometres by Garcier.

NEW STURTEVANT FACTORY.—Work is now under way upon the foundations for the immense new plant of the B. F. Sturtevant Company, at Hyde Park, Mass. That the buildings can be completed none too soon for the urgent needs of the company is evidenced by the fact that their present plant at Jamaica Plain, Mass., is now taxed to the limit and that it has been necessary to run overtime, particularly in the engine and electrical departments.

CLEVELAND OFFICE FOR THE S. K. C. SYSTEM.—The Stanley Electric Manufacturing Company has opened offices in the New England Building, 129-131 Euclid Avenue, Cleveland, Ohio. Mr. Alexander T. Moore, formerly of Pittsburg, has been appointed district manager.

BRITISH THOMSON-HOUSTON COMPANY, LIMITED, representing as a distinct organization the General Electric Company in England, has moved its head office from 83 Cannon Street, London, to its new works at Rugby. The production of high grade and heavy electrical machinery begins forthwith at the new factory.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The Hillman Hotel, just completed, is equipped with a private system of telephones, 240 in number.

OPELIKA, ALA.—A long-distance telephone line has been completed from Lafayette to Roanoke, thereby completing a telephone service from Opelika to Roanoke.

ROGERSVILLE, ALA.—J. Ross Patterson, J. M. Bedingfield, J. A. Lentz and others have awarded a contract to John A. Pruitt for the construction of a telephone system.

CARDIFF, ALA.—The Southern Bell Telephone Company has been granted a franchise to construct a telephone line to Cardiff and Brookside, adjoining the Birmingham lines.

SCOTTSBORO, ALA.—The Cumberland Telephone Company has raised the rate on business telephones to $1.50 per month. All the business houses in town refuse to pay the increased rate.

FLORENCE, COLO.—The Colorado Telephone Company at Florence reports that business has increased over 50 per cent during the last six months in the district embracing Canon City and Florence and the coal camps, which now have more than 400 resident and business telephones.

ATHENS, GA.—The Southern Bell Telephone Company is arranging for a right of way for a telephone line between Athens and Elberton, which the company intends building at an early date.

MONMOUTH, ILL.—The Monmouth Telephone Company will improve its plant by putting in cable extensions.

BEARDSTOWN, ILL.—The citizens of this place are agitating the question of a telephone franchise for the Virginia & Little Indian Telephone Company.

MANHATTAN, ILL.—A new stock company is being formed by members of the country telephone lines, and will be known as the Manhattan Telephone Company.

BLOOMINGTON, ILL.—Farmers in Pike township, Livingston County, have established a telephone system. The line will connect Chenoa, Graymont, Waldo and Ocoya.

HIGHLAND, ILL.—At the City Council meeting a representative of J. A. Stiennan appeared before the Council and asked for a franchise to construct a telephone exchange.

LOVINGTON, ILL.—Mr. C. A. Gregory is operating a telephone system here with 85 subscribers. He has recently built 30 miles of metallic circuit and 25 miles of grounded toll lines.

MARENGO, ILL.—Representatives of the Chicago Telephone Company have been in this vicinity recently and have succeeded in securing enough subscribers to warrant the company in putting in an exchange here.

CHICAGO, ILL.—The strike of the linemen and repairmen of the Chicago Telephone Company for increase of wages, which began on Oct. 1, is still unsettled. The strike extended to Springfield, Joliet, Aurora, Elgin and other places About 400 men in all went on strike. The company announced that it would not treat with the men as a union, but as individuals. The union declined to accept the proposition of the company.

INDIANAPOLIS, IND.—The South Whitley Telephone Company increased its capital from $3,000 to $15,000.

CLAY CITY, IND.—The Central Union Telephone Company is putting in a system here under a franchise granted two years ago.

PERU, IND.—The County Commissioners have granted a franchise to the Grimes Telephone Company to operate in Denver and vicinity and the Home Company to operate in and out of Peru.

EVANSVILLE, IND.—Capitalists of Chicago, Lafayette, Ind., and Evansville have purchased the District Telegraph plant in this city, and will establish an independent telephone exchange here.

MARION, IND.—Plans have been prepared by a local architect for a building to be erected by the United Telephone Company which recently acquired possession of the independent system in this city, as well as the plants of Bluffton, Portland, Montpelier, Hartford City, Upland and the connecting toll lines.

COLUMBUS, IND.—A combination has been formed to patronize only one telephone service in this city. The butchers and grocers have entered into an agreement to discontinue the use of the Bell telephone at their places of business, at the expiration of their contracts. The merchants have taken similar steps. They give no other reason than that the keeping up of two telephones is a useless expense, and that their customers cannot longer force them to do so. The Citizens' system will be patronized. This system has over 500 telephones in use in the city, and nearly that many more on lines extending into different parts of the county. The Bell Company, it is claimed, has but 300 subscribers in the city and very few rural district patrons, which is regarded as a disadvantage to the merchants. It is highly probable that the Bell Company will endeavor to break the combination, and if so a rate war is inevitable.

INDIANAPOLIS, IND.—There was much interest and concern taken by the citizens of this city recently because of a rumor that the Central Union Telephone Company was quietly but surely assimilating the New Telephone Company by buying up the stock of the smaller holders. President Sheerin, of the New Telephone Company, was repeatedly asked for a verification, and gave out the following: "The bulk of the stock in our company could not by any means be touched by other persons, and there is a general understanding that the smaller holders shall not sell their stock. The Central Union owns not a share of our stock to my knowledge. It would be highly more probable that we should buy the Central Union stock, and we would do it gladly if we could. The recent development in the independent telephone movement all over the country make the rumor of our selling out laughable," he said.

CLARINDA, IA.—A new rural telephone system is being organized here.

CHARITON, IA.—The Chariton Telephone Company's central office is being equipped with new wires and new cables throughout, to accommodate the largely increasing patronage of the office.

DES MOINES, IA.—Articles of incorporation were filed at Des Moines by the Woolstock Telephone Company. Its capital is $5,000. C. H. Clifton, president; M. Wallin, J. C. Smith, G. W. Olmstead and W. S. Chatman are the incorporators.

SOUTH MACALESTER, I. T.—The North American Telephone Company will construct a line from South MacAlester to Denison, Tex., and from the latter place to Holdenville.

DE SOTA, KAN.—The De Sota Telephone Company has been incorporated with a capital stock of $5,000.

WETMORE, KAN.—The Wetmore Telephone Company has been incorporated; capital stock, $5.000.

LEAVENWORTH, KAN.—The Missouri & Kansas Telephone Company on Oct. 1 increased the rental of its telephones to $3 per month. The raise will not affect the residence telephones.

KANSAS CITY, KAN.—The Missouri & Kansas Telephone Company has moved into its new exchange at the corner of Sixth Street and Armstrong Avenue. The new exchange is equipped with the central energy system.

FORT SCOTT, KAN.—Grant Hornaday, C. W. Penniman and other Fort Scott officers and members of the Kansas Telephone Company, will make another effort to get a franchise at Wichita. An ordinance has been presented to the Wichita Council.

MIDDLEBURG, KY.—A telephone line is being built from Mintonville to Humphrey, where connection will be made with the line to Middleburg.

SPRINGFIELD, KY.—The Washington County Telephone Company has begun extensive improvements in its lines and a better service will be given.

PADUCAH, KY.—The Cumberland Telephone Company, which has just ordered a new line from Paducah to Joppa, Ill., is to make further improvements and extensions.

LUDLOW, KY.—The Kentucky Telephone Company, of Ludlow, has been incorporated, with a capital stock of $5,000. William R. Shiners and John S. McCormick are the incorporators.

NEW ORLEANS, LA.—The Telephone Company of America is seeking to establish itself in New Orleans and an ordinance is before the City Council applying for a franchise.

CENTERVILLE, MD.—The Diamond State Telephone Company will lay a cable across Chesapeake Bay to establish telephone communication between Centerville and Baltimore.

BALTIMORE, MD.—A controlling interest in the Worcester Telephone Company, of Snow Hill, has been purchased by parties representing the Eastern Shore Telephone Company, of which Harry A. Richardson, of Dover, is president.

WEST NEWBURY, MASS.—A project is on foot to establish a telephone system here.

BOSTON, MASS.—The Fall River Automatic Telephone Company, organized under Massachusetts laws, with $135,000 capital stock, has started operations in Fall River, with 506 subscribers. It charges $36 per annum for business telephones and $24 for residences. The New England Company's charges in Fall River range from $25 to $90. Among the directors are B. D. Davol, E. B. Jennings and R. P. Borden. This company will be connected with the Telephone, Telegraph & Cable Company system connecting New York and Boston.

EVART, MICH.—The Evart Citizens' Telephone Company has extended its line to Temple, Mich. This gives Temple connection with the State lines of all independent telephone lines.

SAGINAW, MICH.—The Union Telephone Company will place Midland in communication with Jam, Coleman, North Bradley, Sanford and Averill, points not heretofore reached by telephone. A branch line will be built from Averill to Hope and Edenville.

IONIA, MICH.—As a result of the franchise given the Citizens' Telephone Company of Grand Rapids for a new exchange, the company has commenced work preparatory to putting in 30,000 feet of underground conduits, running under the entire length of the main street pavement. It states that $75,000 will be spent at once getting the exchange started. The exchange will have 200 or 300 subscribers.

MANKATO, MINN.—The directors of the Mankato Citizens' Telephone Company contemplate important improvements.

KENYON, MINN.—The farmers between Kenyon and Aspelund have organized the Farmers' Mutual Telephone Company, and will build a line connecting these two points this Fall. Their intention is to extend the line from Aspelund to Zumbrota.

MERIDIAN, MISS.—It is reported that the local telephone company has sold out to the Cumberland Telephone Company.

WEST BOWAN, MO.—There is talk of a new telephone line being run from Tucker to Humphreys.

CLINTON, MO.—The Mutual United Telephone Company will soon complete a line to Leesville, Coal, Hortense and the eastern part of the county.

MOUNTAIN GROVE, MO.—The Wright County Telephone Company, of Mountain Grove, has been incorporated; capital stock, $2,500. Incorporators: J. H. Medley, J. D. McComb, W. C. Dugan, and others.

MONROE, N. C.—There is talk of establishing a telephone system here. It is said that $1,000 worth of stock has already been subscribed.

JAMESTOWN, N. D.—A final adjustment has been made by Receiver James A. Murphy, of Jamestown, in the affairs of the North Dakota Telephone & Electrical Company and the creditors will receive 80 cents on the dollar. The liabilities of the company amounted to $4,400.

MIDDLETOWN, N. Y.—The Wallkill Telephone & Construction Company has been incorporated; capital stock, $12,000. Directors: G. W. Ballou, of Wawayanda, and J. G. Harding and T. D. Mills, of Middletown.

NEW YORK, N. Y.—The constituent companies of the Telegraph, Telephone & Cable Company, of America, which has recently come into the control of Mr. C. W. Morse are: Knickerbocker Telephone & Telegraph Company; capital stock, $7,500,000. Boston & New York Telephone & Telegraph Company; capital stock, $5,000,000. Continental Telephone, Telegraph & Cable Company; capital stock, $1,000,000; New Rochelle & Westchester Telephone Company; capital stock, $150,000. Telephone, Telegraph & Cable Company of Eastern New York; capital stock, $100,000. Anderson Telephone Company; capital stock, $50,000. Massachusetts Telephone & Telegraph Company; capital stock embraced in the $5,000,000 of the Boston & New York Telephone & Telegraph Company. The parent company was chartered on Nov. 13, 1899, in New Jersey. Its capital stock was then $30,000,000.

JACKSON, OHIO.—The Jackson Center Telephone Company has been incorporated, with a capital stock of $6,000.

CLEVELAND, OHIO.—The Federal Telephone Company will issue bonds on properties now under construction in Detroit, Dayton, Mansfield, Canton, and several smaller towns.

SHELBY, OHIO.—The People's Telephone Company, of Shelby, is preparing to build a branch exchange at Tiro. About 150 contracts have been secured in the town and surrounding country.

HILLSBORO, OHIO.—The exchange of the Hillsboro Home Telephone Company, will soon be ready for operation. A new multiple switchboard, built by the American Electric Telephone Company, is being installed.

DAYTON, OHIO.—John B. Pierce has been made general superintendent of construction at Dayton in place of W. C. Pickett, who has been appointed superintendent of construction for the United States Telephone Company.

CINCINNATI, OHIO.—A new exchange has been installed in the County Court House. An odd feature of the installation is that all the Superior Court Judges have refused to permit telephones to be placed in their rooms.

CLEVELAND, OHIO.—A summary of the report of the Cuyahoga Telephone Company for August is as follows: Gross earnings, $27,440.83; operating expenses, $15,047.22; net earnings, $12,393.61; fixed charges, $10,358.33; surplus, $2,035.28.

CLEVELAND, OHIO.—The report of the United States Telephone Company for August shows the following results: Gross earnings, $16,388.65; operating expenses, $8,212.44; net earnings, $8,176.21; fixed charges, $7,315.46; surplus, $860.70.

CINCINNATI, OHIO.—The incorporation of the Kentucky Telephone Company has been recorded in Covington. The incorporators are Wm. Cheifers, John S. McCormick, Michael Glore, and J. J. Weaver. The capital stock is $5,000. The office will be located at Ludlow, Ky.

ALLIANCE, OHIO.—The Stark County Telephone Company has commenced cutting in its exchange at Alliance, and about 200 lines are now in service. The switchboard has been completed, but the work of connecting up the balance of the system has been delayed through non-delivery of cable.

LANCASTER, OHIO.—The Lancaster Telephone Company, one of the properties of the Federal Telephone Company, makes the following statement of earnings for eight months. Gross earnings, $4,777.62; expenses, $1,910.17; net earnings, $2,867.45; taxes and interest, $901.08; surplus, $1,966.37.

DAYTON, OHIO.—The Dayton Home Telephone Company will open its exchange with not less than 3000 subscribers, nearly that number having already been secured. Work on the underground system is being pushed in order to complete it before the cold weather. About 300,000 feet of duct will be laid down.

CLEVELAND, OHIO.—J. B. Hoge, chairman of the board of directors of the Federal Telephone Company, says that the business of the various exchanges of the company throughout the State is making unexpected progress, and the next six months will undoubtedly break all records for the company in the way of revenue gains.

CLEVELAND, OHIO.—The Postal Telegraph Company has made arrangements with the United States Telephone Company to utilize its franchises and pole lines in entering East Liverpool, Columbiana, Salem and a number of other towns in Columbiana County, Ohio. Heretofore the Western Union Telegraph Company has had a monopoly in this section.

LANCASTER, OHIO.—The Lancaster Telephone Company has organized for the year as follows: J. B. Hoge, president; Frank L. Beam, vice-president and general manager; W. H. Park, treasurer; W. E. Baker, secretary. The above, with Maxime Reber, and W. B. Woodbury constitute the board of directors. The company is controlled by the Federal Telephone Company, of Cleveland.

FINDLAY, OHIO.—The telephone linemen's strike has been declared off and the men have returned to work. The difficulties were settled through the efforts of President Wheeler, of the International Electrical Workers' organization, who came from Rochester, N. Y. The plant becomes a union one and in return the strikers withdrew their ultimatum requiring the discharge of Manager Duval.

CLEVELAND, OHIO.—K. V. Murrey, well known in the independent field as traffic manager of the United States Telephone Company, has resigned, to accept the position of general manager of the United Telephone Company of Bluffton, Ind. The company has eight important exchanges in the vicinity of Bluffton, and owns several hundred miles of toll lines connecting towns in that section of Indiana.

FINDLAY, OHIO.—Recently the city authorities cancelled their agreement with the Central Union Telephone Company, for service in school buildings, and took up the independent service. The Central Union Company declined to remove the lines until the contracts expired and the teachers have been notified not to use the telephones, and in order to present their use, the instruments and bells have been stuffed with cotton.

AKRON, OHIO.—The telephone linemen's strike at Akron has become a waiting game. The companies claim they have enough men to keep the lines in condition, but they can not do new work. The strikers claim that the Bell companies in Ohio, Indiana, Illinois and Iowa are standing together to break away from union employes, and that they have centered the fight in Akron and will contribute to win the battle at that point.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is now averaging installations at the rate of nineteen per day from its central and branch exchanges. The company now has about 9,000 telephones in operation, which it is claimed makes this the largest independent exchange in the country. A branch exchange has recently been installed for the Big Four Railway at Linndale, connecting all its shops and offices in that place.

CLEVELAND, OHIO.—The Springfield Home Telephone Company, which is composed of Cleveland people, with headquarters in the Garfield Building, is placing contracts for much of its material. Poles and wire have recently been purchased, but the switchboards and instruments are not yet contracted for. The company is breaking ground for a handsome four-story exchange building. Work in securing contracts is progressing favorably.

MARIETTA, OHIO.—The Marietta Telephone Company has been sold to the West Virginia Western Telephone Company, of Parkersburg, of which Senator H. C. Henderson, of Williamstown, is president; J. H. Lunnger, of Harrisville, W. Va., secretary; A. C. Davis, of Parkersburg, general manager, and F. P. Moats, of Parkersburg, attorney. After the transfer of stock the following directors were elected: A. L. Gracey, J. Torner, W. H. Jett, H. C. Henderson, J. H. Lunnger and F. P. Moats. Officers were elected as follows: A. L. Gracey, president; A. C. Davis, secretary and manager; W. D. Dunning, the former manager retiring. It is expected that the Marietta company will be merged into the purchasing concern. The central office will be maintained here and connection be given with over 1000 towns in West Virginia.

HAMILTON, ONT.—The Bell Telephone Company has just completed two new through lines from Hamilton to Toronto Junction.

OTTAWA, ONT.—The Canadian Minister of Public Works has decided upon a change in the rates to be charged on the government telegraph lines to the Yukon. The rate for press despatches, instead of being $3 per 100 words, as at present, will be $1 per 100 words. Cable rates from the Yukon will also be altered. The old minimum rate of $3 a despatch will be done away with entirely, and there will be no minimum rate. Instead, a toll of 40 cents a word will be charged. The question of commercial rates is still under consideration.

RIDLEY PARK, PA.—The United Telephone Company has applied to Council for permission to extend its lines in the borough.

CARLISLE, PA.—The Southern Pennsylvania Telephone Company, with headquarters at Carlisle, will decide by a vote of stockholders here, with the Dauphin County, Adams County, Hanover and Cumberland Valley Telephone Companies, to form a company to be known as the Cumberland Valley Telephone Company, with offices at Harrisburg, Pa.

PROVIDENCE, R. I.—The ordinance granting permission to the Providence Telephone Company to lay conduits, and in certain streets of the city was passed by the Common Council.

ORANGEBURG, S. C.—Orangeburg & St. Matthews Telephone Company, capital stock $1,500, has been incorporated by W. H. Dukes, A. C. Andrews and W. C. Wolfe.

ABERDEEN, S. D.—The Dakota Central Telephone Company will extend its lines to Bismarck via Mound City.

COLTON, S. D.—The Colton Telephone Company, capital stock $10,000, has been incorporated by O. P. Anderson, Martin Larson, A. T. Austin, J. E. Colton and others.

ABERDEEN, S. D.—The capital stock of the Dakota Central Telephone Company will be increased from $100,000 to $500,000. This means improvements in lines already built and the further extensions.

COURTLAND, TENN.—An effort is being made to establish a telephone exchange here.

ROCKWOOD, TENN.—The Cumberland Telephone Company has purchased the local exchange of the Roane County Telephone Company.

WEATHERFORD, TEX.—A franchise has been granted to the O. R. Riddle Independent Telephone Company.

BRENHAM, TEX.—The Campbell, Grace & Mayfield Telephone Company has been granted the right to operate a telephone line within the territorial limits of the city.

SHERMAN, TEX.—The Indianola Telephone & Telegraph Company has filed a charter. The company proposes to build exchanges in a number of counties in the State.

BEAUMONT, TEX.—The Beaumont-Northwestern Telephone Company, capital stock $10,000, has been incorporated to carry on a telephone business in the counties of Jefferson, Liberty, Hardin, Orange, Chambers, Jasper, Tyler, Newton, Sabine, San Augustine and Nacogdoches. The incorporators are J. M. Smith, W. R. Bruce and John Hator.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is laying a large amount of conduit in Salt Lake City.

SALT LAKE CITY, UTAH.—Arrangements have just been made whereby connections with the lines of the Opal and Big Pinney Telephone Company can be had. These lines run north of Opal, Wyo., to Big Pinney, connecting with a number of sheep camps.

RICHMOND, VA.—The Bell Telephone Company has purchased the Virginia Long-Distance Company, whose office is at Staunton and whose lines run from Harrisonburg to Bristol and to Charlottesville and Lynchburg.

RICHMOND, VA.—Mayor Taylor has vetoed the Bell franchise in accordance with a previous declaration. The Bell Company, however, it is stated, has a majority in both the Board of Aldermen and Common Council, and will have a meeting called to pass the franchise over the Mayor's veto.

HUBBARDTON, VT.—The Cornwall Telephone Company is extending its line south and will connect with the Clemmons line at Bomosseen.

PARKERSBURG, W. VA.—The entire system of the Marietta Telephone Company, comprising 800 connections, was purchased by Parkersburg capitalists who will consolidate it with the West Virginia Western Telephone Company.

GRAFTON, W. VA.—The Independent Telephone Companies of Central West Virginia have combined and will be known as the Central West Virginia Telephone Exchange, with H. C. Henderson, of Parkersburg, president; P. W. Lowe, of Mannington, first vice-president; J. I. Alexander, of Clarksburg, secretary and treasurer.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company has increased its capitalization from $3,000 to $30,000.

MARSHFIELD, WIS.—A company has been formed in the town of Masonville for the purpose of establishing a telephone line.

GREENWOOD, WIS.—H. H. Heath, of the Badger State Telephone & Telegraph Company, of Neillsville, is installing a local exchange and toll line.

KENOSHA, WIS.—One hundred residents of this city will bring suit against the Wisconsin Telephone Company asking damages for poles set in front of their property.

LACROSSE, WIS.—The Twin City Telephone Company will construct an independent long-distance line of copper between St. Paul, Minneapolis and La Crosse, the improvements to cost in the neighborhood of $250,000.

RACINE, WIS.—At the annual meeting of the stockholders of the Citizens' Telephone Company it was shown that 805 telephones were in use; that the earnings of the company were largely in excess of the expenses and that although no dividend had been declared, it was probable that one would be declared soon. There was a feeling in favor of extending the business as rapidly as possible and hopes that there would soon be toll service with the larger cities. Officers were elected as follows: President, John B. Simmons; Vice-President, E. B. Belden; Secretary, Gustave V. Kradwell; Treasurer, Charles Carpenter; Directors, G. V. Kradwell, Joseph Breese, J. P. Davies, Dr. Robert Kitto and Dr. Sorenson.

BUFFALO, WYO.—A company has been organized to construct and operate a telephone line between Buffalo, Kaycee and Mayorworth.

ELECTRIC LIGHT AND POWER.

FLORENCE, ALA.—A franchise has been granted to M. C. Buxbaum and others for an electric light and street railway plant. Mr. Buxbaum is representing Northern parties. The city has been without electric lights for six years.

SAN FRANCISCO, CALIF.—The Corona Gas & Electric Company has been incorporated, with San Francisco named as the principal place of business. Directors: J. G. Whitson, A. Harris, H. M. Pabst, L. M. Thompson and P. L. Benjamin. Capital stock, $50,000; subscribed, $50.

DENVER, COLO.—The San Juan Electric Light & Railway Company has been incorporated in Denver, with a capital of $300,000. It will operate in Ouray County. A. S. Thursten, S. T. Hamilton, W. R. Monson, G. A. Taff and J. A. Barclay are the incorporators.

AUGUSTA, GA.—Stewart Phinizy and others have been granted a franchise to furnish electricity and gas in the city.

ROSEWELL, GA.—The Rosewell Cotton Mills will increase the height of its dam, and a movement is said to be on foot looking to the using of some of the extra power for electric lighting in the town.

ALTON, ILL.—It is said that contracts have been let for the equipment of every passenger engine on the Chicago & Alton Railroad with electric head lights. The Alton is the first road in the country to entirely displace oil with electricity.

INDIANAPOLIS, IND.—The Western Electric Engineering & Construction Company, of Indianapolis, has increased its capital from $10,000 to $20,000.

PAOLA, KAN.—The Franklin Light & Fuel Company has been incorporated, with a capital stock of $2,200.

EMPORIA, KAN.—Emporia is to increase the electric plant, which is owned by the city, so as to be able to furnish power for manufacturing plants both day and night. It is also contemplated to put in a street car system, the power to be furnished by the city, and possibly the city to own the street car line.

LAKE PROVIDENCE, LA.—The Board of Aldermen has ordered an election to be held Nov. 1 on the question of issuing $20,000 5 per cent bonds for a system of waterworks and electric lights.

PORTLAND ME.—The plant of the Portland Lighting & Power Company was recently damaged by fire.

SALISBURY, MD.—The sale of the Salisbury, Md., electric light works by the Messrs. R. M. and W. T. Johnson to a syndicate of New York capitalists is announced. The price paid is said to have been $40,000.

BOSTON, MASS.—The gas commissioners have authorized the Cambridge Electric Light Company to issue $50,000 new stock at $140 per share, the proceeds to be expended for additions to plant.

CLINTON, MO.—There is an opening in this town for an electric light plant.

ST. LOUIS, MO.—The Terminal Association is preparing to substitute electric power in the operation of its tunnel fans.

ST. LOUIS, MO.—The Mound City Motor Company, of St. Louis, has been incorporated with a capital of $2,000. The incorporators are John J. Mielke, Edward Doyle, George Bonney and W. J. Perkins.

ST. LOUIS, MO.—The annual convention of the International Brotherhood of Electrical Workers convened here Oct. 21 and will continue through the 28th. It is said that a demand will be made for a wage increase all over the country.

CARSON CITY, NEV.—A company has been formed at Reno to tap the wires of the Truckee River Electric Power Company and distribute energy throughout the town of Reno for lighting, heating and power purposes. Farmers in Mason Valley, Lyon County, have incorporated a company to put in an electric plant on the Walker River and have secured the water rights, etc., preparatory to the commencement of active work. Carson Valley farmers are also establishing a plant on the Carson River, near Gardnerville, Douglas County, where there is ample fall. They expect to supply power for adjacent mines and also for a new electric railway to be built through the Carson Valley from Carson City to the mines in Mono and Alpine counties, California.

NEWBERN, N. C.—A second election on the question of issuing $15,000 electric lighting bonds has been called by the City Council for Dec. 3. The town is at present in darkness, but a temporary contract may be made later with the present electric light company.

RALEIGH, N. C.—If the weather permits it is expected that electric power from Milburnie, on the Neuse River, six miles distant, will be delivered in the city within three weeks. Two hundred and seventy-five horsee-power will be developed at first, although the water wheels are of 900 horse-power. T. L. Eberhardt and E. C. Hillyer are interested.

BERNARDSVILLE, N. J.—Plans have been sent out to local builders for estimates on a large power-house to be erected in this place for the Bernardsville Heat, Light & Power Company. The plans were drawn by the company's engineer. A new power plant is to be installed, costing $20,000.

SPRINGFIELD, OHIO.—The Horn Lighting, Power & Heating Company, of Springfield, has been incorporated, with $100,000 capital stock, by E. S. Kelley, J. E. Bowman, J. A. Linn, H. E. Schenck and Alfred Cavileer.

CINCINNATI, OHIO.—The village council of Madisonville has authorized the holding of a special election on Nov. 11 to determine the question of issuing $25,000 worth of bonds for the improvement of the electric light plant and water works.

OTTAWA, ONT.—The Canadian General Electric Company has arranged with the Dominion government to develop power at Nassau Mills for use in the Peterboro works of the company. Nassau Mills is on the canal about three miles above Peterboro.

OTTAWA, ONT.—The Stave Lake Power Company, of Vancouver, B. C., has completed its negotiations with Eastern capitalists for the financing of the proposition. The money for the development is being furnished by Stone & Webster, of Boston, Mass., and work will begin at once in connection with the installation of the plant. Power will be transmitted to Vancouver and New Westminster. The cost of the work is estimated at $650,000, including $280,000 for a tunnel two miles in length, dam, etc., and $370,000 for generating plant, and pole line.

BAKER CITY, ORE.—The company, which supplies electric light and power in Baker City, recently ordered a quantity of new machinery, which will be set up within a short time, and will greatly improve the service.

PITTSBURG, PA.—The Keystone Electric Company, composed of Braddock capitalists, has begun the erection of an electric light and power plant. It will be a rival to the Monongahela Light & Power Company, which furnishes light, heat and power to the boroughs of Braddock, Rankin, North Braddock, Turtle Creek, East Pittsburg and Wilmerding. The Keystone company has a capital of $100,000. The officers are: Justice Frank T. Redman, president; John Gangwisch, secretary, and Harvey McKinny, treasurer, all residents of Braddock.

SPARTANBURG, S. C.—Ladshaw & Ladshaw have a contract to develop water power near Asheville, N. C., for electric transmission. Power will be used for a cotton mill and other purposes.

COLUMBIA, S. C.—The State Lighting Commission has called for bids for the electric wiring of the State house, bids to be received until Wednesday, Oct. 30, at noon. The contract for current has been made.

DENTON, TEX.—The Denton Water, Light & Power Company is arranging for the use of petroleum as fuel in the plant here.

VERNAL, UTAH, will in all probability be lit by electricity in the near future. Contracts for the plant are already under construction. James Johnson is the promoter of the enterprise.

SALT LAKE CITY, UTAH.—The County Commissioners have granted the Hercules & Telluride Power Company a permit to extend its transmission line to Bingham City. This means a great saving to consumers of this company's light and power, and a saving of $75 per month to the city.

RICHMOND, VA.—The Richmond Industrial Development Company has awarded the contract for a $35,000 plant to J. T. Wilson. The company proposes to supply electric power and floor space to small manufactories which could thrive better with these advantages supplied cheaply. The Traction Company and the Virginia Electrical Railway & Development Company are interested.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—A Baltimore syndicate represented by T. J. Blackwell and associates, recently asked for a definite figure on the sale of the street railway between San Jose and Santa Clara, Calif., and also on the motor line from San Jose to Alum Rock Park.

AUBURN, CALIF.—The new street railway line of the Auburn Electric Railway Company was recently completed. The event was celebrated by the citizens under the direction of Superintendent A. S. Moore. Two gold spikes were driven and a barbecue and ball followed.

DENVER, COLO.—It has been practically settled that the Colorado & Southern Railroad will install electricity as a motive power on all its suburban lines running out of Denver.

CHICAGO, ILL.—The West Michigan Traction Company has been formed at Chicago, with a capital of $1,000,000.

LOGANSPORT, IND.—The Wabash River Traction Company, now operating a line between Wabash and Peru, has asked the County Commissioners for a right of way through Cass County.

SPRINGFIELD, ILL.—The Illinois River Railway, Light & Power Company, Ottawa, capital $2,000,000, has been incorporated by Josiah Cratty, William H. Duval and Edward J. Hamel.

SHELBYVILLE, IND.—Townsend, Reed & Company, of Chicago, have commenced the construction of the Indianapolis, Shelbyville & South Eastern Traction Company, from this city to Indianapolis.

MIDDLETOWN, IND.—The directors of the Muncie, Middletown & Greenfield Traction Company have ordered a survey of the line with a view of beginning construction work at once. W. H. Woods heads the board of directors.

PRINCETON, IND.—A 50-year franchise was granted to Edwin J. Baldwin, through Gibson County, for an electric railway, electric light and power-house privileges. The company recently organized proposes to erect a line from Evansville to this city, and thence to Coals Springs.

CENTERVILLE, IA.—This city will have an electric street railway system, a gas plant, an electric lighting plant and a public heating plant. All these propositions were carried at the special election, when franchises for a period of twenty-five years were granted.

CATLETTSBURG, KY.—The new long-distance line between Gallipolis and Ironton, Ohio, is nearing completion. Over two-thirds of the distance is covered and the entire work is expected to be finished within thirty days.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has petitioned the city of Pittsfield for locations on roads connecting the city proper with Tillotson's, Sternsville and Lower Barkerville. The selectmen of Hancock are petitioned by the company for locations in that town to the New York State line, where the Berkshire company will be met by an Albany company, the combined roads making a through trolley road from Pittsfield to Albany, a distance of about 28 miles.

ST. PAUL, MINN.—Announcement is made that the Twin City Rapid Transit Company has secured from the Northern Pacific the right to build tracks on the right of way between White Bear and Mahtomedi, and that a new electric line will connect the two points before next summer. A survey has been made for the line and construction material has been ordered.

OMAHA, NEB.—The Douglas County Suburban Railway Company has asked the County Commissioners for a franchise for the construction and operation of a suburban line.

CARSON CITY, NEV.—Incorporation papers have been filed with the Secretary of State of a company to utilize the power of Clear Creek to operate an electric railway from Carson City to Lake Tahoe. A new plant has been completed near Winnemucca, Humboldt County.

EXETER, N. H.—The Seabrook & Hampton Beach street railway has been opened for business.

NEWARK, N. J.—The stockholders of the Worcester Traction Company, a New Jersey corporation controlling street car lines in Worcester, Mass., met here and took preliminary steps toward winding up the company's affairs. This was accomplished by adopting a resolution recommended by the Board of Directors, which provides for the cancellation of practically all of the preferred stock. Specifically the resolution calls for the reduction of the number of preferred shares from 20,000 to 400 and the redemption and retirement of the remaining 19,600 shares. It was stated that ultimately the company would go into entire liquidation, although the operation of its lines will not be interfered with for some time to come.

ALBANY, N. Y.—The State Board of Railroad Commissioners has granted the application of the St. Lawrence International Electric Railway & Land Company for authority to construct a road seven and a half miles long between Alexandria Bay and Redwood.

ALBANY, N. Y.—Daniel F. Toomey, president of the Dunkirk & Point Gratiot Traction Company, confirms the report of the sale of his line and the franchise for 99 years, to capitalists who are to construct the trolley line from Buffalo to Jamestown by way of Dunkirk.

STEUBENVILLE, OHIO.—The Pleasant Heights Electric Company, of Steubenville, has been placed in operation.

LIMA, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway will build a passenger, freight and telegraph station in Lima.

CLEVELAND, OHIO.—A bridge over the Huron River is all that is needed to enable the Everett-Moore syndicate to operate cars from Cleveland to Detroit.

BELLEFONTAINE, OHIO.—It is announced that the Dayton, Springfield & Urbana Railway will be extended from Urbana to Bellefontaine.

FINDLAY, OHIO.—It is claimed in Findlay that overtures have been made by the Everett-Moore syndicate for the purchase of the Tiffin, Fostoria & Eastern Railway.

HAMILTON, OHIO.—The Millcreek Valley Traction Company has been enjoined from connecting two sections of its line in Glendale because it neglected to secure a proper franchise.

TOLEDO, OHIO.—The Toledo & Lima Traction Company has awarded a contract to the American Bridge Company for a $27,000 steel bridge to be erected across the Maumee River at Waterville.

CLEVELAND, OHIO.—It is stated that negotiations are under way for the purchase by the Everett-Moore syndicate of the Canton-Akron Railway, now under construction between Canton and Akron.

BARBERTON, OHIO.—A. T. Townsend, promoter of the Barberton, Doylestown & Massillon Railway, has offered to sell his franchise from Barberton to Doylestown to the Northern Ohio Traction Company.

CLEVELAND, OHIO.—M. J. Roseboro, of Cleveland, and J. Cleland and R. H. Reynolds, of Greenwich, Ohio, are securing right of way for an electric railway from Mansfield to Norwalk by way of Greenwich.

MARION, OHIO.—The Findlay & Marion Railway Company has secured a private right of way from Marion to Findlay by way of Carey and Upper Sandusky, and is now securing a 30 foot right of way from Carey to Fostoria.

FINDLAY, OHIO.—The final survey of the Western Ohio Railway from Findlay to Lima has been completed. Large shipments of ties are being unloaded along the route and several forces of men are pushing the grading.

DAYTON, OHIO.—The case of the city of Dayton vs. the Dayton City Railway Company is on trial here. It is a mandatory injunction suit brought to compel the company to use the double trolley wire system as a preventive against electrolysis.

DELPHOS, OHIO.—The Lima, Delphos, Van Wert & Ft. Wayne Traction Company which proposes to build a line from Lima to Ft. Wayne, Ind., has applied for franchises in Delphos and Van Wert. Much of the right of way has been secured.

KENTON, OHIO.—The Defiance, Ottawa, Kenton & Columbus Railway has secured private right of way through part of Union County. The road will extend from Defiance to Columbus, touching Ottawa, Kenton, Richwood, Magnetic Springs and Delaware.

ASHTABULA, OHIO.—It is stated that arrangements have been completed by the Everett-Moore syndicate for the absorption of the lines of the Ashtabula Rapid Transit Company, as soon as the Ashtabula extension of the Cleveland, Painesville & Eastern Railway is completed.

EAST LIVERPOOL, OHIO.—Franchises granted some time ago to Hairt & Smith, of Cleveland, and H. G. Folts, of Lisbon, for railway lines through Columbiana County, have expired through failure to commence work at the time agreed upon, and the ordinances will be repealed.

NEWARK, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has won a suit brought by citizens to restrain the building of its line into the town. To head off an injunction the company placed a large force of men at work and built the track through the contested territory.

LIMA, OHIO.—The promoters of the Lima, Delphos, Van Wert & Ft. Wayne Traction Company have secured nearly all right of way required. A franchise has been granted by the Allen County (Indiana) Commissioners, and franchises are now before the Councils of Delphos, Van Wert and Lima.

WEST JEFFERSON, OHIO.—The controversy between the village of West Jefferson and the Columbus, London & Springfield Railway is still unsettled. The Council granted another franchise which the company declined to accept. If the matter is not speedily settled, the line will be built around the town.

CLEVELAND, OHIO.—The Cleveland Construction Company, engineers for the Beloit, Delavan Lake & Jamesville Electric Railway has placed a contract with the Allis-Chalmers Company, for two Cross compound condensing engines to be installed at the power-house at Beloit, Wis. The road is owned by Cleveland people.

MANSFIELD, OHIO.—After being on paper for nearly five years, the Mansfield, Savanna & Wellington Railway Company has finally commenced construction work. The company has increased its capital stock from $100,000 to $1,500,000. T. Y. McCray is president, and T. Y. McCray, Jr., secretary of the company.

ASHTABULA, OHIO.—Goodrich & Tuttle, of Geneva, who hold a franchise along the highway for a line from Painesville to Ashtabula, claim they have secured financial backing, and the line will be built. The extension of the Cleveland, Painesville & Eastern Railway will be completed between these points next spring.

HAMILTON, OHIO.—The Hamilton, Eaton & Richmond Traction Company has been incorporated in Indiana and Ohio. The road will be built on private right of way from Hamilton to Richmond. The promoters are John J. Hall, Oliver Dillman, Warren D. Riddell and G. M. Hodges, of Hamilton, and J. S. Stewart and Charles Orr, of Cleveland.

CLEVELAND, OHIO.—The directors of the Cleveland City Railway Company have accepted the resignation of J. B. Hanna as secretary-treasurer of the company. John Ehrhard, at present assistant secretary of the company, will assume the duties of Mr. Hanna. A. E. Duty, heretofore assistant superintendent of the lines on the east side, has been made assistant superintendent of all the roads.

HAMILTON, OHIO.—Property owners have secured a temporary injunction against the Hamilton, Glendale & Cincinnati Railway Company known as the Millcreek Valley line. A motion filed by the defendants in the matter of purchase of consents was overruled, the Judge averring that each property owner had equal rights to recompense, and that the purchase of consents in itself was illegal.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railroad, a steam road operating from Cincinnati to Georgetown, has been sold to the Comstock Brothers of Detroit. It will be changed to standard gauge and equipped with electricity and extended to Ripley, on the Ohio River, at once. Later it will be extended to Portsmouth, Ironton and other points in the river valley. The price paid for the property is said to have been $500,000.

CLEVELAND, OHIO.—The Cleveland promoters of the Toledo & Western Railway, now under construction into Michigan and Indiana, are planning to operate freight trains with electric locomotives after the pattern being experimented with in Germany. The road is being equipped with heavy rails and very high speed has already been attained. The equipment of the power-house at Sylvania is now being installed, and cars are being operated as far as Metamora.

EAST LIVERPOOL, OHIO.—G. C. Ingram, of East Liverpool, has applied for franchise in Wellsville and East Liverpool, and Chester, W. Va., for a line which he states will tap towns on both sides of the Ohio River extending from Wheeling to Steubenville, East Liverpool and connecting with Pittsburg. It is probable that the company is the Wheeling Traction Company, which is already building a line to Steubenville. E. W. Moore and H. Clark Ford, of Cleveland, are leading stockholders of the company.

CLEVELAND, OHIO.—The Toledo & Monroe Railway, which will be part of the line from Toledo to Detroit, is proving one of the best paying interurban properties in the country. It has been in operation only about three months and only three cars are operated, yet each car earns in the neighborhood of $80 per day. The run of 22 miles from Toledo to Monroe is made in 50 minutes and the fare is only 25 cents. It is said that the steam road has lost 90 per cent of its local business in consequence of this competition.

DAYTON, OHIO.—It is announced that the work of changing the tracks of the Dayton, Lebanon & Cincinnati Railway for electric traction is to be pushed to completion. It is the intention to operate electric cars during the day and steam freight trains at night. The road has recently been purchased by A. E. Appleyard, who is at the head of the syndicate which owns the Columbus, London & Springfield Railway and the Dayton, Springfield & Urbana Railway. It is probable that through cars will be operated over the three lines.

CLEVELAND, OHIO.—The officials of the Cleveland Electric Railway Company will soon place a contract for an elegant observation car. It is the intention to establish a regular schedule covering a route of 25 miles traversing the best streets and the leading points of interest about the city; both of the city lines being included in the itinerary. The car will be luxuriously furnished and a porter and guide will furnish information regarding the points of interest, besides providing for the comfort of passengers who will pay 25 cents for the ride.

CLEVELAND, OHIO.—The Windsor, Ont., street railway which has recently been purchased by the Everett-Moore syndicate, is to be improved and new rolling stock added. The power-house, which also furnishes light to the town, is to be improved. The Windsor, Sandwich & Amherstburg Railway also purchased by the syndicate, is to be operated from the Detroit power-house of the Detroit United Railways by means of cables stretched under the Detroit River. Both roads will be operated as a part of the Detroit District Railway Company, under the management of J. C. Hutchins.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is breaking ground for another extension to its power-house. Contracts have just been closed for a duplication of the generating set now being installed. The outfit will consist of a 1600-kw General Electric generator direct connected to a cross compound Cooper-Corliss engine. One 250-hp Sterling boiler and one 250-hp Babcock & Wilcox boiler were ordered at the same time. The present boilers will be shifted so that part of the power station will be supplied from Sterling boilers and part by Babcock & Wilcox boilers.

COLUMBUS, OHIO.—The Columbus, Newark, Zanesville & Wheeling Electric Railway, of Newark, has been incorporated with $150,000 capital stock, by Joseph M. Ickes, D. C. Taylor, Chas. H. Geidel, W. O. Littick and John H. Black. The line will extend from Columbus to Bridgeport, opposite Wheeling, touching Newark, Zanesville, Cambridge and Barnesville, with a branch through Cosbecton and Newcomerstown. The road is the result of the consolidation of the Newark, Zanesville & Coshocton Railway, with the interests of Messrs. Taylor and Black, who have secured franchises between Zanesville and Wheeling.

CLEVELAND, OHIO.—The absorption by the Everett-Moore syndicate of the so-called Appleyard roads in Ohio seems about to be consummated. According to a gentleman who is closely identified with the syndicate, there is under way a deal which is more gigantic than any yet attempted by these capitalists. It includes the absorption of roads which will place under one control a line from Cleveland to Columbus and Cincinnati, a line from Cincinnati to Toledo, with probably a line from Toledo to Columbus. This project is separate and distinct from the aims of the Pomeroy-Mandelbaum syndicate of Cleveland for lines touching the same points.

CLEVELAND, OHIO.—The Everett-Moore syndicate has arranged with eastern financiers to take $3,000,000 thirty-year bonds bearing interest at 4½ per cent on the Detroit & Toledo Shore Line. Previous to this transaction the syndicate closed the deal for the purchase of the Toledo & Monroe Railway and the line was consolidated with the Detroit & Toledo Shore Line. Immediately after, the two lines were transferred to the Detroit United Railway, and in the future will be operated as the Shore Line division of the Detroit District Railway, as the Michigan lines are to be known. Contrary to general impression, the Toledo & Monroe Railway has not been the property of the syndicate, but has been held by it under a lease.

CLEVELAND, OHIO.—M. J. Mandelbaum & Company, brokers and bankers, who handle the securities of the projects of the Pomeroy-Mandelbaum syndicate, will soon issue the stocks and bonds of the Little Miami Traction Company, the Western Ohio Railway Company, and the Richmond & Petersburg Railway Company. The securities of the Little Miami consist of $500,000 in bonds and the same amount in stock. The road is 19 miles in length and will be in operation about Jan. 1. The Richmond & Petersburg securities consist of $700,000 in bonds and $600,000 in stock. The road is 24 miles in length and will be in operation within two weeks. The Western Ohio deal consists of $2,500,000 in stock and the same amount in bonds; only $500,000 of the bonds being issued at the present time. The road will be in operation from Lima to Minister, 34 miles, in about 30 days.

CLEVELAND, OHIO.—The Central Illinois Traction Company, of which J. B. Hanna, formerly secretary-treasurer of the Cleveland City Railway Company, will probably be president, will be incorporated within a few days. Mr. Hanna will make his headquarters here, but will spend much of his time supervising the work in Illinois. The company will push construction work on the rights already secured, amounting to about 100 miles of track radiating from Springfield, and as fast as possible will secure right of way for an additional 100 miles of road. It is stated that the system will connect with the roads in the Fox River valley, running into Chicago, now building by a Cleveland syndicate, in which Messrs. Everett-Moore and Mahler are interested, and will extend as far south as East St. Louis, giving entrance to the Missouri metropolis.

OTTAWA, ONT.—Arrangements are reported to have been completed for the building of an electric railway system to connect the leading towns of the island of Cape Breton in the province of Nova Scotia.

OTTAWA, ONT.—The street railway, electric light, incandescent light and telephone companies of Toronto, Ont., have appealed against the increase of their municipal assessments that have just been revised and placed upon them. These increases appealed against are: Street Railway Company, $1,156,000, of which $700,000 is on its cars which have never before been assessed; Bell Telephone Company, $475,000 on poles, plant and wires; Electric Light Company, $129,000; and Incandescent Light Company, $165,000 on plant.

ALBANY, ORE.—The Albany Street Car Company has been incorporated, with a capital stock of $20,000, by J. R. Wyatt, N. V. Murray and J. H. Roberts.

PHILADELPHIA, PA.—Engineer W. S. Twining is engaged upon plans and specifications for a new power-house for the Union Traction Company. The building will be located on Wyoming Street, east of Broad Street.

BLOOMSBURG, PA.—Among the new lines of electric railway to be built in this region is one between Berwick and Nanticoke. The line will be twenty miles in length, connecting with the Columbia & Montour Electric Railway, at Berwick, and with the Wilkesbarre & Nanticoke road at Nanticoke, thus making a continuous line of electric roads between Bloomsburg, Wilkesbarre and Scranton. The officers of the company are: President, C. W. Miller; treasurer, L. E. Waller; secretary, C. C. Peacock; directors, L. E. Waller, C. C. Peacock, C. W. Miller, C. M. Creveling, C. H. Campbell and F. E. Miller.

EDGEFIELD, S. C.—A meeting of citizens of the Roper section has been held in the interest of the proposed electric railway from Edgefield to Augusta, Ga.

KNOXVILLE, TENN.—Ashley S. Johnson is said to be interested in a scheme to construct an electric railway from Knoxville, Tenn., to Sevierville, which will cost possibly $250,000.

HOUSTON, TEX.—The Houston Electric Street Railway Company, together with all its realty holdings, was disposed of at public sale on Oct. 1. The road was purchased by Owen D. Young, of Boston, the price paid being for the street railway $725,000 and for the real estate holdings of the company $67,500.

NORFOLK, VA.—The Norfolk & Atlantic Terminal Company has been fined $100 for violating the ordinance requiring the use of fenders. The trial grew out of the killing of a child by one of the company's cars.

SEATTLE, WASH.—The Seattle Central Railway Company, which expects to have its lines in Seattle, Wash., in operation before the close of October, has introduced a new type of combination electric car. It can be converted from an open to a closed car in three minutes.

NEW INDUSTRIAL COMPANIES.

ST. LOUIS, MO.—The Hill Electrical Manufacturing has been incorporated, with a capital of $25,000. Harry M. Hill holds 240 shares, W. P. Foster 5 shares and Morton Jordan 5 shares.

THE HUBBELL-GRIER ELECTRIC COMPANY, of New York City, has been incorporated; capital, $25,000. Directors: Harvey Hubbell and E. R. Grier, Bridgeport, Conn.; F. E. Laimbeer, New York City.

THE MORTIMER ELECTRIC COMPANY, of New York City, has been incorporated; capital, $10,000. Directors: Charles Mortimer, Jr., and G. P. Heinrich, of Brooklyn, and A. N. Clark, of South Norwalk, Conn.

THE COLUMBIA CONSTRUCTION COMPANY has been organized at Milwaukee, Wis., with a capital stock of $50,000. The incorporators are C. C. Smith, formerly connected with the Falk Manufacturing Company, and George P. Miller and W. H. Miller. The purpose of the new company, as outlined in the articles of incorporation, is to construct, promote and equip street and other railways, electric light and power plants, telephone and telegraph lines, and to operate street railways.

LEGAL.

EXTENSION TELEPHONES.—Where a telephone company having the exclusive privilege of operating lines in a city is prepared, at reasonable rates, to attach extension instruments for its subscribers, the Supreme Court of Rhode Island, in the case of Gardner vs. Providence Telephone Company holds that it may forbid the attachment of private extension instruments to its lines, and refuse the use of its lines and instruments to one who refuses to comply with such regulation.

OBITUARY.

C. WALTON SWOOPE, director of the electrical department of Spring Garden Institute of Philadelphia, died Oct. 7, after an illness of but a few days. Mr. Swoope was an occasional contributor to these columns, and for some years we printed annually an analysis from his pen of the distribution of subjects in the electrical patents of the preceding year. Of recent years he has prepared for the Philadelphia *Ledger* its column of "Industrial Science Notes." The General Index of the Electrical World (1883-96), issued in 1897, was compiled by Mr. Swoope. He was also the author of a book entitled, "Lessons in Practical Electricity," and, by a sad coincidence, the announcement of Mr. Swoope's death arrived in the same mail with a copy from the publisher of the second edition of this work. Mr. Swoope, who was 31 years of age, attended the University of Pennsylvania after graduating from a manual training school, and for a time was a student in the Schenectady shops of the General Electric Company. Accepting a position as instructor in the Spring Garden Institute, he labored with great energy, and finally succeeded in establishing an electrical department, giving complete laboratory instruction to classes of nearly 200 pupils. To provide instruments for the use of the pupils he established the Palmer Electrical Instrument Company, designing apparatus for the use of his own classes and for sale to other institutions.

PERSONAL.

MR. GEORGE WESTINGHOUSE sailed for Europe last week.

MR. J. B. HANNA, for many years secretary of the Cleveland City Railway Company, has resigned.

MR. CHAS. A. COFFIN, president of the General Electric Company, has returned from his recent trip to Europe.

MR. R. LESTER THAYER, of Peoria, Ill., was in Chicago this week, and reports a very favorable outlook for business.

DR. L. H. LAUDY lectured on the historical development of artificial illumination before the Cooper Union Chemical Society, at Havemeyer Hall, Columbia University, New York City, on Oct. 19.

MR. M. J. CARNEY, for many years general manager of the Central Union Telephone Company at Chicago, has been chosen vice-president of the company. He will continue to act as general manager.

MR. JOHN W. McNAMARA, second vice-president of the United Traction system of Albany, N. Y., has been elected president, in place of Mr. R. C. Pryn, who has become chairman of the board of directors.

MR. W. R. FLEMING, president of the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., has just returned from an extended trip throughout Europe, made in the interests of his company with a view to pushing business in that part of the world.

PROF. GUSTAVE GILLON, of the University of Louvain, Belgium, who has been studying electrical conditions in this country, as well as the treatment of technical education here, has returned home greatly interested and impressed with what he has heard and seen.

MR. CHARLES F. MACK, for a number of years secretary of the Warren Electric Company of Sandusky, Ohio, has resigned to accept a position with the Kilby Manufacturing Company, of Cleveland, manufacturer of beet sugar machinery and general lines of heavy work.

MR. C. H. WILMERDING, the consulting engineer of Chicago, and a past president of the National Electric Light Association, has recently issued an interesting pamphlet descriptive of the large electrical plant installed under his direction at the Hannibal shops of the Chicago, Burlington & Quincy Railroad.

MR. MARK DAVIS, well known throughout the independent telephone field as general manager of the Cuyahoga Telephone Company, of Cleveland, has resigned, to accept an important position with the Canada Life Assurance Company, with which he was formerly identified. During the two years of his management of the Cuyahoga Company, the Cleveland exchange has grown from a small beginning to be the largest exchange in the independent field.

MR. NIKOLA TESLA is the subject of an article by Mr. Eliot Lord, in the November *Junior Munsey Magazine*. An interesting review is given of Mr. Tesla's inventions, ideas and personality. As to his experimental work: "Time is with him an infinite stretch. * * * In writing of the probable development of the use of aluminum, for example, he used the word "soon" in a sense so differing from the ordinary that his statement was ridiculed by a leading technical journal."

MR. F. E. DRAKE, director of machinery and electricity for the United States at the Paris Exposition, has for some months been in complete charge of the works of the Union Elektricitaats Gesellschaft at Berlin. It is now understood that upon the invitation of the directors he has agreed to stay until next spring, and that he will carry out some important changes during the winter. The company manufactures on an enormous scale and turns out a remarkably wide range of apparatus.

MR. T. JEFFERSON COOLIDGE, late Minister to France, has given a fund of $50,000 to the Jefferson Physical Laboratory of Harvard University for physical research. The income is to be expended at the discretion of the director, Prof. John Trowbridge. Among the terms of the gift is the following: The income of this fund shall be used primarily for laboratory expenses of original investigations by members of the laboratory staff; but the director, at his discretion, may award therefrom an honorarium, of not more than $500 per annum, for the private use of any person who—although receiving no salary from the university—may wish to carry on original investigations under his direction at the Jefferson Physical Laboratory.

BUFFALO PERSONALS.—The following names are of recent registry at the booth of Electrical World and Engineer, Electricity Building, Pan-American Exposition: J. L. Putnam, Clark Automatic Telephone & Switchboard Company, Providence, R. I.; B. G. Stauffer, treasurer G. C. Towle Manufacturing Company, Lancaster, Pa.; C. L. Edgar, Boston, Mass.; Bert C. Benham, Muscatine, Ia.; E. Reubel, St. Louis, Mo.; N. Lazarnick, New York City; Max Loewenthal, New York; W. B. Hale, Western Electric Company, Chicago; Horacio Valdis, Brussels, Belgium; Harry Rodrick, East Las Vegas, New Mexico; Geo. Brady, Chicago, Ill.; H. F. Nichols, Adelaide, South Australia; W. M. Barnes, Philadelphia, Pa.; C. A. Vandersyde, Chicago, Ill.; James W. Queaby, Chicago, Ill.; C. S. Chamberlain, Brooklyn, N. Y.; Thos. D. Macrae, Buffalo, N. Y.; Theshie Shaw, Genoa, N. Y.; J. E. Farrar, Rochester, Mich.; W. M. Sharp, Rochester, Mich.; Cecil Hodgson, Manchaster, Eng.; F. A. Vaughn, Milwaukee, Wis.; W. M. Barnes, Philadelphia, Pa.; James Walker, Lansing, Mich.; W. C. Harris, Philadelphia, Pa.; Fred. Hazelbauer, Corning, N. Y.; M. J. Vannett, New York, N. Y.; Mrs. R. M. Vannett, New York, N. Y.; E. R. Larter, Youngstown, Ohio; F. L. Rogers, Perry, Ia.; Arthur Merkhofer, Cincinnati, Ohio; Fred. C. Murphy, Buffalo, N. Y.; J. F. Doherty, Bones, Cuba; Thos. Chambers, New York, N. Y.; T. S. Coysvill, Attica, N. Y.; W. T. Bushman, Buffalo, N. Y.; J. L. Harper, Buffalo, N. Y.; C. S. Russel, Pittsburg, Pa.; H. W. Locklin, Lyndonville, Vt.; Henry W. Hall, Titusville, Pa.; M. H. Rogers, East Aurora, N. Y.; Geo. S. Davis, Cleveland, Ohio; Thos. P. Thompson, Norfolk, Va.; Alex. S. Hedman, Brooklyn, N. Y.; R. H. Moore, Buffalo, N. Y.; H. E. Hatchunch, Grand Rapids, Mich.; H. E. Greenwood, Newark, N. J.; Edward C. Ruth, Mt. Vernon, N. Y.; Ezra Fawcett, Alliance, Ohio; Chas. F. Schnitz, Hartford, Conn.; F. C. Corley, Cambridge, Mass.; P. S. Graves, Pittsburg, Pa.

Trade Notes.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., has just issued Bulletin No. 7, which has for its subject three-wire secondary distribution. It contains illustrations of Pittsburg transformers.

SEVENTY-FIVE THOUSAND.—It is given out on the authority of the Electric Appliance Company, Chicago, that there are over seventy-five thousand Adams-Bagnall now in use in the United States and Canada.

"LIGHT READING."—This is the title of a pamphlet just issued by the New York & Ohio Company, Warren, Ohio, giving some facts regarding Packard incandescent lamps. A good deal of information on the subject of good lamps is given.

THE FAIRBANKS COMPANY, Philadelphia, known throughout the world and with branch stores in all principal cities, has just taken the agency for the Cross oil filters and Burt exhaust heads, manufactured by the Burt Manufacturing Company, of Akron, Ohio.

THE ROSS ANNUNCIATOR.—The Electric Gas Lighting Company, 195 Devonshire Street, Boston, is sending out a private mailing card containing a fine engraving of the Ross annunciator with "Colonial" case, representing the instrument as it appears on the wall.

TRI-LIGHT.—The Pinckard Tri-Light is the subject of a little pamphlet issued by E. B. Latham & Company, 39 Vesey Street, New York. This lamp gives three different degrees of candle-power, by simply turning the socket key, which varies the connections of the lamp filaments.

UNITED TELPHERAGE COMPANY, 20 Broad Street, New York City, has just issued Circular No. 17. The first page illustrates and describes its center-bearing telphers. The second page shows side-bearing telpher with an electric hoist. Methods of line construction are freely and admirably illustrated also.

SMALL TOOLS.—The Pratt & Whitney Company, Hartford, Conn., has issued a catalogue of its small tools, standards and gauges. This catalogue is very completely illustrated and contains 152 pages, including a complete index, besides various mathematical tables which will save labor in calculations. The illustrations are very artistic and the catalogue as a whole is an excellent piece of work.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is calling attention to the "Ideal" dry battery. This battery is rapidly becoming a favorite in telephone work, and the Central Company is expecting the demand to increase rapidly as the battery has now stood the test of practical work. This company wishes also to inform its customers that it will be pleased to quote prices on batteries of all makes, both fluid and dry.

STURTEVANT MOTORS, DYNAMOS, ETC.—The latest addition to the attractive literature produced by the B. F. Sturtevant Company, Boston, Mass., is a 50-page catalogue (No. 117) on the subject of Sturtevant electric motors, generators and generating sets. The illustrations show motors of different styles for various purposes. The pamphlet is gotten up in the Sturtevant Company's usual attractive manner and describes the apparatus concisely.

COMBUSTION APPARATUS.—Messrs. Baker & Company, the well known platinum refiners, of Newark, N. J., have issued a neat little pamphlet describing Tucker's combustion apparatus for determining with accuracy the volatile ingredients in organic matter. It may also be used to great advantage for the dry distillation of substances and for making qualitative determinations of the volatile ingredients of ash obtained from various materials, as well as of other matter than ash. The apparatus is carefully described and clearly illustrated.

ECONOMIZERS.—Green's fuel economizer is completely and very artistically illustrated in a handsome catalogue just issued by the Green Fuel Economizer Company, Matteawan, N. Y. Steam users will find a good deal of valuable information on this important subject in this pamphlet, and apart from its practical value the pamphlet is a model of artistic execution. The half-tones used are of the finest quality and very clearly illustrate the device in actual operation. Various curves are given showing the saving effected by the use of Green's economizer.

THE SIGNALOID CHEMICAL WORKS, formerly the Phenix Chemical Works, have removed from Brooklyn to Jersey City. The new factory address is 167-169 Clendenny Avenue, where they have larger facilities for the manufacture of "Signaloid," a lamp coloring and frosting compound for incandescent lamps and other decorative glass work. The name has been changed as given in order to more clearly indicate their work by making as a part of their title the brand of coloring compound which has become widely and very favorably known. The office of the company is 382 Bergen Avenue, Jersey City, where Mr. Greeder will cheerfully show specimens of the compound and give any information concerning it.

PROTECTION OF LIFE AND PROPERTY.—Those interested in devices for the protection of life and property should procure from the Central Electric Company of Chicago, bulletins on D. & W. material. These devices include junction boxes, street car and power motor cutouts, transformer cutouts, car heater cutouts, subway boxes, feeder blocks, service switches and cutouts for lighting, telephone and fire alarm systems, all of which are equipped with D. & W. non-arcing fuses. These enclosed fuses are highly recommended by the National Board of Fire Underwriters, as they overcome the flash of the old style open fuses, and therefore lessen fire risk to a minimum. The Central Electric Company will be pleased to furnish full information regarding this material on application.

CHARLES H. BESLY & COMPANY, 10-12 N. Canal Street, Chicago, Ill., report their general business very good. They are especially busy in the tap and grinder departments of their factory at Beloit, Wis. They made a carload shipment to Chicago of Gardner grinders and Besly band machines in September, and expect to make another carload shipment of these same machines in October. These machines are being shipped to all parts of the United States and Europe. New catalogues of Gardner grinders and Besly band machines, and other specialties of their manufacture will be mailed free upon application. Many orders are being received from jobbers for their parallel clamps, Bonanza, Badger and Perfection oil cups, as well as for their celebrated Helmet oil. They consider the outlook for future business very bright.

TEACHING LANGUAGES BY PHONOGRAPH.—We have received from the International Correspondence Schools, Scranton, Pa., a handsome brochure in two colors, announcing that to their already large curricula of one hundred courses they have added the studies of French, German, and Spanish. Instruction in these subjects by the International system is conducted almost entirely

by means of an Edison standard phonograph and the Schools' specially prepared instruction papers. The lessons are sent out in the shape of records and pamphlets—the one a key to the other—each record being a master record bearing the voice of the native instructor. After studying his lesson, both from the pamphlet and the record, until he has thoroughly mastered it, the student recites into the phonograph, using one of the wax cylinders furnished him, and returns it to the schools. These examination records show exactly the student's progress—whether he is acquiring ease, fluency, correct articulation, distinct utterance, etc. The records are carefully examined by his instructor, who writes the student letters of criticism and suggestion. Thus the work goes on lesson by lesson to the end. It is specially worthy of note that the records sent the student are original or "master" records; that is, they contain the voice of the native instructor directly transmitted. Taken in connection with the Schools' instruction papers, the student can quickly and easily acquire a thorough working knowledge of one or more of the modern languages. The new courses have already met with great favor, and will no doubt do much toward swelling the Schools' enrollment, which is already over 325,000. Interested parties should send to the International Correspondence Schools for the free circular on modern languages, which contains a full account of how they teach these subjects by correspondence.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 15, 1901.
[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

684,407. ELECTRIC ARC LAMP; Hugo Bremer, Weheim, Germany. App. filed Nov. 2, 1900. (See Current News and Notes.)

684,408. TROLLEY ATTACHMENT; T. J. Burke, New Orleans, La. App. filed July 1, 1901. To enable one trolley to pass another on the same wire, one of them carries a bridge passing underneath it, upon which the second wheel runs, in passing.

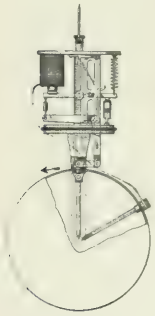
684,415. QUADRUPLEX TELEGRAPHY; C. E. Diehl, Harrisburg, Pa. App. filed Feb. 25, 1901. In a system wherein signals are sent by strong, weak, positive and negative currents, means are provided for avoiding the false signals liable to occur when a current impulse sent to operate the neutral relay has its polarity reversed by the operation of the transmitter to vary the polarity of such impulse.

684,440. SIGNAL TELEGRAPH; E. Lavens and E. J. Lavens, Brooklyn, N. Y. App. filed Jan. 7, 1901. Two identical instruments electrically connected and each adapted to transmit an order which will be visibly and audibly indicated by the opposite instrument.

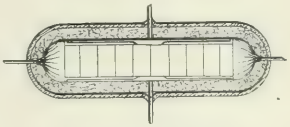
684,459. ELECTRIC HEATER; E. F. Porter, Boston, Mass. App. filed Jan. 29, 1898. The blades of an electric fan are electrically heated to heat the air against which they strike.

684,467. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. A self-restoring coherer, comprising a central tube and an outer tube, the former containing a sheet of foil having transverse and longitudinal slits in it.

684,506. TELEPHONE RELAY; Bela Gati, Temesvar, Austria-Hungary. App. filed March 22, 1900. (See Current News and Notes.)



684,619.—Electric Arc Lamp.



684,467.—Wireless Telegraphy.

684,541. SYSTEM OF TESTING COILS; R. W. Conant, Boston, Mass. App. filed Jan. 7, 1901. Self-inductive coils and resistance coils in circuit with portable terminals; a source of current supply and means for indicating a difference in the self-inductive capacity of the two sides of the circuit.

684,579. MEANS FOR OPERATING ELECTRICAL MACHINES SYNCHRONOUSLY; C. J. A. Machalke, Charlottenburg, Germany. App. filed Dec. 31, 1897. In an alternating current power-circuit, a plurality of armatures each provided with an alternating current winding, field windings for each of said armatures deriving their current from any suitable source of alternating current independently of the armatures, and leads for electrically interconnecting the said armatures for the purpose of producing equalizing-currents therein when the armatures do not occupy corresponding relative positions.

684,596. ELECTRIC RAILWAY; B. Bidwell, Philadelphia, Pa. App. filed Aug. 14, 1884. (See Current News and Notes.)

684,600. ELECTRIC RAIL BOND; I. B. Chantler, Sewickley, Pa. App. filed Jan. 16, 1901. Spiral springs encircle the fish-plate bolts and press against the rail and the plates to maintain the connection.

684,601. TELEPHONE APPARATUS AND SYSTEM; Frank B. Cook, Chicago, Ill. App. filed April 13, 1898. (See page 683.)

684,602. APPARATUS FOR TELEPHONE SYSTEMS; Frank B. Cook, Chicago, Ill. App. filed April 17, 1899. (See page 683.)

684,604. CONDUIT PIPE; A. S. Dixon, Los Angeles, Calif. App. filed March 29, 1901. The pipe is built up of alternate layers of paper and asphaltum composition.

684,609. CONTROLLING SYSTEM FOR RAILWAY VEHICLES; E. R. Hill, Wilkinsburg, Pa. App. filed Sept. 20, 1900. In a multiple unit system, means are provided for stopping the controllers at the full series position, and at the full multiple position, independently of the main controlling switch.

684,612. SYSTEM OF ELECTRICAL DISTRIBUTION; C. J. A. Michalke, Charlottenburg, Germany. App. filed Dec. 31, 1897. A dynamo provided with two sets of windings, one receiving current from an alternating source; a transformer provided with fixed coils interposed between the second set of windings of the dynamo and the source of current and means whereby the relative connection between the transformer and the second set of windings are varied.

684,615. TELEPHONE CALL BELL APPARATUS; Wm. S. Paca, Erie, Pa. App. filed Dec. 26, 1900. (See page 683.)

684,619. ELECTRIC ARC LAMP; C. M. Shafer, McDonald, Pa. App. filed June 26, 1901. The carbons stand at an angle to each other, one being fixed to the globe, and the latter is moved by the lamp mechanism, so that the carbons will approach or recede.

684,628. ELECTRIC RESISTANCE; W. A. Carrell, West Homestead, Pa. App. filed June 21, 1901. Details.

684,631. PIPE COUPLING; H. R. Dean, Brooklyn, N. Y. App. filed April 30, 1901. Details.

684,641. INSULATOR FOR STORAGE BATTERY PLATES; Chas. S. Kaufmann, Chicago, Ill. App. filed Jan. 7, 1901. (See Current News and Notes.)

684,642. PLATE FOR STORAGE BATTERIES; Chas. S. Kaufmann, Chicago, Ill. App. filed Jan. 9, 1901. (See Current News and Notes.)

684,643. PLATE HOLDER FOR ELECTRIC STORAGE BATTERIES; Chas. S. Kauffmann, Chicago, Ill. App. filed Jan. 20, 1901. (See Current News and Notes.)

684,695. PROCESS OF ELECTRICALLY CONNECTING PLATINUM WIRES OR SHEETS WITH NON-METALLIC BODIES; Richard Kuch, Hanau, Germany. App. filed Oct. 15, 1901. The process consists in loosely connecting platinum wire to a non-metallic fine smeltable oxide, smearing the end of this body with a solution of platinum or platinum salts, heating the same to a glow to form a metallic connection, then strengthening by a small amount of easy smelting metal which can be absorbed or alloyed with this sponge.

684,706.—System of Signaling.

684,697. STORAGE BATTERY FOR BOATS; Robt. McA. Lloyd, New York, N. Y. App. filed June 14, 1900. (See Current News and Notes.)

684,699. STORAGE BATTERY; Robt. McA. Lloyd, New York, N. Y. App. filed Feb. 15, 1901. (See Current News and Notes.)

684,700. STORAGE BATTERY; Robt. McA. Lloyd, New York, N. Y. App. filed Feb. 15, 1901. (See Current News and Notes.)

684,706. SYSTEM OF SIGNALING; A. J. Mundy, Boston, Mass. App. filed April 5, 1901. To determine the distance between two points across water, a wireless telegraph signal and a sound signal are simultaneously sent from one point; the difference in the time of their receipt at the second point determines the distance between the two points.

684,725. MEANS FOR CONTROLLING ENERGY DELIVERED TO TRANSLATING DEVICES; J. Sachs, Hartford, Conn. App. filed March 9, 1900. For self-propelling vehicles, an engine, a dynamo, a motor and an automatic controlling device are used. By means of the controller, extra current is supplied to the motor by the dynamo, when necessary to exert more power, but such extra current is supplied at a lower electromotive force, which conequently drives the motor at a slower speed. The result is a constant output by the prime motor and a variable output at variable speed by the translating motor.

684,732. COUPLING FOR SECTIONAL THREADING RODS; R. H. Villard, Rochester, N. Y. App. filed Feb. 27, 1901. Details.

684,736. BUSHING; A. J. Wurts, Pittsburg, Pa. App. filed March 23, 1901. A wire passing through a hole in any body is surrounded by a bushing fixed to it, so that movements of the wire in the orifice will not chafe the insulation of the wire.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, NOVEMBER 2, 1901. No. 18.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - 6.00
Single Copies, - .10
In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 2, 1901.

CONTENTS.

	PAGE
Editorial	709
Electric Omnibusses in New York City	712
Electrical Engineers of the Day—XVIII; R. N. Baylis	712
Electric Power Distribution in a United States Navy Yard	713
Electric Roads in Berlin	713
The Rise of Electric Power Distribution, by Alton D. Adams	716
A Means of Measurement of the Angle of Lag and the Power Factor with a Voltmeter, by Geo. T. Hanchett	718
The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles per Hour—VI; by Walter Reichel	719
Elements of Illumination—XXXIII, by Dr. Louis Bell	721
Meeting of the American Institute of Electrical Engineers	723
Modern Electric Light Accounting	726
National Reciprocity Convention	728
Electricity Building for the St. Louis Exposition	729
The Yale Bi-Centennial	729
New Telephone Patents	729
Electric Furnace	730
Electric Street Railways for St. Petersburg, Russia	730
Recent Figures of American Trade	731
Transandine Railway Projects	731
Burlington Suburban Service at Chicago	731
Current News and Notes	731
LETTERS TO THE EDITORS:	
Waste Heat Engine, by Emil Josse	733
Theory of the Edison Nickel-Iron Cell, by Woolsey McA. Johnson	733
Some Elementary Requirements in Export Trade, by the Excelsior Electric Company	733
Digest of Current Electrical Literature	734
New Books	738
The Nash Gas Engine, by Jas. M. Cremer	740
The Electrical Equipment of the Largest White Goods Factory in the World	741
An "All Switch" Portable Test Set	743
North Bay Power House at the Pan-American	743
Motor-Driven Job Presses	744
Novel Methods of Electric Drive	744
Motor-Driven Matrix Machine	745
Portable and Desk Lamps	746
Bullock Motors	746
Wall Suspension Motor in the Rochester, N. Y., Mechanics' Institute	747
New Universal Enclosed Motors	747
The Mayer Dynamos and Motors	748
Direct-Current Motors of the Lundell Type	748
The New Eck Motor	749
Round Pattern Motors	750
A Motor-Driven Miller	750
Crocker-Wheeler Engine Type Generator	751
Band Polishing Machine	751
Water Power Plant at Silver City, Idaho	751
A New Consumer of Niagara Power	752
New Back-Geared Motor	752
Aaron Multipolar Dynamo and Motor	752
The McKenzie Traveling-Grate Stoker	753
Electrical Drive for a Stereotype Plate-Shaving Machine	753
Thirty-Ton Driven Armature Press	754
Ferracute Machine Company's Pan-American Exhibit	754
Belting at the Pan-American	754
News of the Week	755

FEATURES OF EXPORT TRADE.

It is interesting and encouraging to note that while certain countries in Europe who are our best customers for mechanical and electrical apparatus are suffering severely from trade depression, the demand for such goods still continues brisk. Indeed, it may be questioned whether the need for economy in production due to lower prices does not of itself act as a stimulus to the purchase of better labor-saving machinery. In the meantime, it can be affirmed without fear of contradiction that no one here views with pleasure the distress existing in some parts of Europe, notably Germany. On selfish grounds alone a return to prosperity is to be desired, for it is hard to conceive of an America long prosperous while Europe, its best customer, has lost purchasing power. A better understanding and a fuller reciprocity are the needs of the hour in our international trade, and it is a hopeful sign of the time that a reciprocity convention will be held in Washington this month under the auspices of the important American Manufacturers' Association.

Turning from large issues to minor details, we cannot refrain from calling attention to the letter of Mr. Alexander, from London, in which he points out some of the conditions to be met in export trade. The suggestions he makes are in general excellent, and many of them obvious. Others might be mentioned, such as the careful packing of goods destined to be shipped considerable distances, as indicated by our weekly record of electrical exports, the apparatus often being of a rather delicate and fragile nature. These things cannot all be learned at once, perhaps, it being another case of "solving the problem as you go," but the successful cultivation of a larger international trade evidently depends quite appreciably on these points alluded to in the letter from London.

RECOGNITION BY YALE.

It is with a feeling akin perhaps to disappointment that in reading over the names of the sixty-two gentlemen honored for their scholarship and other attainments at the bi-centennial at Yale University last week, we find among them no representative of applied science, in the fields either of engineering or of invention. Yale has so long occupied a pre-eminent position among our institutions of learning, has shown such a broad and progressive spirit in educational matters and has been so truly representative of the highest American ideals in education and public duty, that not only her own graduates but those of other colleges look to her to lead in the recognition of intellectual progress wherever gained. Surely the alma mater of Eli Whitney, the inventor of the cotton gin, and of Samuel F. B. Morse, of telegraph fame, not to mention many others who have passed from her portals to win renown for her as well as for themselves in scientific research and in the broadening of engineering knowledge, should be the first to recognize the value of such achievements and the benefits conferred by them on humanity at large. America has been pre-eminently the home of inventive genius and applied science. To this has been due in large part its present dominating influence in the industrial and political world, and men like Alexander Graham Bell, Thomas A. Edison, Edward Weston, George Westinghouse, Elihu Thomson, Nikola Tesla and Frank J. Sprague, who have done so much to make this condition possible, causing ten blades of grass to grow where one grew before, have certainly contributed in no small measure to the world's resources of knowledge and happiness. Such services if performed in Great Britain or Germany would undoubt-

edly have been recognized by knighthood or other preferment by the crown, by whom conspicuous merit in engineering and invention has been rewarded in this way in numerous notable instances.

These remarks apply with equal force, of course, to all branches of engineering work, inclusive of electrical engineering. Those who have followed the work accomplished by our different institutes, such as that of the Electrical Engineers, or the societies of Mechanical or Civil Engineers, recognize that these bodies really exercise the function of great post-graduate schools in which the members, who are continuously engaged in technical work, have done more to advance the science than any other agency. If more of the instructors or professors at Yale were members of the American Institute of Electrical Engineers this fact might be better understood at New Haven. For this reason, the president of each of these bodies stands in the position of a president of a post-graduate school for the advanced study of a particular branch of engineering, so that it would be a graceful act for some of the leading universities occasionally to recognize this fact by the award of a degree to the president of one of these bodies when the occupant of that position has been particularly prominent for scholarly attainments, or for engineering achievement.

POWER FACTOR INDICATION.

Elsewhere we print an account by Mr. George T. Hanchett, of an interesting method of measuring the power factor of an alternating-current circuit, the chief value of which resides in the fact that its application requires no other instrument than the ordinary alternating-current voltmeter. As will be noted, however, there is some complication in arranging the circuits, and while this is not a grave objection to the method, yet it sets a limitation to its general use. Perhaps the greatest value of the method is that it furnishes a means available to all who own an alternating-current voltmeter, for calibrating a power factor indicator of the Tuma type, which instrument is so simple in its parts that its construction comes easily within the range of amateur skill. An account of the principles of this type of indicator will be found in an article by Mr. Aug. J. Bowie, which appeared in our issue of Oct. 27, 1900, and also in a paper read by Professor William Hand Browne, Jr., before the Buffalo meeting of the American Institute of Electrical Engineers, and reprinted in our issue of Sept. 7. Briefly, the indicator consists of two coils secured at an angle on a shaft, and movable in a magnetic field maintained by a current derived from the main circuit. The two coils are connected across the circuit of which the power factor is to be measured. The conductor from the latter has two branches, one of which includes one of the angularly displaced coils and an inductance, and the other the second coil and a non-inductive resistance, which disposition results in a displacement of the phase of the currents flowing through the coils. If the several data involved be accurately calculated, the angle indicated by the instrument will be the actual angle of phase displacement. If, however, means are at hand for calibration such as is offered by Mr. Hanchett's method, it will merely be necessary to insert enough inductance and resistance to give rise to a considerable phase difference in the currents flowing through the two coils. The article by Mr. Bowie above referred to, gives the application of this type of indicator to both single-phase and polyphase circuits.

THE RISE OF THE ELECTRIC MOTOR.

Mr. Adams' recent paper on the growth of electric lighting is admirably supplemented by the examination of motive power statistics published elsewhere in our columns. The data from Massachusetts are complete enough to give a clear view of the situation, although, of course, the figures from Boston dominate the total so completely that it was wise to separate them as Mr. Adams has done. The statistics show the growth not only of the business but of the art as well. The use of the electric motor first came in with the extension of the arc lighting business. Once electric circuits were available the motor came quickly into use, and by the time low-tension incandescent systems were fairly under way they took a hand in the business. At first electrical energy was a rather costly commodity, and it is natural enough to find that the early motors were on the average of small output. On the constant-current system any motor of more than a very few horse-power was not only a burden to its circuit, but a source of serious danger. These objections very quickly told against the arc-circuit motor, and within its practicable radius of distribution the low-tension constant-potential system had a firm grasp of the situation. Alternating-current systems were few and alternating motors were practically non-existent.

Probably the real stimulus that did most for the growth of the electric motor service was the sudden and sensational boom in electric railways that took place a little more than a decade since. Not only did this serve as a demonstration that electric motors were of downright practical value, but it put trolley circuits within general reach. There was an immediate effort to utilize them for general motor service, which was promptly squelched by the fire underwriters wherever they had the power. They would gladly have done the same bad turn for electric lighting *in toto* a few years before, but the dangers of working motors off a grounded circuit were appreciated even by the unbiased general public, and the motor on railway circuits had to go. The demand for it, however, pointed out an important opportunity for business, and the special power circuit was very rapidly developed, with excellent results. It has grown in later years side by side with the growth of service on incandescent circuits until at the present time it includes about two-fifths of the total number of motors installed. The next step in the advance of the art was the introduction of the polyphase motor. By the time of its advent, however, the direct-current systems were so thoroughly intrenched behind ramparts of invested capital and vested rights that outside of isolated plants in which they are not uncommon, polyphase motors cut very little figure in Massachusetts statistics. Nor for the same reason will they for some time to come play an important part where large cities are the main field of motor service. In the older States distributed industry is dying out, and the cities grow relatively more important so that the future of electric motive power depends on the policy and methods of a few large stations.

Elsewhere, in California, for example, the story of the growth of electric motor service would be equally instructive, but very different. It would tell of early use of constant-current motors, of special power circuits arranged for them, and vigorous competition with constant-potential motors. The latter pushed out the former slowly and with some difficulty as the low-tension networks gradually spread out and reached more and more customers. But long before the constant-current motor was exterminated the polyphase motor came into use and took a very important place in the extension of the industry. These motors must be for the most part added to the list of motors on incandescent circuits, for while separate motor circuits are sometimes run, their existence is due either to extraordinary conditions as to demands for power, or to a pottering and incompetent management in the matter of regulation. To revert to Massachusetts, the increase in the motor business has been very irregular. If the figures are to be trusted the growth in 1899-1900 was almost entirely in large motors, arranging over 10 horse-power each, and less than half as many motors were added as in the previous year. In Boston for 1899-1900 there is clear evidence of the increasing use of large motors.

In fact, it is safe to say that the whole recent tendency is to extend electric motor service into the larger industries, and this is con-

seriously the encouraging side of the business. The small motor field has been pretty well worked already, but there is still ample opportunity for displacing gas engines and small steam engines with excellent economic results. It is to this work that central stations must now address themselves. As to methods we are inclined to think that the special power circuit is doomed to decay. It is a relic of the days when a thousand-light alternator was looked upon as a colossus, and three-wire mains were installed with No. 0 wire. With modern machines and methods of dealing with regulation, a separate motor system is simply a nuisance, tolerated because for the time being it is cheaper to keep it going than to drop it. The increasing use of larger motors may sometimes cause temporary difficulties, but generating units and distribution mains are growing faster than motors, so that this phase of the matter can be trusted to take care of itself. The future of the motor business is a very great one, both in its commercial possibilities and its physical importance. More than this, it bears a momentous relation to civic progress, for it is by far the most considerable factor in the struggle against the smoke nuisance. The various articles in our present issue, as to motor use, will doubtless be noted with general interest.

The Variations in Speed of Parallel-Driven Alternators.

Several interesting papers on this important subject, of which abstracts appear on other pages, were read before the American Institute of Electrical Engineers last week. In the early days of direct-current central-station practice, there was considerable difficulty with the operation of direct-current dynamos in parallel, when each machine was driven by a separate steam engine. When the first engine and dynamo were brought into action everything went smoothly enough. As soon as the second dynamo was thrown into circuit, oscillations in pressure and speed sometimes manifested themselves. The ammeters in the circuits of the two respective generators showed that sometimes one dynamo carried almost the entire load, and that occasionally the dissymmetry went so far as to produce a reverse current through the under-loaded machine tending to make it run as a motor or auxiliary of its own engine. The difficulty was traced to the steam engine governors, and when these were adjusted, all serious hunting disappeared. A certain small amount of hunting between direct-current generators is yet, however, to be observed in some direct-current central stations, due to the uncorrected residue of the original difficulty.

In the case of two direct-current generators driven at equal internal e. m. f. and connected in parallel on the same load, the law of relative load distribution is that the armature drops shall be equal, thus leaving their terminal e. m. f.'s equal. This means that if their armature resistances are equal, the load current will be equal, and if their armature resistances are unequal the load currents will be inversely proportional to the said resistances. Expressing the proposition in another way, the load current among a number of direct-current generator armatures operated at constant equal internal e. m. f., will be directly proportional to the conductances of the said armatures. In a similar manner, if two alternators are driven at constant equal frequency and cophase e. m. f. on a common load, the law of their operation is that the drops in their armatures shall be equal, leaving their terminal pressures equal. Since the reactance of the armatures is always much greater than the resistance, the armature resistances have relatively little influence upon the drop, and the armature reactances exercise the controlling influence. Consequently, if the two machines have equal synchronous reactance, they will divide the load equally, and if the reactances differ, the load current will be approximately inversely proportional to the respective reactances. Expressing the proposition in another way, when a number of alternators are driven with constant equal frequency and cophase e. m. f. on the same load, as when a number of alternator armatures are rigidly coupled on the same shaft, the load currents in the various armatures will be approximately directly proportional to the armature synchronous susceptances. If the direct-current machines are not driven at equal speeds and e. m. f.'s, but one of them is varied with respect to the others, the share of load increases with the e. m. f. until, when the terminal e. m. f. of the leading generator is equal to the internal e. m. f. of the neighboring machines, all the load is carried by that generator. Since the fundamental law of the engine governor is that as the speed increases the steam power diminishes, the regulation of the multiple-unit system becomes stable provided that the percentage speed regulation limits of each engine shall be less than the percentage of e. m. f. drop in each armature. If, however, the governors are liable to hunt under load, each engine may in turn carry all the load periodically and leave the others idle.

With alternators driven in parallel, without any assumption as to equal and constant speed, whichever engine accelerates will carry an undue share of the load, both by reason of the higher induced e. m. f., and of the advance in the phase of that e. m. f. This will tend automatically to retard the speed and the governor will also tend to reduce the steam supply. Assuming that the governor is dead-beat in its movements, a certain interval of time must elapse between the accidental acceleration of the engine and the reduction of its supply of steam power by the action of the governor. This lag in reactive force combined with the inertia of the moving mechanism is equivalent to the production of a pendulum of such nature that any accidental disturbance of the speed of the engine, such as might accompany a sudden variation of load, would give rise to a succession of periodic variations in speeds alternately above and below the speed of uniform governing. If the electric circuit of the alternator, by reason of its apparent inductance and capacity, happens to have the same natural periodic time as that of the equivalent pendulum formed by the engine and governor, the conditions of operation will be unstable and resonance will occur between the mechanical pendulum on the one hand and the electrical pendulum on the other. In such a case there may be cumulative oscillation and surging of the alternator or alternators with dead-beat governors. If, however, the governors are not dead-beat, that is to say, if a retardation in speed of the engine will cause the governor to move beyond the restoration point and pass to the accelerative side, then the power delivered to the engine may become periodic, and if the period of steam fluctuation is approximately coincident with the period of the moving parts considered as a pendulum, violent cumulative surgings may be looked for even if there is no electric periodic storage of energy.

In either case, therefore, the necessity exists of preventing the coincidence of the period of the moving parts of the engine mechanism with the period of the electric circuit, on the one hand, or with the period of the governor on the other. Mr. Emmet has undoubtedly hit upon the general solution of the latter problem, by producing a dash-pot connected with the governor in such a manner, that while the governor is capable of responding to slow and steadily prolonged retardation or acceleration, it is practically incapable of responding to swift and sudden variations in speed. This virutally means that the governor period is artificially rendered much longer than the natural period of oscillation of the moving parts of the engine considered as a pendulum. This is, perhaps, also the reason why Mr. Emmet finds it better to dispense with heavy flywheels, because heavy flywheels increase the inertia of the moving parts of the engine as a whole, and tend to make the natural period of oscillation of the moving parts greater, or their vibration slower. This would call for a still lower period of vibration in the engine governor, and a still further automatic locking of its parts, than if the engine were provided with less inertia, and a smaller flywheel.

Electric Omnibusses for New York City.

Mr. Henry Sanderson, president of the New York Electric Vehicle Transportation Company, which will operate the new stages, says: "Within four weeks our company will, it is expected, have eight electric stages in service in Fifth Avenue, running between Bleecker and Eighty-eighth streets. The present horse stages will be withdrawn. We expected to have the new stages for use before this time, but there has been delay in their construction. One of the smaller electric stages is completed, and the seven others like it contracted for will be ready within four weeks.

"These stages will accommodate 12 persons inside and 5 passengers on top, in addition to the driver. We are also having two large 'double-deckers' built, which will have seating capacity for 34 persons. We have had two electric stages running in Fifth Avenue between Eighty-eighth Street and 135th Street since Jan. 1. As the business develops we shall increase the number of stages on that part of the route.

"We are making trial trips with one of the smaller stages for the purpose of making up a time schedule, and expect to cut down the present horse schedule nearly one-half."

The new electric stage already completed is a great improvement over the antiquated horse stage. It is much wider than the old vehicle. The roof is high enough to permit a tall man to stand erect.

The body of the vehicle is painted a dark olive, while the running work is yellow, striped with black. The driver wears a dark blue uniform with brass buttons and the customary automobile cap. The vehicle was used successfully in the automobile ride given to the ladies of the American Street Railway at the time of the recent convention.

Electrical Engineers of the Day—XVIII.

R. N. Baylis.

Electrical engineering being the youngest of the engineering professions, it is natural that it should have been taken up by many whose original interests and training were in the older branches of mechanical and civil engineering. Among the well known electrical engineers whose career is an example of this kind of experience and capacity, is Mr. Robert Nelson Baylis, who has combined to a marked extent in his work both the mechanical and electrical branches of the profession. Mr. Baylis was born on March 16, 1867, at Englewood, N. J., where he received his early education at private schools preparatory to entering Stevens' Institute, from which he graduated with the degree of M. E. in 1887.

After leaving college, Mr. Baylis entered the shops of the Southwark Foundry & Machine Company, in Philadelphia, as an apprentice. Here he went through all the drudgery and hard work of a machinist's helper, acquiring a thorough knowledge of the practical machine shop work. Many men who go into the machine shop as apprentices for the purpose of learning the practical work, become disgusted after a short time, or, at all events, do not get the full benefit of the experience, from the fact that the natural tendency of foremen and others is to keep them at one kind of work. This very often is the fault of the apprentice himself, who is frquently lacking in either the ability or the energy rapidly to graduate from one branch to another. Mr. Baylis exhibited both of these qualities to such a degree that in something like a year he had advanced from the lowest work through the various grades of hand chipping and bench work to the handling of the large and important machine tools.

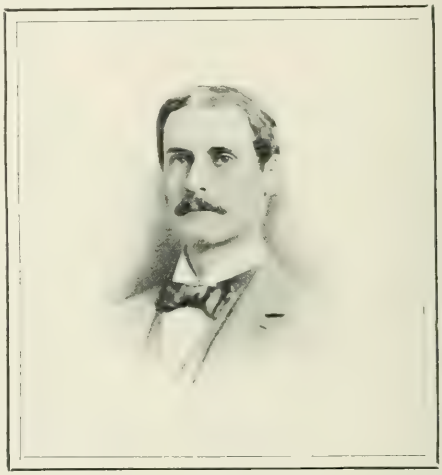
In January, 1890, Mr. Baylis left Philadelphia to take a position as draughtsman and engineer with the C & C Electric Motor Company, of New York. His first work was naturally in the line of handling the mechanical design of the electrical machinery of that company, and the effect of his sound mechanical training and judgment became at once apparent in the larger sizes of motors and dynamos brought out by this company at that time. From this time onward Mr. Baylis gave his chief attention to electrical work, and finally became chief engineer and factory manager of the C & C Company.

It was at this time that he devised the ingenious "reaction" brush holder which was such a radical departure from all previous devices of the kind, that when it was first introduced it aroused endless arguments as to whether the carbon could possibly remain in the holder when the machine was in motion. Mr. Baylis introduced numerous improvements into the factory methods and management of his company.

In the spring of 1893 Mr. Baylis left the C & C Company, going to Chicago, where he remained until the following winter, making a thorough study of the engineering work at the World's Fair. During this time he was associated with the late Charles E. Emery and others in the elaborate tests that were made of the intramural power station.

Having devoted a great deal of attention to street railway work, which at that time was increasing enormously, Mr. Baylis was requested by the Walker Company to examine some of its plants with a view to improving the equipment. Later he took charge of the Walker Company's exhibit at the Atlanta Fair, at the conclusion of which he went to Cleveland, becoming shortly afterward chief electrical engineer of the Walker Company.

At this time the great extension of electrical railway systems all over the country had brought about a great demand for electric railway apparatus of all kinds, including power generators of much greater capacity than had heretofore been used in this class of work. So rapid had been the advance in the electric railway field that engineers and designers had not had time thoroughly to investigate all the practical requirements of railway service, and many designers did



not realize the arduous requirement of such service. The natural result was that in getting this experience many mistakes were made in design and construction of apparatus with consequent breakdowns and interruption of service. In many cases generators constructed on the same lines as had been found successful for electric lighting work, were used in railway service and were found to be entirely inadequate to meet the conditions. Mr. Baylis' first step after taking charge of the electrical design for the Walker Company was to make a thorough investigation of the actual conditions of operation of the electric railways all over the country, and by personal inspection to determine the practical requirements of the service. Having satisfied himself on these points he proceeded to design railway generators on a much more liberal scale than had been heretofore practiced, and the extremely heavy and substantial railway generators, for which the Walker Company was noted, were largely the result.

Mr. Baylis remained with the Walker Company until the spring of 1897, when he resigned his position and returned to New York. He did not, however, sever his connection entirely, but acted for the company as technical expert in many of the patent suits in which it became involved.

In 1898 Mr. Baylis formed with his brother the firm known as The Baylis Company, for the purpose of carrying on a general engineering and contract business. Finding that there was a large demand from motor builders and users for the Baylis reaction brush holder, The Baylis Company went into the manufacture of these holders, and have since then branched out into the manufacture of various other mechanical devices and specialties.

Mr. Baylis is a member of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, being a member of the Board of Examiners of the latter.

Electric Power Distribution in a U. S. Navy Yard.

THE construction department of the Brooklyn Navy Yard has recently been engaged in changing the motive power in its shops from steam to electric motor drives, in most cases applying the well-known method of equipping each tool or group of tools with its own electric motor, and thereby eliminating the line shafting. The results have been gratifying and the department is so well pleased that it is contemplating further applications of electric motors. The character of the equipment and the results obtained certainly justify this attitude, and a discussion of them forms the subject of what follows.

The most extensive portion of this installation comprises a large carpenter shop, which is equipped with Thresher motors, and it is ultimately intended to supply the same with power from two 200-kw Thresher generators direct connected to McIntosh & Seymour engines. In the further extensions which are contemplated, motors which are near the distributing center will be supplied with power at 110 volts, while distant motors will receive their power at 220 volts. The carpenter shop comprises the following equipment, which is listed in detail herewith because it is believed that the powers of the motors found to be satisfactory in operating the various devices will be of interest. Two band saws, 15 horse-power each; one jig saw, 2 horse-power; one emery wheel, 2 horse-power; one plug cutter, 5 horse-power; one circular saw, 5 horse-power; one circular saw, 15 horse-power; one band saw, 15 horse-power; shafting carrying several grindstones, 5 horse-power; one log shifter, 25 horse-power; 1 surface planer, 5 horse-power; one surface planer, 15 horse-power; one surface planer, 20 horse-power; one surface planer, 25 horse-power; one four-sided planer, 50 horse-power; one large log saw, 100 horse-power.

This plant has displaced about 210 ft. of jack shafting and a quarter-turn mule, together with a 12 by 12 engine and boiler equipment. Beside doing away with the maintenance and the annoyance of these devices, the comparative coal economy, figuring electric power on the basis of 5 lbs. of coal per horse-power-hour, is 4.3 to 12. That is to say, the plant is now operated on about one-third the coal that was previously used.

Besides this, a comparison of labor accounts shows a still further saving.

The former equipment comprised the following daily items: Engineer, $3.12; fireman, $2.48; oiler, $2, or a total daily charge of $7.60. This service is replaced by services of an electrical inspector who devotes a small portion of his time to examination and keeping up the motor equipment, which is figured in at about $1 per day, thus representing a daily saving on labor account of $6.60.

The accompanying illustrations show typical motors used in the installation and their methods of control. In Fig. 2 is shown a 100-hp motor, which operates a large circular saw. Its speed is 600 r. p. m., and it is a good representation of what is called the "open" type of motor in the test tables which appear beyond. This motor is placed on the lower floor of the carpenter shop and belted upward, as shown in the cut. It is started and controlled from the second story, where the large log saw is located. Fig. 3 illustrates the controller board, which is one of the Cutler-Hammer multi-switch type. That is to

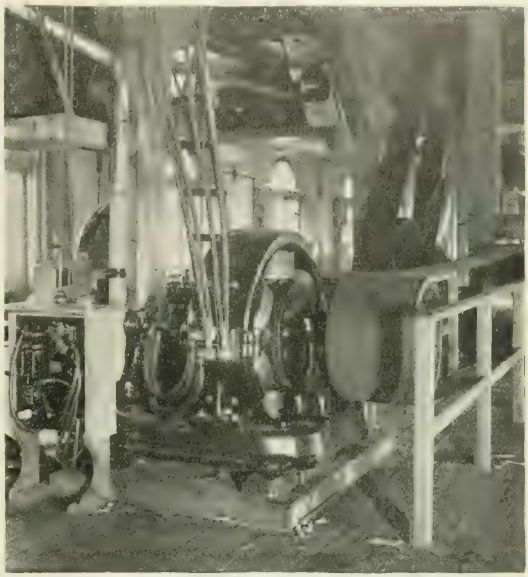


Fig. 2.—100-hp motor on saw, 600 r. p. m.

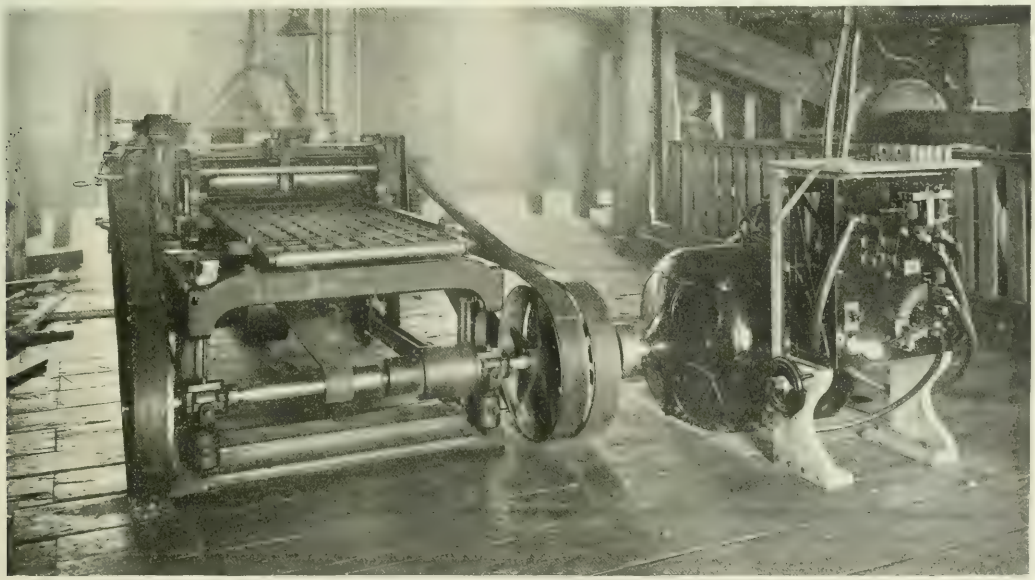


Fig. 1.—Planer Driven by 20-hp Motor, 550 to 800 r. p. m.

say, the rheostat points instead of being arranged to switch in with a lever in the customary way, are manipulated by a succession of switches which appear in the middle of the board. The first switch gives the motor full field, and closes the armature circuit through all the resistance, and the succeeding switches cut the resistance out point by point. A system of latches is provided so that it is impossible to throw one switch until its predecessor is closed, unless by deliberate intent. A low-voltage release magnet controls the first switch, and if that switch is thrown open, it unlocks and releases all others, thereby stopping the motor. At the top of the board is a time-limit circuit breaker, which deserves mention.

The main contacts are made through a laminated spring jaw pressing upon two rectangular blocks set in the surface of the board. The auxiliary contacts which take the arc are heavy carbon blocks set between magnetic poles which effectively extinguish the arc. The circuit breaker opens quite widely, thereby making the arc very attenuated, and the strong magnetic field cutting across it renders its rupture certain. The auxiliary contacts are shielded from the main contacts by appropriate plates of insulating material. The latch of the breaker has a roller contact, which acts on the time limit principle. The tripping coil has quite a number of turns and does not carry the full series current, but only a portion that is deflected around the shunt. The time element, therefore, enters on account of the period that must elapse before the temperature of the shunt rises and increases its resistance sufficiently to put a potential difference on the tripping coil adequate to actuate it. The lower switch, which cuts off everything, is also interesting inasmuch as it exhibits a departure from the ordinary jack-knife plan, and favors the laminated contact method, the laminations being held in place by a latch which is tripped by a slight pull on the handle which also serves to close the switch.

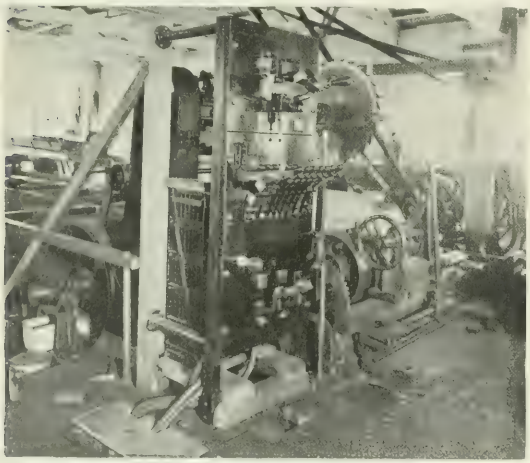


FIG. 3.—CONTROLLER PANEL.

Referring to these illustrations, it is only just to say that the construction department is contemplating building a new carpenter shop, and hence the wiring has been executed in a temporary manner, which though thorough is not representative of its customary methods of installation.

Fig. 4 shows an enclosed motor directly connected to a band saw, and, in fact, wherever possible the motor is directly connected to the tool without the medium of belts or gears. This motor is enclosed in every sense of the word, this feature being carried to such a degree that the doors over the commutator and other parts of the motor are rubber gasketed and held in place by screw pressure. If the bearings were provided with stuffing boxes, the motor could be immersed in water without injury. This complete enclosure of the motor makes it somewhat larger for its capacity than would otherwise be the case, because the machine must get rid of its heat entirely by conduction through its casing, and has no ventilation whatever. The temperature figures, as will be noted in the table beyond, are, however, exceedingly low and compare very favorably with the open type of motor, and for the enclosed type employed are quite remarkable. This complete enclosure is believed to be necessary because the carpentry department is full of combustible dust and light, inflammable material, which it is specially desirable to keep from danger of ignition.

The small motors are all controlled by means of Cutler-Hammer controller boards of the type shown in Fig. 5, which incidentally shows the motor connected to a horizontal planer. This controller board consists of a switch, a circuit breaker and starting box, with low voltage release conveniently and neatly mounted on slate board. The 50-hp planer, however, is an exception to the usual shop arrangement. Two 25-hp motors are used, either of which alone drives the planer on light work, and they are connected in series or parallel by an automatic switchboard of a somewhat unusual type.

This board, which was designed by Mr. Frank P. Lewis, master electrician of the construction department, acts on a relay system. The master controller resembles a small starting box, and supplies current to the solenoid bobbins shown on the board above. The first step of the controller closes only the lower solenoid, giving both motors full field. The next connects the motors in series by means of two of the upper switches and gives voltage to the armature with all

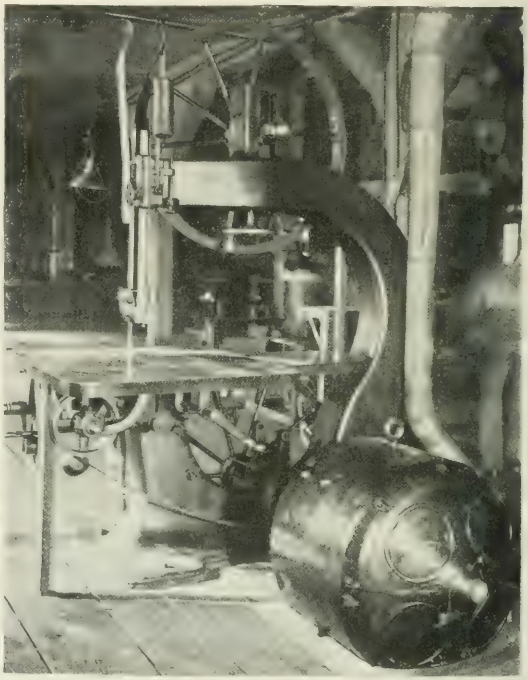


FIG. 4.—BAND SAW, 15-HP MOTOR.

the resistance in circuit. On the next two steps the two other lower bobbins act, cutting out the resistance in two successive steps; still another bobbin at the next step cuts a resistance in series with the shunt field, thereby weakening it and increasing the speed of the motors. The next step connects the motors in parallel and opens all of the lower switches except the main switch and thereby restores all resistance to the line, and strengthens the field, and successive steps repeat the operations that have been described on the series notches. It will be noted that the switches making a change from series to parallel are mechanically as well as electrically connected so that the closing of one set necessitates that the other shall be open and eliminates possible sticking and therefore avoids short circuit that would occur if both sets should be closed together. As these two motors are powerful and the circuits feeding them correspondingly large, this is quite a necessary precaution, and has proven very effective.

The following table gives test data of most of the motors used in the installation. The first division is devoted to manufacturer's specifications. The second to the test on the motor under various working loads, while the last columns give the data resulting from an overload

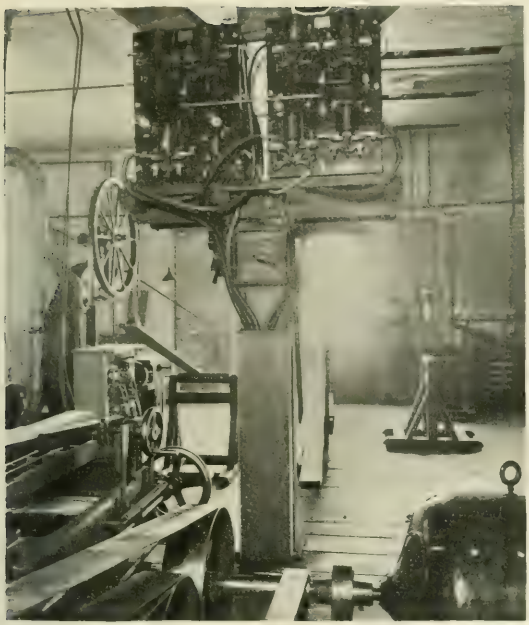


FIG. 5.—25-HP MOTOR CONTROLLER BOARD

test. The speeds with the motor hot and cold exhibit notably small differences, which are in part accounted for by temperature figures given beyond.

Commenting on resistance figures it may be noted that the resistance measured by the resistance method. This is accounted for by the fact that thermometer tests were simply temperature tests of the air on the interior of the shell, while resistance tests gave the internal temperature of the coils, which was, of course, considerably higher. These tests, it is stated, are quite reliable in this respect, as they were made by one set of engineers and checked independently by another with exceedingly slight differences. Sufficient data are given in the tance as measured by the thermometer differs quite widely from that tables to enable the designer to figure out most of the important properties of the entire motor, and as far as the enclosed motors are concerned, they represent a series which can be profitably compared, and which are interesting in view of the excellent results that have been obtained.

It is gratifying to note that even in the Navy electric motors are beginning to supersede small steam engines, both afloat and ashore, and the conveniences and economies of the installation which has just been described has rendered the replacement of wasteful steam auxiliaries still more certain. The figures of steam consumption of auxiliary shipboard engines are very formidable; 140 to 150 lbs. of water per horse-power-hour are not uncommon figures for pumps and hoists, as has been repeatedly found by engineering tests on shipboard. Besides this disconcerting consideration it must also be remembered that this condensed water goes overboard, a fact which is almost as serious as the extravagance in consumption just quoted. The present example, though one ashore, constitutes another most practical argument in favor of complete electric auxiliary power service.

Electric Roads in Berlin.

A special cable dispatch notes that it is characteristic of the Kaiser to surprise his subjects by unexpectedly taking the initiative in some matter of public importance. The outcome of the conference of Herr Kirschener, the Burgomaster, and Herr Hoffmann, the City Architect, with his Majesty at Hubertusstock shows that the Kaiser is first in the scheme of beautifying Berlin. Both these gentlemen had, on the invitation of the Emperor, gone to Hubertusstock, where they were treated right royally by his Majesty, who sent his own carriage to meet them at the railway sation and afterward regaled them with a choice dinner.

Having put his guests at their ease the Emperor entered upon the discussion of Berlin's burning questions. The project of running trams in Unter den Linden found the Kaiser unaltered in his objections. The Emperor's decision was based upon feelings of personal responsibility for the safety of the public. His Majesty pointed out that traffic is congested in that thoroughfare. The introduction of electric trams would multiply accidents. If, therefore, he gave his consent to the project he would feel responsible for every accident that occurred there.

"The best way to obviate the difficulty," urged the Emperor, "is to run the trams under ground, the passengers being taken up and down to the carriages by means of lifts, as in London.

"There they have been found to be absolutely practicable. German engineers could certainly be found to overcome any difficulties in the way of carrying out this plan."

SPECIFICATIONS / LOAD TESTS

H.P.	R.P.M.	Efficiency ½	Efficiency ¾	Efficiency Full	Type	Poles	Brushes	Brushes per Holder	Brush Dimensions	Armature Diam.	Armature Slots	Armature Clear	Commutator Diam.	Commutator Length	Commutator Segments	R.P.M. ¼	R.P.M. ½	R.P.M. ¾	R.P.M. Full Hot	R.P.M. Full Cold	Has run	Volts	Amp.
5	1100	80	84	[illegible]	Encl	4	2	1	1 x 2	[illegible]	51	¼	[illegible]	2½	51	915			[illegible]	815	8	11	[illegible]
10	450	80	8[illegible]	85	Encl	4	2	2	¾ x 2	14	51	¼	12	6	51	452	452	450	453	440	[illegible]	11	[illegible]
15	400	81	84	86	Encl	4	2	2	2 x 1	16	51	¼	12	[illegible]	51	...	[illegible]		468	[illegible]	[illegible]	11	112
20	800	83	85	87	Encl	4	4	3	3 x 1½	16½	140	¼	10	[illegible]	14	802	800	...	810	[illegible]	8	11	140
25	800	82	86	88	Encl	4	4	[illegible]	1½ x 2½	16	120	¼	10	6¾	12	804	802	800	800	800	8	11	180
100	600	86	[illegible]	[illegible]	Open	[illegible]	6	4	1 2½ x 1½ / 1 2¾ x 1½	23	134	¼	20	10	154	[illegible]	[illegible]	...	512	488	[illegible]	11	717

LOAD TESTS

Average R.P.M.	Resistance Cold Arm.	Resistance Cold Field	Resistance Hot Arm.	Resistance Hot Field	Temperature Rise Resistance Arm.	Temperature Rise Resistance Field	Temperature Rise Thermometer Arm	Temperature Rise Thermometer Field	Efficiencies ¼	Efficiencies ½	Efficiencies ¾	Efficiencies Full	Has run	Volts	Amp	R.P.M.	Resistance Hot Arm.	Resistance Hot Field	Temperature Resist. Method Arm.	Temperature Resist. Method Field	Temperature Thermometer Arm	Temperature Thermometer Field
915	.0673	137.5	.0754	157.1	28	33	63	46	..	....	..	89	2	110	46	[illegible]	.0777	157.1	35	33	0[illegible]	70
450	.0369	70.9	....	81.4	....	35.3	....	....	67	83.7	88.5	88.5	2	110	14	453	0441	81.4	46	35.3	42.7	4[illegible]
400	.024	42.8	.0259	51.2	21.8	47	54	40	74	86.8	89.5	2	2	110	150	400	.0244	51.1	37	47	0	42
800	.0293	45.8	...	....	...	....	....	...	..	...	88.4	91.3	2	110	170	800	.0337	...	38	..	[illegible]	1
800	.0160	41.9	.0225	15.8	36	20.6	48.8	51	70.6	84	91.3	2.2	2	110	221	800	.0232	15.8	42	20.6	[illegible]	[illegible]
500	.00907	21.5	.0107	24.4	27	32.2	51	42	.	...	..	2.4	2	110	1055	510	.01086	....	27		[illegible]	42

OVER-LOAD TESTS

The Rise of Electric Power Distribution.

By Alton D. Adams.

HUNDREDS of thousands of horse-power are daily distributed through motors by electrical supply systems in American cities. These motors are performing almost every class of work to which mechanical power is applied, from the grinding of coffee to the operation of elevators. The sizes of motor units also present a wide range from the trifling requirements of a jeweler's lathe to 100 or more horse-power in a large factory. Electric motors by their cleanliness, convenience, safety and low cost of operation have done much to stimulate the development of small manufactures in centers of population, and have thus created for themselves a part of the field they now occupy. In larger part, however, electric motors have displaced engines of the various types on the premises of small power users in cities, thus tending to concentrate steam plants at electric stations.

This introduction of a new motive power in tens of thousands of establishments, to the displacement of old and tried equipment has taken place during little more than a decade. Electrical supply systems in cities of the United States were at first established solely to furnish light, and the distribution of mechanical power from motors was, in most cases at least, merely an afterthought. As it grew evident that demands for power could be supplied from electrical systems, motors were connected to existing circuits and machinery, designed primarily for lighting purposes. At the beginning of motor service from electric stations, comparatively few systems for the distribution of alternating current were in operation, and no practicable motors for general use with such current were available. During some years after electric power distribution from central stations grew to be common, nearly all additions of alternating generators were of the single-phase variety. Consequently, when two and three-phase alternating motors were developed most of the existing electrical supply systems were unable to serve them, even if desired to do so by their customers.

As a result of these conditions, electric motor service from central stations was inaugurated with direct currents, and necessarily continued along this line during some years thereafter. Even when the equipment of some central stations with two and three-phase generators, and the development of practicable motors for use with such machines, made the distribution of electric power from alternating currents possible, a serious impediment remained to be overcome. Consumers of electrical energy for power purposes have invested, in the aggregate, great sums for direct-current motors, and such motors are useless for work on alternating service. Naturally, power users are in no hurry to accept a kind of electric service that will destroy the greater part of their investments in direct-current motors. A further fact that operates against the general use of alternating motors is their higher price, compared with that of the direct-current type.

Two classes of direct-current circuits existed at the time when electric motors began to be supplied from central stations. These circuits were the constant-current, variable pressure type for the operation of arc lamps in series, and the constant pressure, variable current type for the supply of incandescent lamps in multiple. The arc circuits when operating at full capacity usually had pressures of 1000 to 3000 volts, approximately, the lower voltage representing the requirements of about 20, and the higher voltage of about 60 open arc lamps. The pressure on any of these arc circuits when in operation might vary all the way from that necessary for a few lamps up to the full capacity. Amperes of current in these arc circuits were usually limited to about 6.5 or 10, according to the nominal candle-powers of the lamps in use.

Constant pressure circuits were limited by incandescent lamps to approximately 125 or 250 volts, according as the two or three-wire system of distribution was used. Amperes of current in these circuits might reach any desired figure.

Each of these two classes of circuits has its own peculiar advantages and disadvantages for the distribution of power through large numbers of motors.

The constant pressure systems usually operated within a radius of one mile of their central stations, because a rapidly increasing cost of conductors made much greater extensions at their low voltages impracticable. Constant-current circuits, on the other hand, were, to a large extent, independent of the limitations of distance, and readily supplied motors up to five or more miles from their stations. Within their limited radii of operation the quality of service rendered through motors by the constant-pressure incandescent systems was all that could be desired. Most kinds of work to which mechanical power is applied require a nearly constant speed, independent of momentary changes of the load. The nature of shunt-wound motors operating on constant-pressure circuits is to maintain nearly constant speeds for all loads within their capacities, automatically, and without the aid of any regulating mechanism. A practically unlimited ampere capacity in the constant-pressure system makes it possible to supply a motor of any desired horse-power. About 250 volts, the usual pressure of a three-wire system, is too low to offer any serious danger from personal contact with the current-carrying parts. This last fact is of great importance in general distribution of power from central stations, because motors must often be placed where accidental contacts with them are probable, and be operated by unskilled persons. Furthermore, the fire risk is smaller with the low-pressure system. To offset its one advantage as to radius of service, the arc circuits lack all the good qualities of their incandescent rivals. Motors supplied with constant current do not operate at a uniform speed of revolution, unless provided with some regulating mechanism external to the motor proper. Such mechanisms are sources of trouble, and do not yield as perfect results in speed regulation as are given automatically by shunt-wound motors on constant-pressure circuits. At most, each motor on an arc circuit can have only a small capacity, because of the limitations on the circuits themselves. Take for illustration, a circuit of 3000 volts maximum pressure and 10 amperes constant current, the largest commonly used for arc lighting. The entire power of this circuit, or $3000 \times 10 = 30{,}000$ watts, when expended in a motor of 90 per cent efficiency, yields only $(30{,}000 \div 746) \times .90 = 36$ horse-power on the shaft. But the pressure of 3000 volts at the terminals of this motor, when under full load, is entirely too high for personal safety in general use. Moreover, arc circuits are primarily intended for arc lamps, and all or even a large per cent of the capacity in any case cannot usually be given up to motors.

After an experience of several years with motors on arc and incandescent circuits had demonstrated their general utility, power generators and circuits designed especially for motor service, began to come into use. The aim in thus adding independent dynamos and circuits to existing systems was to secure the advantages of power distribution from incandescent circuits without their limitations as to the radius of operation. For this purpose power generators and their circuits were originally designed and have remained at about 500 volts constant pressure. This voltage is substantially twice that of the three-wire system with 110-volt lamps, and multiplies the practicable radius of operation in that system by four, since the distance to which electrical energy may be transmitted at a given rate, with a fixed weight of conductors, varies directly as the square of the voltage employed, for a constant per cent of loss.

After the introduction of independent generators, stationary motors continued to be supplied from arc and incandescent circuits in many cases, so that the development of electric power distribution has proceeded on three distinct lines. With the foregoing facts in mind, it is the intention here to point out the general movement in each of these lines, and the total result. For this purpose the records of the numbers of motors supplied from arc, incandescent and power generator circuits, and their total capacity, in each year, as compiled by the Board of Gas and Electric Light Commissioners of Massachusetts, since 1887, for each city and town, are employed.

Besides Boston, Massachusetts contains a large number of cities and towns, ranging in population from more than 100,000 downwards, that are well supplied with electrical distribution systems. It, therefore, seems desirable to show the development of electric power distribution in Boston separate from that of the State as a whole. In this way it is hoped to bring out any features of the service to stationary electric motors that are peculiar to great cities. The tables given are intended to include all motors operated by electrical supply systems, except a very few in places having municipal electric plants and fan motors. A glance at the figures for the number of arc motors in use at Boston and throughout the State shows that this class of service never reached more than trifling proportions, and has already lost what little importance it once had. It is worthy of note that arc motors were used in the greatest numbers just after power generators were introduced for stationary motor circuits, that is, about the year 1890. The conclusion is obvious that the 500-volt, constant-pressure circuits sucessfully invaded the territory formerly occupied exclusively by arc lines, because beyond the reach of incandescent service. The very few arc motors now in use because of some special conditions are certain to shortly disappear.

Inspection of the tables makes it clear that the great struggle for supremacy in the field of power distribution from lighting stations has been and is between the incandescent and the purely power circuits. In this contest the incandescent circuits have the advantage of an earlier occupany of the richest portions of territory, and of the support of the lighting business.

In 1887, the first year for which records are available, the number of motors supplied from the circuits of lighting stations throughout the State was only 176. Stationary motors operated from power circuits did not appear until 1889, and in that year there were 48 such machines in use. Meantime, the number of motors connected to all circuits had increased to 538, and the number on power circuits was 8.9 per cent of this total.

Numbers, types and horse-power of stationary motors supplied from electric lighting stations in Boston.

Year ending June 30.	Motors on arc circuits.	Motors on incandescent circuits.	Motors on power circuits.	Horse-power of all motors.
1887	31	80	....	298
1888	40	104	....	405
1889	90	239	....	704
1890	81	417	....	1,326
1891	83	684	....	2,304
1892	91	960	49	3,373
1893	..	....	....	3,831
1894	45	1565	105	5,233
1895	38	1732	334	6,046
1896	28	1591	780	7,092
1897	8	1734	831	8,794
1898	6	1946	1151	10,261
1899	5	2701	901	12,330
1900	5	2467	1042	14,959

Numbers, types and horse-power of stationary motors supplied from electric lighting stations in Massachusetts.

Year ending June 30.	Motors on arc circuits.	Motors on incandescent circuits.	Motors on power circuits.	Horse-power of all motors.
1887	31	145	....	422
1888	43	193	....	614
1889	111	379	48	1,422
1890	100	579	128	2,723
1891	173	851	195	5,250
1892	104	1294	376	5,485
1893	..	....	530	6,848
1894	142	2031	591	8,944
1895	69	2365	1067	10,924
1896	54	2293	1688	13,930
1897	29	2505	1928	16,318
1898	10	2775	2235	18,930
1899	6	3742	2171	22,740
1900	11	3735	2572	27,133

After 1889 the per cent of motors operated from power circuits rapidly increased up to the middle of 1898, when it stood at 44.6. During the year following this last named date the number of motors operated from power circuits declined to 36.6 per cent of the total, but rose to 40.7 per cent in the following year.

Per cent of all motors in Massachusetts on power circuits.

Year.	Per Cent.	Year.	Per Cent.
1889	8.9	1895	30.4
1890	15.8	1896	41.8
1891	16.0	1897	43.2
1892	21.2	1898	44.6
1893	....	1899	36.6
1894	21.4	1900	40.7

The corresponding per cent is given in the table for each year of the period except 1893. Some data for important stations is lacking for that year, and any conclusions drawn from the remainder would be misleading.

No motors on power circuits are recorded for Boston until 1892, when 4.4 per cent of the total number there were so operated. As was the case for the entire State, the proportion of motors operated from power circuits at Boston advanced rapidly up to 1898, standing at 37.1 per cent of the total for that year. From the middle of 1898 to the like date in 1899 the number of motors served from power circuits in Boston fell back to 24.95 per cent of the total, but rose to 29.6 per cent during the following year. The similar change noted for all the motors in the State during the same year can be traced mostly to Boston, for while the number of motors on incandescent lines in the entire State went up by 967, the number of similar motors at Boston increased 755. This marked change in the service of motors at Boston seems to have been due to arrangements connected with the erection of a new generating station for one of the companies there in the year named. For the year ending June 30, 1900, the number of motors served from incandescent circuits at Boston fell back by 234, while the same circuits lost only 7 motors in the entire State. The ability of the State outside of Boston to make up the loss in the number of motors on incandescent circuits in that city during the year last named is probably due to the increasing number of two and three-phase motors operated by alternating systems, as these motors are all reported under the head of incandescent.

Per cent of all motors in Boston on power circuits.

Year.	Per Cent.	Year.	Per Cent.
1892	4.4	1897	32.3
1893	....	1898	37.1
1894	6.1	1899	24.9
1895	15.0	1900	29.6
1896	32.1		

At the middle of 1887 the total capacity of motors connected to the circuits of electric lighting stations in Boston was 298 horse-power, and the like figures for the entire State were 422 horse-power. Boston at that time contained, therefore, 70.6 per cent of the capacity in motors operated from electric lighting stations in the entire State. The table gives the like per cent in each year from 1887 to 1900:

Per cent of capacity of motors operated from electric lighting stations in Boston to capacity of all such motors in the State.

Year ending June 30.	Per cent at Boston.	Year ending June 30.	Per cent at Boston.
1887	70.6	1894	58.5
1888	65.9	1895	55.3
1889	49.5	1896	50.9
1890	48.7	1897	53.3
1891	43.9	1898	54.2
1892	61.5	1899	54.3
1893	56.0	1900	51.1

The portion at Boston of total motor capacity for the State declined as stations in other cities began to supply electrical energy for power purposes, and was only 43.9 per cent in 1891. During the next fiscal year 500-volt power generators were introduced in the Boston motor field, as they had been at some other points in the State as early as 1889, and on June 30, 1892, that city contained 61.5 per cent of the total motor capacity connected to electric lighting stations in the State. This last figure is the highest ever reached for the relation of the motor load at Boston to that of all electric lighting stations, and since 1893 the load at Boston has been but little more than one-half the total. According to the census of 1900, the population of Massachusetts was 2,805,346, and of Boston 560,892. It thus appears that Boston had 20 per cent of the population of the State at the time that its electric lighting stations were operating 51.1 per cent of the stationary motor load. From this it follows that the capacity of such motors operated in Boston is $(51.1 \div .20) \div (48.9 \div .80) = 4.2$ times as great per unit of population as in the remainder of the State. As 76 per cent of the entire population of Massachusetts is in places of 8000 or more inhabitants each, the ratio above found serves to bring out the superiority of a very large city over smaller places as a field for the supply of power through electric motors.

The table shows a gradual and somewhat irregular increase in the average horse-power of all the motors connected to lighting stations throughout the State. In 1887 this average was only 2.4 horse-power, but the average for 1900 was 4.3 horse-power. Taking the five years from 1895 to 1900, their average was 3.9 horse-power. This increase

in the average size of electric motors is what might be expected, as they are applied to more important purposes with extending use.

Average horse-power of electric motors supplied from lighting stations.

Year ending June 30.	Average horse-power.	Year ending June 30.	Average horse-power.
1887	2.4	1894	3.2
1888	2.0	1895	3.1
1889	2.6	1896	3.4
1890	3.3	1897	3.7
1891	4.3	1898	4.5
1892	3.1	1899	3.6
1893	....	1900	4.3

In spite of the great capacity of electric motors connected to the circuits of lighting stations during the past few years, there are no indications that service of this sort has reached its maximum figures. On the contrary, every year except three since 1888 has shown a larger addition of motor capacity than the previous year, and the increase for 1900 was greater than that in any other year of the period.

Yearly increase of capacity in motors supplied with energy from lighting stations.

Year ending June 30.	Horse-power added during year.	Year ending June 30.	Horse-power added during year.
1888	102	1895	1980
1889	808	1896	3006
1890	1301	1897	2388
1891	2527	1898	2612
1892	235	1899	3810
1893	1363	1900	4393
1894	2096		

The fact that motors of 4393 horse-power capacity were added to the circuits of lighting stations during the last year is sufficient to show the importance of the movement.

In the three years from 1887 to 1890 the capacity of motors served from electric stations increased more than six times. For each year since 1890 the capacity of such motors has been computed as a per cent of their capacity in that year, as follows:

Year ending June 30.	Per Cent.	Year ending June 30.	Per Cent.
1890	100	1896	511
1891	192	1897	590
1892	201	1898	695
1893	251	1899	835
1894	328	1900	996
1895	401		

The total power increase during the ten years is 896 per cent of the capacity in 1890, or an average of 89.6 per cent yearly. For the year of 1900 the increase was 161 per cent of the power in 1890.

Electricity in Korea.

Mr. Horace N. Allen, United States Minister at Seoul, makes an interesting report of electrical developments in Korea. On Aug. 17, the Seoul Electric Company formally opened its electric lighting plant by turning on the power and illuminating the city by arc and incandescent lights. This lighting plant is run in connection with the electric street railway, the installation being of the polyphase system. The Seoul Electric Company is a Korean concern, but the builders and operators are American—Messrs. Collbran and Bostwick—who hold the plant on mortgage until all indebtedness is paid. This is not the first electric plant to be erected in Korea. In 1886, an Edison incandescent plant was installed in the palace, and was successfully operated until the boilers were worn out. In 1894, a new and complete plant was erected by the American electrician of the Korean Government, Thomas W. Power, but the advent of the Japan-China war prevented its use for more than a short experimental period.

A Means of Measurement of the Angle of Lag and the Power Factor with a Voltmeter.

By George T. Hanchett.

It sometimes happens that an electrical expert finds himself in a situation where it is exceedingly desirable to know the power factor on a certain circuit, and the only instrument at hand is an alternating-current voltmeter. This is usually the first alternating instrument that is acquired by the electrical engineer, and it is often the case that it is the only one that he happens to have with him at the time. In view of these circumstances, the writer believes that the method outlined in the following paragraphs will serve a useful purpose, and therefore be of interest.

It is well to state at the start that the method is not valuable unless the conditions are those of constant load and power factor, such as obtain in the case of a simple inductive resistance across a constant

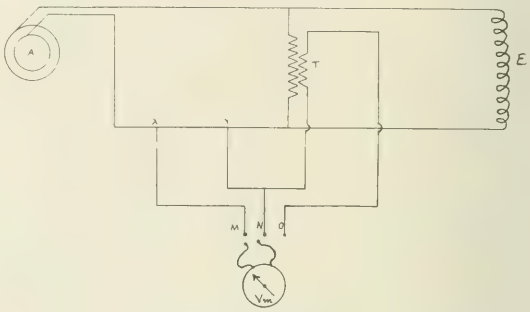
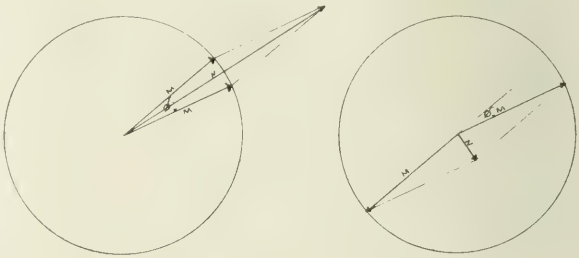


FIG. 1.—DIAGRAM OF CONNECTIONS.

potential, or in case of an induction motor driving a fan or other constant load. Three measurements and a short calculation are required, and some expediency in arranging the circuits for tests. A diagram of the connections of these are shown in Fig. 1, in which *A* is the alternator, *B* inductive load, *T* a potential transformer, which latter must be unloaded and may be of any convenient capacity. From the main circuit two leads, *X Y*, are brought out in shunt with a short non-inductive conductor of moderate resistance, such as would be furnished by a single straight piece of wire. Around the magnetic circuit of the transformer are wound a few turns of wire forming a low-voltage secondary. These turns may be of very small wire, and can consequently be threaded through a very small opening, and they require only nominal insulation. No. 26 B. & S. double cotton covered will answer nicely. If the coils of the transformer can be conveniently tapped it will answer to bring out leads, including a few turns of the secondary. It is necessary that the secondary turns, whatever the method used, be few so that the voltage obtained therefrom shall be low. The voltmeter should be a low-reading instru-



FIGS. 2 AND 3.

ment. Such an instrument is not commonly sold, but it is very easy to bring out the mechanism of the instrument to a separate binding post and insert a sufficient non-inductive resistance so that a few volts will give the entire scale deflection. This device the writer has found so exceedingly useful that he has been accustomed to equip all of his voltmeters in this simple manner.

The process is as follows: The voltmeter is applied to the terminals

of the transformer $X\ Y$, and the reading is noted. Call this reading M. By means of a switch the reading of the voltmeter is then transferred to the terminals $M\ N$, and the distance between points $X\ Y$ are adjusted until the same reading as that obtained on $N\ O$ is reached. If the circuits $M\ N$ and $O\ N$ be connected together in series, these two e. m. f.'s will be combined, and a voltmeter connected across the terminals of the combined circuit will indicate the resultant of the two e. m. f.'s. It is plain that if these two forces are connected in opposition and are in phase, the resultant will be zero, and if connected in conjunction the resultant will be 2 M. If, however, the current is either lagging or leading, the resultant will be of a different value due to the fact that the two e. m. f.'s are not in phase. It is convenient to call this resultant reading N. Fig. 2 shows the condition of things when the e. m. f.'s are added, and Fig. 3 the result when they are in opposition.

From the trigonometry of these diagrams, it can be at once deduced that the angle of lag equals

$$\frac{N^2}{2\,M^2} - 1 = \cos\phi;$$

or in the second case

$$1 - \frac{N^2}{2\,M^2} = \cos\phi.$$

ϕ is the angle of lag, and can at once be obtained by reference to appropriate tables, and cosine ϕ is, of course, the desired power factor. It would be preferable to connect the e. m. f.'s in conjunction rather than opposition, because the third measurement N will then be a much larger quantity, and will give a better reading on the voltmeter scale, for the indications of an alternating-current voltmeter around zero deflection are notably non-readable.

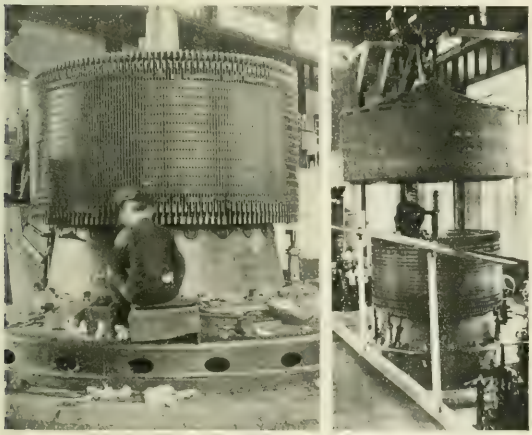
It is also plain that if the conditions are at all fluctuating, the three measurements must be made as nearly simultaneously as possible, and for that reason it is convenient to arrange a switch in order that the voltmeter may be rapidly thrown from circuit to circuit.

The number of turns on the secondary of the transformer should be chosen so as to give an e. m. f. of practically one-half of the entire scale reading of the instrument, for if a larger figure is used, the value of N may be so great as to cause the reading to exceed the range of the instrument. It is plain that this method is to be recommended more for its expediency than its convenience. It is, however, theoretically correct and practically usable under certain conditions.

The Re-winding of a 5,000 H. P. Armature.

By Arthur B. Weeks.

Fig. 1 shows a 5000-hp armature at the power house of the Niagara Falls Power Company, which was recently re-wound in five days,



Figs. 1 and 2.—Rewinding a Niagara Power Armature.

breaking all previous records. All the conductors are shown in place, extending vertically from several inches beyond the armature core, top and bottom. Tapered wooden pieces are secured between the conductors next to the core, to strengthen the bars at that point. The small openings in the core are air ducts. Hard rubber caps are fitted to the lower end of the copper bars. The top of the tapered armature shaft is shown in Fig. 1, as well as in Fig. 2.

In Fig. 2 the field ring is about to be lowered into place. The man standing on the armature sees that the proper clearance is obtained, before the field ring is lowered, by means of a 50-ton electric crane.

A force of ten men was required, working day and night (a double shift of ten men each), to complete the re-winding of this gigantic armature. To heat the soldering irons, of which a great number were used, a very ingenious method was employed. A small motor was belted to a blacksmith's forge, in which charcoal was burned—a great improvement over the former method of using gasoline soldering pots.

In recognition of the services rendered by the men employed on the re-winding, Mr. Paul M. Lincoln, electrical engineer of the company, tendered them a dinner at a local hotel, and divided among them the additional bonus of $50 above their regular wages.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.—VI.

By Walter Reichel.
(Chief Engineer Siemens & Halske Company.)

TESTING.

The motor installation was first tested by subjecting the primary winding to 4000 volts. The motors were then run without load under voltages from 1850 to 2000. The efficiency test with the ordinary friction brake presented some difficulty on account of the high output and high speed. Only 100 horse-power could be handled continuously, owing to violent oscillations of the brake lever, but for short periods this could be increased to 260 horse-power.

For larger outputs the method might be employed of belting the motor to a generator, the current from the latter being dissipated in resistances. Even in this case, however, difficulties would arise from the high speed of the motor as well as trouble from the journals, owing to the pull of the belt. The most suitable method is that of Kapp, in which two motors with pulleys different in diameter are connected in opposition to each other, one of the machines being run beyond synchronism as a generator, and the other below synchronism as a motor. To reduce the lateral pull the pulleys were made as large as possible, and, on account of the large circumferential velocity, they were of cast steel.

In the final experiments motors were tested up to 200 horse-power. On June 21 a test was made in which a motor worked at this load in connection with the regular car equipment, consisting of the transformers, rheostats, etc. Current for this test was taken from a 600-kw, 1300-volt, direct-connected, three-phase generator. During the time the friction brake was applied it was found that the lubrication

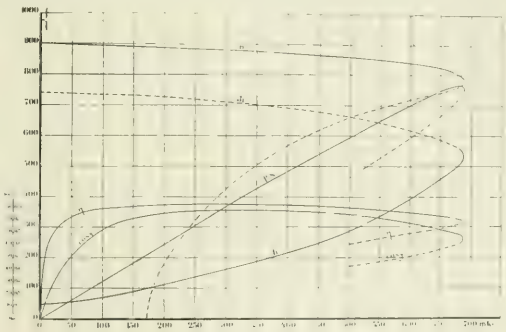


Fig. 33.—Curves of 1150-volt Motor.
Horse Power, P. S.; Rev. per min., n.; Primary current, J.

of the motor bearings was very good. The data taken of the total and magnetizing current, cos ϕ and efficiency were in good conformity with the calculated values as represented by the curves in Fig. 33, for 1150 volts, and in Fig. 34 for 850 volts, and also in the

circle diagrams of Figs. 35 and 36 for 1150 and 1850 volts, respectively. In constructing these latter diagrams the short-circuit current was

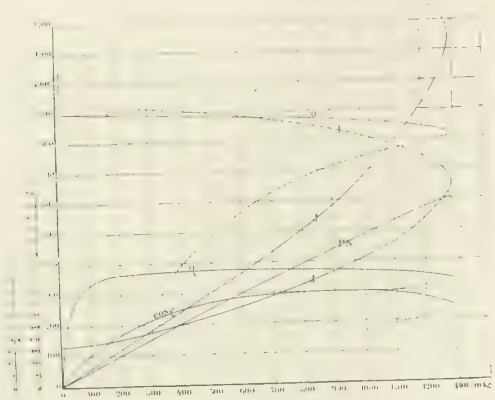


FIG. 34.—CURVES OF 1850-VOLT MOTOR.

Horse Power, P. S.; Rev. per min., n.; Primary Current, J1; Secondary Current, J2.

given a low value as well as cos ø and the efficiency, in order to be on the safe side.

The use of four motors on a car gives a great reserve of power, as three motors and even two would undoubtedly be sufficient for a 96-

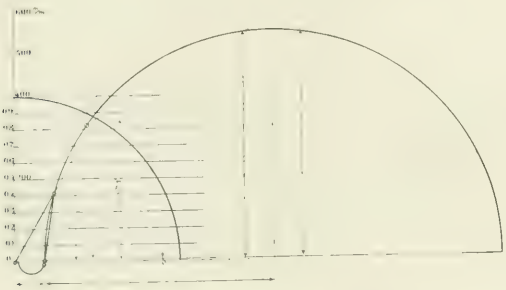


FIG. 35.—CIRCLE DIAGRAM OF 1150-VOLT MOTOR.

ton car, as may be seen from the diagrams. The special and symmetrical arrangement of the motor equipment will allow a reduction from 96 to 74 tons if the present cars should prove to be too heavy for the trial roadbed. By thus reducing to two motors, only one

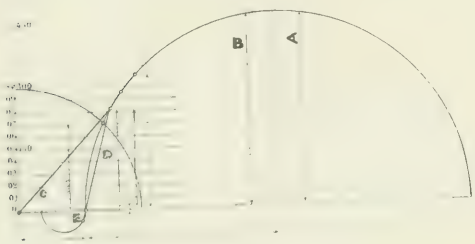


FIG. 36.—CIRCLE DIAGRAM OF 1850-VOLT MOTOR.

A, max. torque; B, working current; C, primary current; D, secondary current; E, magnetizing current.

transformer, two sets of resistances, two rheostats and one set of low-tension apparatus will be required, all of which apparatus can be placed at one end of the car and the motors at the other end, so as to give an approximately even distribution of tractional weight, which would amount to about 13.8 tons for the motor axles and 11.6 for the

96-TON CAR.

Motor	Connections	Total Power of Motors			Torque			Secondary Current			Acceleration		
		Start	End	Mean	Start	End	Mean	Start	End	Mean	Constant	Time	Distance
		kg	kg	kg	mkg	mkg	mkg	amp	amp	amp	m/sec²	sec	m
4	Star..	384	5140	4250	600	780	665	305	490	400	0.382	150	4260
4	Delta	[illegible]	3200	2480	310	500	390	300	530	400	0.214	270	7700
3	Star..	2700	3800	3140	560	790	645	340	500	390	0.200	220	6250
3	Delta	1500	2700	1940	315	560	405	290	550	390	0.138	410	11800
2	Star..	1540	2720	2000	490	850	625	300	540	385	0.140	405	11400
74-TON CAR.													
2	Star..	1540	2720	2000	490	850	625	300	540	385	0.184	310	9100

other axles. It is true that two motors would be somewhat heavily loaded, but they are capable of carrying the additional load and have a sufficient margin of torque.

The data for starting at full weight and at only 74 tons of car weight are given in the accompanying table, from which the curves of Figs. 37 and 38 have been plotted, the former referring to four and the latter to two, motors. The calculations are made on the supposi-

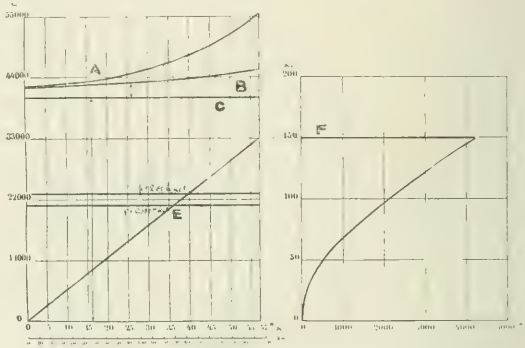


FIG. 37.—STARTING DIAGRAM.

A, available torque; B, air and traction resistance; C, traction resistance; E, accelerating time; F, total distance run.

tion that part of the torque of the motors is used to overcome the train resistance of the track and the air resistance, the rest serving to accelerate the car. From the acceleration power the acceleration constant is determined, and from this the time of acceleration to the final speed. The acceleration power is taken as constant, the torque to be developed by the motor being increased in accordance with the increasing train and air resistance. In the assumed case the initial

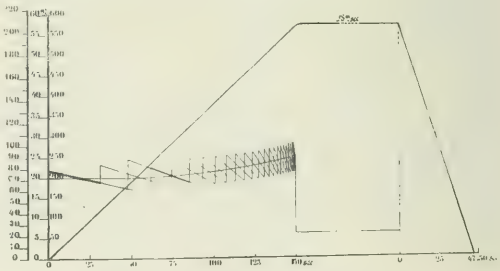


FIG. 38.—RUNNING CURVE ON LEVEL WITH FOUR MOTORS, STARTING WITH 1850 VOLTS AND RUNNING WITH 1150 VOLTS.

torque of the four motors is 3840 kilograms and the constant accelerating power 3870 kilograms. The acceleration then for 96 tons will

be .382 meters per second per second, and the time of acceleration to attain 57 meters per second per second will be 150 seconds, consequently the acceleration distance will be 4260 meters.

Figs. 39 and 40 refer to braking retardation, Fig. 39 applying to mechanical brakes, and Fig. 40 to electric brakes. The brake retarda-

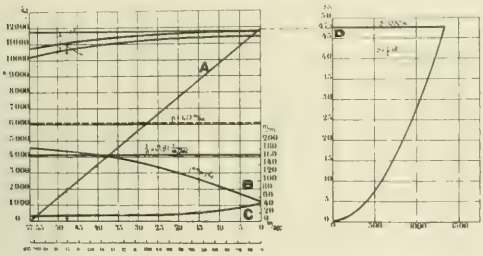


FIG. 39.—MECHANICAL BRAKING DIAGRAM.

A, time of braking; B, brake pressure in per cent of car weight; C, curve of Weichart formula; D, total braking distance.

tion is assisted by the gradually decreasing train and air resistances. It is assumed that the braking power is increased inversely with the decreasing resistance so that the actual retardation may remain constant. The retardation is thus represented by a straight line. Fig. 39 also indicates the amount of power on the mechanical brake shoes, which also depends on the available coefficient of friction between the shoes and steel tires for varying speeds, Weichart formula being used.

Owing to the heat that will appear at the brake shoes it is necessary to reduce the ideal retardation of 1.23 meters per second assumed in laying down the curves, or assist the retardation

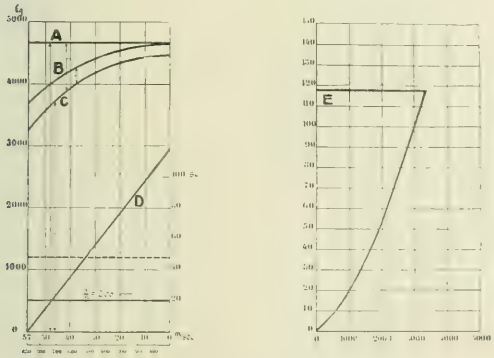


FIG. 40.—ELECTRICAL BRAKING DIAGRAM.

A, air and tractor resistance; B, traction resistance; C, electric brake pressure; D, time of braking; E, total braking distance.

by means of electric brakes. The conditions under which the curves were plotted were selected, however, in order to represent the most favorable case of braking, and for the reason that retardations of 1.1 meters per second per second are not infrequent.

In electric braking (Fig. 40), the primary winding of the motor is supplied with direct current at 26 volts, and as its resistance is .19 ohm, the corresponding current is 140 amperes. This will produce three-phase currents of 770 volts in the secondary, which are dissipated in resistances. The motor thus brakes by acting as a generator. The effect, of course, is not the same as in the case of a mechanical brake, as the braking effort is applied on only four axles. As the number of revolutions decrease the motor torque is increased by cutting out resistances from the secondary. When all the resistances are cut out, the torque of the motor quickly decreases and the electric brakes must be assisted by the mechanical brakes.

Elements of Illumination—XXXIII.

By Dr. Louis Bell.

In general terms, two incandescent lamps of the same candle-power at some particular voltage will not remain equal if the voltage be changed. On the other hand, for small variations of voltage the difference will generally be so small as to be within the ordinary errors of observation, and, in fact, practically negligible. Fig. 1 shows the curves of variation of candle-power with voltage in three typical lamps of differing efficiencies. All three show an approxima-

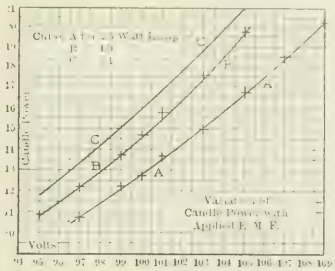


FIG. 1.—CANDLE-POWER CURVES.

tion to the common rough-and-ready rule of a variation of one candle-power per volt. Of course, the slope of the curves is the important consideration, and this generally decreases slightly with the efficiency of the lamp.

A brief examination discloses the relations between the curves. Suppose the working standard to be a lamp of moderate efficiency, say, 4 watts per candle, as shown in Curve B. Assuming the working voltage as 100, a rise of one volt or a fall of one volt increases or diminshes the light by as nearly as possible 85 candle-power. If the lamp under comparison corresponds to Curve A the increment or decrement is not far from .75 candle-power per volt, while with the lamp of Curve C the change is a little over .9 candle-power per volt. These three lamps represent about as large differences as will generally be found, and it is therefore safe to say that for variations of less than one volt on either side of the normal the differences in candle-power as between the lamps tested will be less than 0.1 candle-power, and for practical commercial testing may be neglected. But a difference of four or five volts would obviously lead to variations of a considerable fraction of a candle-power which would evidently be quite inadmissible.

The single-circuit method then must be used with caution, but when so used is generally quite as good as the two-circuit method, unless the latter be applied with extraordinary care. It should be remembered that unless the voltmeters employed have very open scales the ordinary errors in reading them involve errors in candle-power quite as great as those between two lamps on the same circuit under a slightly shifting voltage.

Of the two methods the writer, on the whole, prefers the single circuit one for ordinary use. It is usually easy to find a time for testing when the variations in voltage are small and slow enough to be easily reduced by a little attention to the rheostat.

It is not advisable in commercial testing to attempt the comparison of incandescent lamps with standards of another character. Such comparisons depend for their correctness on a knowledge of the absolute value of the voltage—a knowledge seldom very precise. They also introduce the factor of color difference which is enormously troublesome even with trained observers, and the full resources of a well-equipped laboratory.

When the lights compared by means of a Bunsen or Lummer Brodhun screen differ considerably in color, absolute balance is attainable at no one point on the scale. The same observer will obtain very regular apparent values for the comparison, but another observer is likely to obtain a somewhat different set of values. Such personal differences may easily amount to 5 per cent or more, if comparing, for instance, a Welsbach with a Hefner lamp, or an incandescent lamp with an enclosed arc.

There will also be considerable differences in the results with a

single observer if the absolute brightness of the colored radiants changes, even when the relative brightness remains the same. That is, if one were comparing a Welsbach and a Hefner lamp and obtained what appeared to be a satisfactory balance, that balance would be destroyed by doubling the distance of each light from the screen.

These color difficulties are physiological and subjective. They depend upon a property of vision sometimes known as Purkinje's law, stated by Von Helmholtz as follows: "Intensity of sensation is a function of the luminous intensity which differs with the kind of light."

This difficulty in color photometry is precisely akin to that involved in comparing the loudness of two noises of differing quality, although fortunately somewhat less serious. For example, one would have extreme difficulty in forming any notion of the relative loudness of a bugle note and a pistol shot, or a shout and a steam whistle. One's first instinctive effort at comparison would probably be made by investigating the distance at which each sound became inaudible or barely audible.

A similar procedure based on visual acuteness has often been tried in rough color photometry. In its crudest form it consists of noting the distance from each radiant at which a printed page held at arm's-length just becomes legible. A very little experience will convince the experimenter that the results depend upon the general state of the eye, the personal equation of the observer, practice, preconceived notions of the relative intensities and other factors so variable that the result is little better than guesswork. Yet this wildly inaccurate method has not infrequently been used in estimates of street lighting.

With proper apparatus and a careful and unprejudiced observer, however, the principle involved is capable of giving useful approximate determinations of illumination. An instrument for this purpose

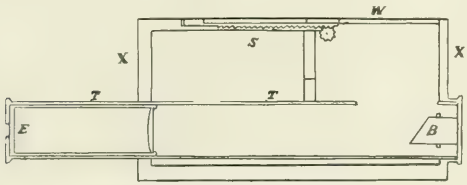


FIG. 2.—SECTION OF ILLUMINOMETER.

which has become fairly well known in this country is Houston & Kennelly's illuminometer, shown in section in Fig. 2. In the cut *X X* is a small box thoroughly blackened on the inside and provided with an eye tube *T*, *T*, pointing directly at a removable inclined block *B* on the face of which is placed a group of printed test characters. A focussing eye piece *E* enables any observer to see the test object distinctly. In the top of the box is a window *W* closed by a translucent diaphragm of porcelain opal glass, or the like, which serves to illuminate the test object. This window can be closed by an opaque shutter *S*, moved by a rack and pinion, the latter turned by a milled head outside the box.

The instrument is used by facing the window toward the source of illumination and opening or closing the shutter until the test characters are just legible. A scale attached to the shutter then gives the illumination directly in *bougie-metres*.

The scale is calibrated empirically by testing with a source of light of known intensity at definite distances. The instrument is small enough for the pocket, and is very convenient for relative measurements. So far as absolute values of the illumination are concerned it can hardly be considered seriously unless in experienced hands, and calibrated by the user, but in comparative measurements the average error of a single careful reading is less than 10 per cent, which is a great improvement on guesswork. A skillful observer by frequently checking the calibration of his instrument could bring the absolute errors somewhere nearly down to this figure. The question of color is partially eliminated by the great reduction in intensity of the light. As has been noted in a previous paper, color differences are inconspicuous in very faint light.

To return to photometry proper, this same expedient of reducing the intensity of the light that reaches the eye from the photometer screen is of material assistance in comparing colored lights. Observing the screen with nearly closed eyes makes comparisons very much easier, and leads to fairly consistent results. But color perception changes so notably in dim illumination that results so obtained do not represent working conditions nearly enough for results making any pretence of precision.

Numerous expedients to avoid these difficulties have been devised, all amounting in the last resort to the selection of conventional conditions, representing the practical requirements of illumination. None of them are perfectly satisfactory under all conditions, but probably the best available method is Crova's. This is based on the experimental fact that in comparing two lights even of very different color their total intensities are sensibly proportional to their relative intensities in the region of the spectrum of wave length about 0.582 μ, that is, in the clear yellow of the spectrum.

The troublesome part of such a comparison is to segregate the rays of about this wave length without resorting to spectro-photometry, which necessitates the formation of two spectra from the two sources side by side. Crova found that a solution of 22.3 grams anhydrous perchloride of iron and 27.2 grams chloride of nickel in 100 cubic centimeters of distilled water forms an absorbing screen that serves the purpose. The former constituent cuts out the green and blue, the latter the red. A layer of this standard solution 7 millimeters thick used as a screen through which to observe the photometer screen serves the purpose, although a thicker layer limits the desired region more closely.

The objection to the method is principally the large amount of light cut off by the screen so that it works best in comparing rather powerful lights.

As a matter of general practice such refinements are seldom used. Excepting arc lamps the ordinary sources of light can be compared without serious difficulty from differences of color. With flame radiants a well standardized Methven screen forms by far the best working standard, while in comparing incandescent lamps the working standard should be an incandescent of moderate efficiency.

In comparing arc lamps serious trouble is encountered. In the first place, the difference between the intensity of an arc and any feasible standard is inconveniently great, and in the second place the colors, especially in dealing with enclosed arcs. The first difficulty may be averted by using the arc at a sufficient distance from the screen to give a proper working distance, say, 3 or 4 ft. between the screen and the standard. In the tests by the committee of the National Electric Light Association already quoted, the color trouble was dealt with by observing the screen through a rapidly rotating disk having narrow radial slits. This in effect cut down the brilliancy of the screen to a point where color perception was considerably weakened. It is rather doubtful whether this procedure affected the standard and the arc in equal ratios.

In arc photometry still another troublesome factor is met in the tendency of the arc to wander from side to side of the carbon or to slowly rotate, so that the real luminous intensity is very difficult to catch. In the research just mentioned this was escaped by using a pair of mirrors simultaneously reflecting light from two sides of the arc lamp diametrically opposite, upon the photometer screen, the direct radiation being screened off. The line joining these mirrors was, of course, perpendicular to the line of the photometer bar, and the absorption of the mirror surfaces could readily be allowed for.

"Touching the Blooming Button."

The British Admiralty is much interested in the working of the Personnel bill in the American Navy, with the view of the possible amalgamation of the line and engineer officers of the British service. Mr. Arnold-Forster, secretary to the Admiralty, recently requested special reports on this matter, and Vice-Admiral Fitzgerald writes to the *London Times* on the same topic. The Admiral's letter is a spirited defence of the navy against many recent criticisms. But he admits that the line officers must wake up and become expert mechanics as well as good seamen, in order to master the complicated machinery of the fighting ships, or else the engineers will oust them from their present predominant position. "I am not prepared," he says, "to advocate the amalgamation of the engineers and executives, in imitation of the Americans. We are certainly not ripe for it yet. Moreover, it is just as well to wait and see how it turns out with them. But if an amalgamation is to be eventually avoided it can only be by our executives becoming practical mechanics. All real work is now done by steam, electricity and hydraulics. 'Touch the blooming button,' as Jack says, 'and let her go up.' I doubt not that he who is the most expert in touching the 'blooming button' at the right moment will be the victor in future naval battles, just as the best sailors won of yore."

Meeting of the American Institute of Electrical Engineers.

The subject for the New York meeting of the A. I. E. E. on Oct. 25 was the "Regulation in Prime Movers and Successful Operation of Alternators," with an introduction by President Steinmetz. The following papers were presented: "Angular Variation in Steam Engines," by Mr. P. O. Keilholtz, of Baltimore; "Parallel Operation of Engine-Driven Alternators," by Mr. W. L. R. Emmet, of Schenectady; "Parallel Running of Alternators," by Mr. Ernst J. Berg, of Schenectady; "Angular Velocity in Steam Engines, in Relation to Paralleling of Alternators," by Mr. Walter I. Shlicter, of Schenectady. A number of engineers prominent in the steam engine, gas engine and turbine field were also present, and participated in the discussion, with Messrs. C. F. Scott, of Pittsburg; Dr. A. V. Garratt, of Boston; Messrs. R. T. Lozier, R. D. Mershon and C. O. Mailloux, of New York. The meeting was very well attended, about 175 being present.

The five papers read at the meeting related more or less directly to the parallel running of alternators. In a paper introducing the subject, President Steinmetz dealt with the general considerations relating to the speed regulation of prime movers and the parallel operation of alternators.

In considering the effect of speed regulation of prime movers on the parallel operation of alternators therefrom, Mr. Steinmetz said that three principal factors enter as follows:

1. The permanent variation of speed, due to a change of load. 2. The temporary change of speed, due to a sudden change of load. 3. The periodic change of speed during each revolution.

1. With a change of load on the alternator, the power supplied to the prime mover must be changed correspondingly. This is done by a regulating mechanism which is based either on the speed (speed governor) or the acceleration (inertia governor). The speed of the prime mover is a function of the load, usually decreasing more or less with the increase of load. Since, however, alternators in parallel operation, and thus the prime movers driving them, must run in synchronism with each other, it follows that the division of load between alternators driven by independent prime movers depends on the division of power between the prime movers at (electrical) inequality of speed, but not upon the characteristics of the alternator. Thus it cannot be changed by a change of excitation of the alternator, etc., but only by reacting upon the governor (or by a change of belt tension with alternators belted to the same shaft). Therefore, for parallel operation of alternators a certain drop in speed with increase of load is necessary, and with a governing mechanism maintaining absolutely constant speed at all loads, the division of load becomes indefinite and parallel operation ceases to be feasible. If the drop of speed with increase of load is not uniform, but the speed almost constant for moderate load, alternators may operate satisfactorily in parallel at load, but see-saw at light load.

2. With a sudden change of load, since time is required for the governor to act and for the flow of power to the prime mover to change to the condition corresponding to the changed load, a temporary change of speed occurs, larger than corresponds to the change of load, and to reduce this variation of speed, storage of energy by the momentum of the flywheel is necessary. With the steam engine the momentum of the steam as expansive fluid is usually negligible in its effect, and the temporary effect of speed depends mainly upon the rapidity of the action of the governor. With water power, frequently the momentum of the moving mass of water predominates as a cause of the speed fluctuation with sudden change of load, and the speed fluctuation thus depends upon the momentum of the total moving mass of water. Stand pipes, relief valves and deflecting nozzles, represent means to reduce or eliminate the effect of the momentum of the moving water column upon the regulation of speed at sudden change of load.

3. Most rotary prime movers, as waterwheel, steam turbine, etc., give a uniform supply of power, and thus uniform speed during the revolution. Others, however, as reciprocating prime movers, steam and gas engines supply the energy by a number of impulses, and the torque, and, therefore, speed of the prime mover thus periodically varies during the revolution. The resultant torque of these prime movers consists of the pulsating torque of the energy supply (indicator diagram), the alternating torque of acceleration and retardation of the reciprocating masses, the alternating torque due to the finite length of the connecting rod, with vertical engines, the alternating torque of gravity in the ascent and descent of the reciprocating masses, and in gas engines also the pulsating negative torque of the compressor. The speed variation resulting herefrom can be reduced by such a design of the prime mover that the different components of torque superimpose upon each other to a more nearly uniform torque, or by the ues of a heavy flywheel. The most objectionable result of this periodic variation of speed is, however, the hunting of alternators and synchronous apparatus (as motors and converters), and this tendency to hunting seems to be aggravated by the use of heavy flywheels on the prime mover.

Electrical motors, as a rule, are not considered as prime movers, although no reason appears for making a distinction between the supply of power through a hydraulic pipe line or through an electric transmission line. With electric motors the rate of rotation is uniform and the periodic variation of speed thus absent, and due to the practical absence of a time lag the temporary variation of speed at a sudden change of load absent also, constancy of the supply voltage assumed. With continuous current shunt motors a cumulative series field may be necessary for parallel operation of alternators to secure the necessary drop of speed with increase of load. With induction motors, while the drop of speed under load may be considerably less than required for good parallel operation of engine-driven alternators, the speed variation with the load is so uniform that no difficulties are met.

In parallel operation of alternators driven by synchronous motors, due to the absolute constancy of speed under load, an entirely different set of phenomena occurs, similar in some respects to the parallel operation of rigidly connected alternators, but differing therefrom due to the flexibility of the synchronous motors in their relative phases, but rigidity in frequency. Difficulties with parallel operation of alternators driven from separate prime movers may be due to:

1. Lack of synchronizing power, arising from excessive armature reaction. This is practically unknown with modern alternators, in which the synchronizing power is always far in excess of the requirements of keeping them in step.

2. Surging or hunting between the alternators. In this case, forced surging and cumulative or resonating surging may be distinguished. With prime movers giving a periodic variation of speed during the revolution, periodically varying cross-currents flow between the alternators and between alternators and synchronous motors, in extreme cases even between alternator and induction motor, of an amplitude depending upon the amplitude of the speed variation. Under certain conditions this surging becomes cumulative, gradually increasing in amplitude so that the machines may break out of synchronism. The cause of this cumulative effect may be found in the electrical circuit in certain relations between the momentum of the moving mass and the electric constants of the circuit, or it can be found in the mechanical construction of the prime movers, foremost their governors. When due to the former cause it can occur also with turbine-driven prime movers and synchronous motors, while the mechanical hunting of the governing device, which is the more frequent and serious phenomenon, is most frequently found in direct-connected engine-driven plants.

The cumulative hunting is overcome by eliminating its cause, that is, breaking the resonance condition of the electric circuit by interference, or by changing its constants and damping the governor so as to stop its ability to hunt, or by reducing the amplitude of the hunting by a damping device in the electric circuit, usually in the field of alternators or other synchronous apparatus.

Mr. W. L. R. Emmet, in a paper on "Parallel Operation of Engine Driven Alternators," referred to the trouble met with in early alternating experience in operating engine-driven alternators in parallel. After referring to some remedies that had been proposed for the problem, and giving some of his own observations on the difficulties that had presented themselves, he described a solution which he had found very effective, and which consists in deadening the motions of the governor occasioned by engine oscillations, and at the same time leaving the governor free to move when actual changes of load came upon the machine. The device whereby this object was accomplished, and which Mr. Emmet perfected with the aid of Mr. H. W. Buck and Mr. Harte Cook, is shown in the accompanying illustration.

The main piston rod shown in this sketch is connected to the governor weights in such a manner as to be moved directly by them. The space on both sides of the piston and all the port spaces are filled with a heavy grease. By-passes *F*, are provided, through which this grease can flow from one side of the piston to the other. Each of these by-passes is actuated by a small piston valve *C*, backed by a spring *G*, and provided with a small by-pass *B*.

The practical effect of this device is that the springs tend always to

keep the gates of the main by-passes closed, and that the piston is thus virtually locked until the pressue at one end of it has forced the by-pass valve back. The first motion of the main piston is thus limited by the size of the small by-pass *B*, whereas its later motion, after the valve has been forced back, is limited only by the size of the main by-pass *F*. It will be readily seen that this dash spot can be so adjusted that it will act as a temporary lock on the governor mechanism, and that it will release entirely after the tendency to govern has continued for a certain length of time.

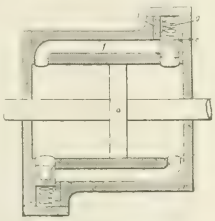


FIG. I.—SECTION OF DASH-POT.

Such dash-pots were first applied to the engines in the plant of the Boston Electric Light Company, and it was found that they afforded a positive and complete cure of the oscillating troubles which had been experienced there. By their use, with proper adjustment, the engines can be operated under all conditions of load, and with any number in parallel, without the slightest indication of the oscillating trouble which was at first so difficult to prevent. In this case the tendency to oscillation was much more positive than in any other which has come to his notice, and the perfect success of the remedy has led him to believe that the method is universally applicable, and that all similar troubles can be cured by its intelligent application.

In order that this form of dash-pot may properly accomplish its functions in the most difficult cases, it must be made strong enough mechanically and hydrostatically to bear for a time, the entire force imposed by the governor weights in their effort to assume a new position, and the period of such opposition must be such that the dash-pot will not unlock within the time of a single period of oscillation when the machines are operating in parallel. It is also necessary that the dash-pot be kept full of grease, so that there will be no lost motion through air spaces. If the dash-pot falls short in any of these particulars, the remedy which it affords will only be partial, and in difficult cases it may prove inadequate. It is only in certain difficult cases that we need use such complete preventives as were found necessary in Boston.

Mr. Emmet briefly touched upon a few other facts which have developed in the course of his experience in the parallel operation of alternators. It is popularly supposed that it is necessary to use very heavy flywheels, in order that alternators may be successfully operated in parallel, it being the custom of some engineers to consider a guarantee of small angular variation as the equivalent to a guarantee for parallel operation. Mr. Emmet's experience has rather indicated that generators with light flywheels are most easy to operate in parallel. The frequency of natural oscillations in such machines is high, and the conditions of engine operation are generally unfavorable to their development. Large flywheels are desirable on direct coupled alternators because a steady frequency is a valuable feature in any system. The requirements of parallel operation, however, are rather unfavorable than otherwise to the use of heavy flywheels.

The peculiar periodic action of an engine's governor is not confined entirely to the parallel operation of alternators, but also may occur and cause trouble where a single alternator is operating a load of synchronous apparatus. We may even have alternators which will operate together in parallel, but which will, through periodic action of the governors, give trouble with certain loads of synchronous apparatus. It is thus desirable in all cases to prevent this periodic action of the governors, and by this prevention many troublesome difficulties may be lessened or overcome.

The behavior of all parts of the system while this oscillating trouble occurred in parallel operation was very beautifully illustrated during some experiments at Philadelphia. The shafts of engines were in line, and the relative positions of poles could, at all times, be seen; the poles of one machine appearing to stand still when the machines were in perfect synchronism. The movements of the governor mechanism could also be seen by oscillations of a lever arm which was in the line of vision. Ammeters and voltmeters were also placed in the same line. It was possible at a glance to see the degree of angular displacement of the poles, the degree of motion of the governor, and the fluctuations of the current and voltage. An observation of these conditions showed very clearly the exact character of this phenomenon. It was found that under some conditions the oscillation was an extremely sensitive matter, and had very little power of sustaining itself. A slight change in the field strength of one of the machines would sometimes break it up so that it entirely disappeared, after which the machines might remain steady for some time and then gradually begin to swing again. Under other conditions it was more persistent. Everything indicated, however, that it could not exist for any appreciable period without the actuating force afforded by the irregularity of steam impulses.

In a paper entitled, "Parallel Running of Alternators," Mr. Ernst J. Berg gives an analytical discussion of the principles governing the parallel operation of alternators driven by steam engines or turbines. One of the conclusions is that two machines of the same induced e. m. f. and armature reaction running in phase will share the load evenly. If one has twice as high armature reaction as the other, it will take one-half of the load, etc. Thus since machines of identical regulation have practically armature reactions inversely proportional to their size, it is possible to run such machines from the same engines at a proper share of the total load. Should, however, two machines of the same size and different armature reaction run from the same engine, the distribution of power will not be in accordance with the rating.

To balance the load it is then necessary to add reactance in one armature or to mechanically offset one armature in regard to the other, or, finally, to run them at such field excitation as will cause considerable cross-current, which effect will be discussed later.

In the analytical discussion it was assumed that the machines were running strictly in phase, which would practically limit the case to alternators clutched together. If, however, they are rigidly connected together, but out of phase, the current which is due to the resultant of the two e. m. f.'s has different phase displacement from the e. m. f. of one machine as from that of the other, that is, the energy corresponding is different in the two machines, or the one supplies more power than the other.

The relation of currents to e. m. f.'s can also be changed by changing the excitation. Assume machines of the same armature reaction which, before being thrown in parallel, have unequal e. m. f.'s. After being connected together their terminal voltages must be the same, therefore a cross-current must flow between them which, in the higher excited alternator, is lagging, and in the other leading; which currents, in conjunction with the field excitation, give a resultant field of same magnitude in the two, but displaced in phase. In the higher excited machine it will bring the resultant field more in phase with the energy current, thus giving a result equivalent to an armature of lower reactance; in the lower excited machine a result same as higher armature reaction. It is, therefore, possible to change the load by change of field excitation by sacrifice of current, since this method involves wattless currents between the generators.

It is thus evident that the question of distribution of power between alternators is quite simple, if they are running at absolutely the same speed at all loads; that is, if the engines regulate so closely as to permit the clutch to be opened and the armatures still retain the same positions. In reality, however, engines cannot be made to govern so closely, but one will tend to hold up the speed somewhat better than the other. That being the case, it is safe to say that, as a rule, the engines will not tend to give the same power at exactly the same speed.

With the same armature reaction and induced e. m. f., if different power is given each machine, the armatures must be offset a certain and fixed degree, which means that by even the most minute difference in speed regulation the armatures are forced to change their relative positions, which obviously is a cause for "hunting."

The relative power given by each machine depends upon the respective powers of the engines at identical speeds. The analytical discussion shows that a definite tendency for "hunting" exists, and that this hunting is manifest in a mechanical pulsation in the speed of the armatures, and a transfer of power from one unit to another.

A most superficial investigation will show that this flow of power is much greater than that corresponding to the stored energy of the armature flywheel, etc., at the relatively small differences in speed, and that pulsating power actually has to be supplied by the engines. Therefore, and since power cannot be obtained from an engine without corresponding steam, the flow of steam must be periodic to sustain an accumulated hunting.

The remedy is, therefore, to be found by preventing such periodic flow of steam, which can be accomplished by proper dash-pot arrangements at the governor. Other remedies also suggest themselves, the favorite being to make a short-circuited winding in and around the field of alternators. The object of such winding obviously is to establish a load when these oscillations occur, which load tends to stop

the acceleration and retardation of the armature. The disadvantages of this method are that losses of no small magnitude not only are introduced when the machines hunt, but also when they are running at steady speed, which losses are caused by induced currents in this short-circuited winding, due to pulsations of flux incidental to modern construction of iron-clad armatures.

Mr. Walter I. Slichter in a paper entitled, "Angular Velocity in Steam Engines in Relation to Paralleling of Alternators," dealt more particularly with the function of the governor of an engine in cases when an engine is direct connected to an alternating-current generator.

It was pointed out that when an engine is direct connected to an alternating-current generator, there are peculiar variations in tangential effort on the crank, and a consequent variation in speed of the shaft and flywheel. The angular velocity of the flywheel varies in two entirely different ways, due to two different causes. The first and best known is that due to a change of load; then the average velocity changes, and there is a change in the number of revolutions per minute.

The second effect is due to irregularities in the applied force and transmission of that force, and consists in a variation of the instantaneous value of the angular velocity, while the average value and the revolutions per minute remain the same and constant.

The first is altogether a function of the governor of the engine. The latter phenomenon, which is the one discussed by Mr. Slichter, is more complicated both in its causes and effects, as it introduces the distribution of the steam pressure in the cylinder, inertia of reciprocating parts, angularity of connecting rod and moment of flywheel. It is of importance where two or more alternators are to be run in parallel, or where synchronous motors are to be run from one or more alternators. Such machines tend to run in exact synchronism, and their inertia gives them a tendency to run at constant angular velocity. If now an irregular pulsation is impressed upon the system by the steam engine, there is a continual effort in each machine to keep in exact step with this pulsation, which causes an exchange of cross-currents and a liability of falling out of step.

When two alternators are running in parallel, if they differ in angular position even if revolving at the same speed, a cross-current will flow between them, tending to pull them together. This cross-current may be wattless, but even then it consumes some energy in the form of $I^2 r$.

The paper then assumes the case of a cross-current limited to 10 per cent of the full load of one generator, and the angular displacement allowable is calculated and found to be 2.3 degs.

The cause of the irregular effect is ascribed to the fact that the pressure of the steam on the piston due to cut off and expansion is uneven, being great during the first part of stroke, and small and even negative, due to compression, at the end. In the vertical engine the weight of the piston, rod, cross-head and part of connecting rod have to be lifted on the up-stroke, but are additive to the steam pressure on the down stroke. This makes a difference in the power of each stroke, raises the peak of one and increases unbalanced energy.

This pressure is transferred to the crank-pin through a varying angle so the effort is roughly equal to $P \sin \phi$, varying between zero at beginning and end of stroke and P at middle. Thus there is a combination of maximum values at the point of cut-off, as that comes near the middle of the stroke, and we get quite a pointed peak here.

The angularity of the connecting rod has a different effect in the forward and backward strokes, as in the forward stroke during the early part while the pressure is high anyway, it increases the effect of that pressure on the crank pin, and in the latter part it diminishes that effect. On the return stroke it has the reverse effect, diminishing in the early part and increasing in the latter. So that the final effect is to increase the peak of one impulse and diminish the peak of the other.

The inertia of reciprocating parts absorbs energy at the beginning of the stroke, and gives it up at the end, so it has a beneficial effect on the diagram, smoothing the peak and raising the low values. The combination of two or more cylinders on the shaft naturally tends to even the effort and also to diminish the length of time one impulse lasts, thus diminishing its effect.

Combining the effort of three cylinders would seem to give a more even torque than two cylinders, but the actual diagrammatic combination shows there is very little choice between a two cylinder or three-cylinder engine.

In a single cylinder, double-acting engine there are two impulses per revolution, and in a cross-compound engine there are four impulses. Each impulse is more or less like any other. By analyzing the variation in speed during one impulse we can derive our conclusions. Though as all the impulses are not equal, it is as well to select that impulse having the greatest amount of unbalanced energy so as to know the worst conditions.

During the first quarter of impulse, the effort is less than average, during the second and third quarter (approximately) the effort is greater, and during the last quarter it is low again. The unbalanced effort represents a force which, acting on the mass of the flywheel, produces an acceleration, $a = f/m$. Thus by referring the torque diagram (Fig. 2) to the line of average torque as base, we get a curve of acceleration.

Integrating this acceleration, we get a curve of velocity v. This curve lags 90 degs. behind the acceleration curve. Thus starting from a point of minimum torque a, the acceleration will be negative. From a to b the torque is less than average, the acceleration negative, the speed will keep dropping in value until b is reached, where, since the acceleration changes sign, v is a minimum, and commences to increase again; v will keep on increasing as long as the acceleration is positive, or to d, where v has its maximum value.

If we assume the variation is sinusoidal, then the average value of v from a to c is v_1, and of s, the percentage variation in speed, is $2\,s/\pi$.

The speed is low from a to c, or while the crank is passing 0° deg. of the crank circle; during this time the crank continually falls behind the position it would maintain at constant angular velocity, and

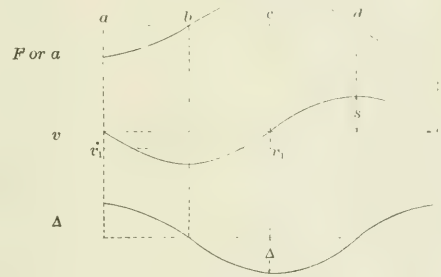


FIG. 2.—TORQUE DIAGRAM.

at C the maximum displacement occurs, for there the speed again becomes greater than average.

The paper then proceeds to an analytical investigation of the various factors influencing speed variation, which in part duplicates portions of the Keilholtz paper. The results are applied to the data of an actual engine.

A paper by Mr. P. O. Keilholtz entitled, "Angular Variation in Steam Engines," gives the result in analytical, tabular and graphic form of an investigation undertaken with a view to determining the angular variation of a cross-compound vertical engine of a certain type, direct-connected to a 500-volt railway generator. The manner of conducting the test is described, an analytical investigation is given of the factors entering, and the results are given in the form of tables and of curves.

An artificial load was put upon the generator by means of a water rheostat consisting of iron plates immersed in a dock, whereby a constant load of 1440 amperes at 562 volts was maintained. Simultaneous readings were made of the current and e. m. f.'s, and at the same time indicator diagrams were taken and a record by means of a tuning fork which registered the angular variation in speed.

The tuning fork was driven by a storage battery, the usual make-and-brake device being employed. Manila paper was secured to the face of the flywheel engine by shellac varnish applied at the edges, then slightly moistened. Upon drying a smooth surface was obtained upon which to take the tuning fork record. A paint was applied to the paper so as to enable the record to be taken with phosphor bronze points on the tuning fork. With the tuning fork at rest and the wheel revolving, the record consisted of a circle. With the tuning fork in operation this line was crossed at three points during each complete vibration of the tuning fork, and the measurement of the distances thus cut off gave the data for determining the variation of the engine speed.

In calculating the turning effort, the flywheel rim and spokes, the crank disk and armature were reduced to the crank center and the

indicated effort at the crank pin was corrected for accelerating and returning forces introduced by these and the connecting rod, the radii of gyration in each case having been determined for this purpose.

Modern Electric Light Accounting.

IN a paper with the above title read at the recent Buffalo meeting of the Association of Edison Illuminating Companies, Mr. A. S. Knight described the accounting system of the Boston Edison Company.

Mr. Knight first reviewed the conditions which establish the accounts of a manufacturing corporation. The money paid into a corporation by its stockholders is invested by the officers in the plant of the company. This fact necessitates several accounts; first, the credit to the stockholders (or the capital stock account) for the money paid in, and the charge of the same money first to the cash account, then to the plant account, or as it may be called, the installation and property account. The capital stock and the installation and property accounts are termed the permanent accounts, the transactions entering into these accounts possessing a finality not participated in by any of the later accounts. Part of the stockholders' money must, at least at first, be utilized as a working capital, thus necessitating upon the ledger a set of accounts which are termed miscellaneous or cash assets. The principal accounts of this character are the already mentioned cash account, a merchandise account, and the consumers' accounts, or the accounts receivable. He said:

If the stockholders have not paid in sufficient money to start the business, money must be raised in some other manner, usually by bonds issued by the stockholders, which are commonly considered a part of the permanent debt, although they are really a temporary obligation (often for a long term of years) of the stockholders to the bondholders, the title to the plant always remaining with the stockholders so long as the bond interest is paid. Still more temporary liabilities (the floating debt) are created by the buying of supplies or the borrowing of money on the company's notes, the principal accounts necessitated being accounts payable and notes payable.

The operation of the plant creates a new set of accounts, the first of which is the operating account against which are charged all supplies and labor used in the manufacturing process, excepting such as are required to remedy the wear and tear on the plant, the expenditures for the latter being charged to repair and renewal. These accounts are, of course, offset by the earnings account, which should be credited with the bills rendered the customers as fast as they are sent out, and these accounts, together with a few others such as the interest account, dividend account (the latter being charged with all money paid back to the stockholders out of the company's net earnings), constitute what are known as the profit and loss accounts, inasmuch as they are all closed at the end of each year into a profit and loss account.

By arranging the accounts on the monthly balance sheet into the groups mentioned above, as shown in Table I., we are enabled to consolidate the company's standing and condition into a very few totals, such as may be easily impressed upon the mind at any time it may be desired.

It has been found a great advantage to separate, upon the general ledger, the installation and property account into the completed plant and that which is under construction, calling the latter the unfinished installation account. The details may be kept as fine as desired in the latter account and transferred in bulk when the work is completed, thus affording a much better opportunity for ascertaining later the cost of any particular work, than if the charges are jumbled into the installation account haphazard merely in the order in which they happen to be paid. Before commencing any installation work an appropriation for doing it is opened, based upon the estimated cost of the work. Each appropriation covers a certain piece of work, say, installing an engine and dynamo, or laying a new feeder, and all orders for installation work must be drawn against their proper appropriations and entered under them in the appropriation book, specifying for what the orders are drawn. Estimates, of course, are entered against the orders, and as soon as the totals of these equal the amount of the appropriations no more orders will be approved without an increase in the appropriation. Costs are shown against each particular order when completed, the totals of which must not overrun the appropriation, or somebody will be asked to explain. The idea of the appropriation is twofold, first, to summarize the cost of doing work into intelligible groups, and, second, to know at all times what we are doing and how we stand in this important branch of our business. We believe also in the importance of impressing upon our people the amount of money they are spending and carry this idea into the operating field where every order drawn must bear an estimate of cost before being approved, variations of 10 per cent either way between the cost and the estimate requiring special approval.

The merchandise account should, of course, be kept at cost prices and goods credited as nearly as possible at the prices at which they are charged. By this means when inventories are taken of merchandise on hand, the totals should agree with the amount called for by the books. It is to be hoped there is no electric lighting company at the present day which depends upon the system, still common in ordinary mercantile business, of taking an inventory to determine its profit; such a system in our business is absolutely inexcusable with the present simple methods of ascertaining earnings and expenses monthly. This is referred to since the modern system of accounting depends upon the pricing and charging at cost of all requisitions for material used.

It has been found very useful to have an additional account in which to group the many miscellaneous transactions that are bound to come up. This is called on the general ledger, "Sundry Open Accounts," and it contains the minor accounts which would ordinarily require a special ledger account. Most of the accounts opened upon this ledger are of a temporary nature, or their ultimate disposition has not been decided upon. All payments on account, unless for new construction (which would go into the unfinished installation account) are charged this account and held there until the final bill is approved, when this account is credited and the final account charged. This is also utilized to even up the different months' expenses, by taking care of payments made only once a year, a proportion being charged into each month's expenses and credited sundry open accounts, against which the bill is charged when paid, thus balancing the account. A balance sheet is, of course, taken off of the sundry open accounts every month.

No details of the accounts payable have been kept for several years. That is, the general ledger not only does not show the parties from whom they buy goods, but they keep no sub-ledger showing the accounts with these parties. With a properly planned voucher system, some form of which all companies should adopt, it is possible to keep track of this information directly from the register of disbursements, by merely noting in the latter the dates when vouchers are paid and taking a trial balance off this book each month. After the first month the previous month's trial balance is utilized and any

TABLE I.

General Ledger Accounts.

The following comprises all the accounts carried on the General Ledger and the arrangement shown is that of the Monthly Balance Sheet.

DEBIT ACCOUNTS.	CREDIT ACCOUNTS.
PERMANENT INVESTMENT.	PERMANENT DEBT.
A. Installation and Property.	AA. Capital Stock.
B.	BB. Installments on New York.
C. Liverpool Wharf Estate.	CC. Trust Mortgage Bonds.
D. Unfinished Installation.	DD.
MISCELLANEOUS ASSETS.	FLOATING DEBT.
E. Cash.	EE.
F. Station.	FF.
G. Stock.	GG.
H. Notes Receivable.	HH. Notes Payable.
J. Accounts Receivable.	JJ. Accounts Payable.
K. Sundry Open (either Dr. or Cr. acct.)	
L.	LL. Taxes Accrued.
M.	MM. Legal Expense Accrued.
N.	NN. Unpaid Dividends.
PROFIT AND LOSS ACCOUNTS	PROFIT AND LOSS ACCOUNTS.
O. Operating.	OO. Earnings.
R. Repair and Renewal.	RR.
T. Maintenance.	TT.
U. Dividends Declared.	UU. Discounts.
V. Interest (either Dr. or Cr. acct.)	VV.
W.	WW. Reserve for Maintenance.
X. Profit and Loss (either Dr. or Cr. acct.)	XX.

unpaid vouchers during the current month added, the whole balancing with the accounts payable ledger account.

OUTLINE OF CLASSIFICATION.

The ledger accounts as shown in Table I. are each represented by a letter which is always used when the account is sub-divided. In explaining this matter Mr. Knight quoted from his "Classification of Accounts," issued under date of July 1, 1900.

"Details of the Installation Property Account (A), Unfinished Installation Account (D), Stock (G), Operating (O) and Repair and Renewal (R) accounts are indicated by numbers following the letters shown, each account taking such of these numbers as are necessary for its divisions."

To facilitate memorizing, the numbers of the same sub-divisions in different ledger accounts are always the same. For example, A 23 is installation and property meter account, G 23 is the stock meter account, O 23 is the operating meter account, and R 23 is the repair and renewal meter acount, so that the employes of the meter department have only one number to remember and by making use of the initial letter of the operating and repair accounts, memorizing the classification is made as simple as possible, and mistakes are almost unknown. By referring to Table II. the details of these divisions and the numbers representing same will be found.

Quoting again from the Classification Book before referred to: "Some of the preceding divisions are further sub-divided, and these sub-divisions will be found in the following index tables. The numbers previously given when following the general ledger account letter, constitute the 'original numbers'; the sub-divisions shown in the following tables (which, however, I am unable to furnish with this paper for want of room) are to be indicated by 'additional numbers,' which in each case should follow the original number, a decimal point, or dash, separating the two.

"Attention is called to the fact that the location of a number with reference to the decimal point is of the greatest importance. * * * If it is not desired to use the figures intervening between the number used and the decimal point, ciphers should be put in their places in order that the number used may retain its proper position with relation to the decimal point. * * * It will be found that in the generating account three figures are necessary for the additional numbers; these have been apportioned so that the tenth (or first figure to the right of the decimal point) always indicates only the station number, the hundredth (or second figure) only labor or material, while the thousandth (or third figure) represents further sub-divisions if any are required. In the distribution accounts, inasmuch as no station numbers are needed, rather than retain the 'hundredth' to indicate labor or material, necessitating always a cipher between it and the decimal point, the cipher has been dropped so that the tenth there represents labor or material, and the hundredth the additional sub-division. In classifying bear in mind that 'labor' is intended to cover only that upon the company's pay rolls, 'material' covering everything else, including even any labor which may be furnished and billed by outside parties."

To make this system clearer, the following illustration is given: As will be seen by referring to the sub-division in Appendix B, account O 41 is the operating fuel account. In this account all three of the figures in the additional number are made use of, the first figure representing the station number where the fuel was consumed, the second whether the charge was for (1) labor, or (3) material, and the third figure whether it was for (1) soft coal, (2) hard coal, (4) carting coal, (5) carting ashes, or (9) miscellaneous. Therefore, a charge marked O 41.331 would go against operating fuel at third station, the second decimal figure (3) would show it was material, and the third figure (1) would indicate soft coal. Also O 41.115 would mean operating fuel account, first station labor carting ashes.

It will be seen that the use of these numbers gives a tremendous opportunity for sub-divisions so that practically any desired extensions can be made at any time, while absolutely no disturbance is created if it is decided to drop some of the finer sub-divisions, in fact, any of the accounts could be at any time stripped down to the ledger letter if desired.

During the last three or four years a systematic classification of earnings has been kept in greater detail than is customary in most companies. Several different kinds of contracts were closed with customers, and it was considered important to know the results of each of these different classes. In addition to the customary classification into incandescent, arc, power, etc., the contracts were separated into half a dozen classes under each of these divisions, viz., (1) commercial rates (or the non-contract customers), (2) long use contracts (additional discount for average use of connected load), (3) fixed discount contracts, (4) fixed amount contracts, (5) special contracts and (6) maximum demand contracts. This has proved of great value, as a monthly report shows, for each class, the number of customers, kilowatts connected (or maximum demand in the case of Class 6) kilowatt-hours sold, and net income; from this information is derived, and shown on the same report, the average hours' use per day, the average income per kilowatt-hour, and the total income per day per kilowatt connected.

The effort of any accounting officer must always be directed to keeping down the clerical expenses inasmuch as this is in one sense unproductive labor. The principal thing to prevent is a duplication of work, and this in Boston has been accomplished as completely as is possible with due regard to verification and proving of accounts.

As indicated above, practically all the sub-ledgers (excepting for accounts receivable), and all abstracts of shipments from stock, such as are ordinarily kept by large corporations, have been done away with. There has been adopted instead a standard form called the "Disbursement Sheet," a reduced sample of which is shown herewith. One sheet is provided for the smallest sub-division of each account and filed in its proper numerical place, additional sheets, of course,

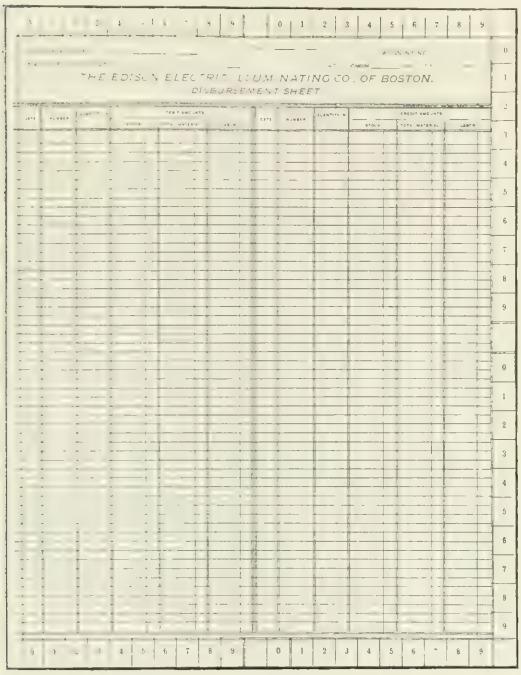
TABLE II.

Sub-Division of Accounts with "Original" Numbers

General Expense Accounts.			System of Distribution Accounts.			Generating Accounts.		
Ledger Accounts	Original Numbers.	Names.	Ledger Accounts	Original Numbers	Names	Ledger Accounts.	Original Numbers.	Names.
		OFFICE EXPENSES.	O.	20.	Distributing Dept. Exp.	O.	4[illegible]	Generating Dept. Exp.
O.	1.	Officers' Salaries.	A. D. G. O.	21.	Incandescent Lamps.	O.	41.	Fuel.
O.	2.	Office Pay Rolls.	A. D. G. O. R.	22.	Arc Lamps.	O.	4[illegible]	Water.
O.	3.	Office Sundries.	A. D. G. O. R.	23.	Meters.	O.	43	Oil and Waste.
O.	4.	Exploiting.	D. O. R.	24.	Buildings Wired.	O.	44	Labor Boilers.
O.	5.	Legal Expenses.	A. D. G. O. R.	25.	Street Cond's.	O.	45.	Labor Engines.
O.	6.	Stationery, Printing and Postage				O.	46	Labor Electrical.
O.	7.	Insurance.				O.	47.	
O.	8.	Taxes.				O.	48.	Battery Supplies.
O.	9.	Rents.				O.	49	Sundries
O.	10.	Miscellaneous Expenses.						
		TECHNICAL EXPENSES				R.	52	Station Building.
O.	11.					R.	53	Mechanical Apparatus.
O.	12.	Supply Department Pay Rolls.						
O.	13.	Freight, Teaming, etc.				R.	54	Boilers.
O.	14.	Boxing, etc.				R.	55	Engines.
O.	15.	Building Sundries.				R.	56.	Dynamos.
O.	16.	Miscellaneous Stock Exp.				R.	57.	Electrical Apparatus
O.	17.	Laboratory Exp.				R.	58.	Batteries.
O.	18.	Engineering Exp.				A. D.	[illegible]	Real Estate.
						A. D.	62.	Station Building.
						A. D.	[illegible]	Station Apparatus.

being inserted as fast as the first one is filled. Every invoice, requisition for material taken from stock, teaming ticket, petty cash ticket, or pay roll charge is entered directly on its proper sheet. In order that the sheets might be readily located a little system was designed of indexing around the edges of the sheet, which provides for indexing to six numerals. At the time the sheet is opened it has the unused numbers cut off, so that when it is put in its place it forms a part of as many flights of steps as there are figures used, and can be almost immediately picked out from among several hundred.

Weekly reports of the expenses are taken from the disbursement sheets on forms provided for the purpose and sent to the heads of departments interested, each department being furnished only with its own figures, the reports providing a comparison with the figures for



SAMPLE OF DISBURSEMENT SHEET.

the same account for the previous year. These weekly reports may perhaps be a refinement which, although desirable in a large company, might not be required by the smaller companies, but their omission would not at all interfere with the system, as monthly reports are also taken off and would answer the requirements of most of the companies.

Separate columns are provided on the disbursement sheets for the shipments from stock, and the footings of these columns are taken at the end of the month to form a transfer voucher which is entered upon the register of disbursements crediting stock and charging the proper accounts.

It will be noticed upon examining the sheet that it provides for showing the quantities of the articles charged up, and this is a great benefit which is taken advantage of wherever possible; for example, the number of carbons used, the pounds of coal burned, etc., are all entered upon the disbursement sheets, thus enabling all the required statistical data to be taken from this book. Being in loose leaf form, as many binders may be used as are needed, the limit being determined by convenience in handling.

For the encouragement of the smaller companies, Mr. Knight said that he had also tried this system in a small company and as far as it was adopted it was a perfect success.

A similar sheet is employed for the distribution of earnings. It is numerically indexed similar to the disbursement sheet, and the quantity consumed as well as the net amount of the bill is entered, thus enabling to be taken from these sheets all the data necessary, excepting the connected load, which is reported monthly by the contract clerk from his card catalogue of the different classes of contracts. The income sheets is the only place where the earnings are entered (excepting, of course, the customers' ledgers where only the net bills and dates of same are posted), as the old form of report of bills rendered or meter sheets have been done away with, and all the posting, etc., is from the customers' cards upon which the figuring is done. The income sheets are proved with the total amount of customers' bills, as shown by ledgers, the bank balance ledger form adopted nine years ago being used. Each ledger can be balanced separately with the income sheets and also with the station cash book in a loose leaf form, the collectors turning in the sheets which are filled out as they make their collections, and these sheets are consolidated with those showing the collections at the office and totals carried forward from sheet to sheet in the office.

The simplicity of this system from the treasurer's standpoint, who keeps the general books, will be seen when from the fact that he has but three journal entries to make each month, viz., (1) comprising the totals of the income sheets which is charged by him against accounts receivable and credited earnings and any other miscellaneous accounts interested, (2) the footings of the station cash book, which are charged by him to the station account and credited accounts receivable, and any miscellaneous accounts interested (the credit to the station account coming on his general cash book for the total amount deposited each month), and (3) the footings of the register of disbursements of which the principal credit is to accounts payable and the charges to the miscellaneous accounts interested.

National Reciprocity Convention.

A national convention for the discussion of commercial reciprocity will be held in Washington, D. C., beginning on Tuesday morning, Nov. 19, and continuing for three days. This convention will be composed exclusively of manufacturers properly accredited as delegates by trade and commercial organizations, and its deliberations will be confined to commercial reciprocity in its bearing upon the industries of this country and its influence upon our export trade. Those who desire to attend this convention and participate in its discussions should seek appointment as delegates from organizations with which they are allied, under the conditions set forth in a circular issued.

This convention is to be held in pursuance of action taken at the annual convention of the National Association of Manufacturers in Detroit in June, 1901, and subsequent action by the Executive Committee of that association. The committee of arrangements, appointed by the executive committee of the National Association of Manufacturers, met in Philadelphia at its offices and prepared a call, in part as follows, for the appointment of delegates to the convention:

"In pursuance of a suggestion advanced by the National Association of Manufacturers, at its annual convention in Detroit in June, 1901, and subsequent action by the executive committee of that association, arrangements have been made for the holding of a national Reciprocity Convention in Washington on Nov. 19. The sole purpose of this convention is to discuss the expediency and practicability of the broader application of the principle of commercal reciprocity as a means of expanding foreign markets for American products, without sacrificing the interests of any of our industries. The object of this convention is to ascertain accurately the views of representative manufacturers on this subject, and to formulate, if possible, some practical suggestion for such legislation or diplomatic negotiation as may be necessary to establish more intimate commercial relations between the United States and other nations."

President Search, chairman of the committee of arrangements, announces that as far as possible invitations to appoint delegates will be addressed direct to the various trade and commercial organizations of the country, but should any be overlooked through inadvertence or because of lack of information, it will be entirely in order for those thus omitted to address the committee of arrangements and to ask for instructions and credential blanks.

The co-operation of all organizations that embrace manufacturers within their membership is earnestly solicited in order to ensure the complete success of this effort to give definite form and expression to the views of the manufacturers of the United States on the subject of commercial reciprocity.

Electricity Building for the St. Louis Exposition.

The Electricity Building for the St. Louis Exposition of 1903 is the work of Walker & Kimball, of Boston and Omaha, who were chief architects of the Omaha Exposition. The structure is located on the main central avenue, and is one of the leading elements of the main Exposition picture. It will have a frontage toward the north

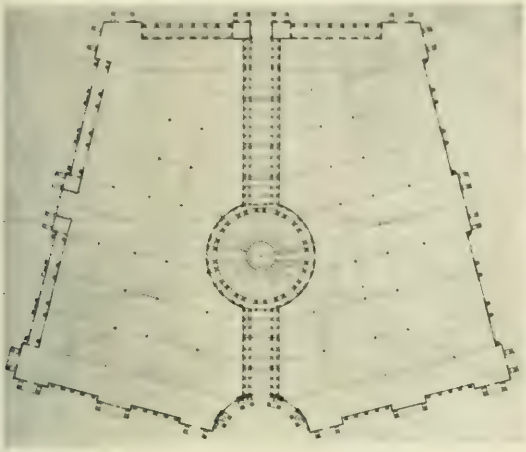


FIG. 1.—PLAN OF ELECTRICITY BUILDING.

of 650 ft., and toward the east of 525 ft., facing the main lagoon. The design is a bold columnated treatment of the Corinthian order. The columns are carried well down toward the ground, to give height to the facades.

The facades are well accentuated by elevated pediments and tower effects over the four main entrances and at the corners. Over the accentuated places, as well as over the twin columns, which form a pleasing variation of the treatment of the facades, opportunity for ample sculptural decoration is supplied.

The fenestration is bold and appropriate, giving ample light and substantial wall treatment. On two sides of the building are loggias which add pleasing effects of light and shadow. There are numerous openings on the facades, such as exhibitors always seek in selecting

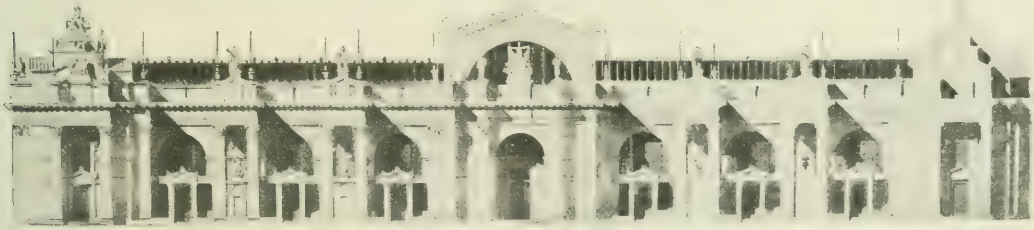


FIG. 2.—ELEVATION OF ELECTRICITY BUILDING.

their exhibit space. The plan of the building is simple and well treated, showing an effort to supply as much exhibit area as is possible with the 350,000 square feet of floor space. The exhibit space is compact and symmetrical. An extensive balcony sweeps around four sides of the building, supplying 100,000 square feet of additional exhibit space.

The Yale Bi-Centennial Exercises.

Yale University has just celebrated with great enthusiasm and eclat the two hundredth anniversary of its foundation, and New Haven was *en fete* during the whole of last week, when thousands of old Yale graduates and visitors thronged the beautiful City of Elms and joined in the various exercises appropriate to the occasion. A number of degrees were conferred, as noted editorially elsewhere in our pages.

It is needless to say that electric lighting and decorative effects formed a conspicuous feature of the Yale Bi-Centennial. Mr. Geo D. Foote, an electrical engineer of New Haven, prepared plans for the display. One chief feature was a liberty pole of electric lights, illustrated herewith. A big star surmounted the pole. From the pole there were festoons with tri-colored lights sweeping in curves from 240 to 420 ft. in length, centering in stars of lights at the old elm

YALE BI-CENTENNIAL ILLUMINATION EFFECT.

trees. There were also festoons of electric lights between the trees themselves. In these decorations it is stated that 4300 lights were required. The front of the City Hall was also outlined by electric lights, and elsewhere in this city electrical illuminations could be seen. The current for the work was obtained from the trolley system of the Fair Haven & Westfield Railway Company. The official contractor for the work was Mr. W. W. Gale.

New Telephone Patents.

Among last week's telephone patents was one covering the use of an arc lamp circuit as a telephone relay. In the latest issue of the Patent Office a patent is granted to Harry A. Rhodes, of Denver, Colo., on a telephone repeater involving the use of the phonograph. A record is made on the phonograph by a recording tool actuated by a solenoid, which takes the place of a receiver or repeating coil, and a tracing tool, impinging on the record transmits its motion by means of a multiplying lever to a microphone. The arrangement of coils and circuits to provide each line circuit with its respective recording and tracing apparatus at the repeating station is ingenious, but we fear that neither the arc lamp nor the phonograph will solve the telephone repeater problem.

An addition to the army of party-line selective bell systems is found in the invention of William W. Dean, of Chicago, to whom a patent has just been granted on a party-line system. As will be seen by the diagram the system is applicable to a four-station line, one plus and one minus bell on each leg of the metallic circuit, which, for signaling purposes, is adapted to be used as two distinct grounded circuits. Referring to the diagram, line 1 carries a plus bell at station C and a minus bell at station D, and line 2 carries a plus bell at sta-

tion A and a minus bell at Station B. The bells are permanently in series, and are shunted to telephonic currents by the non-inductive resistances a^1, b^1, c^1, d^1. It is clearly seen by the arrangement of ringing keys and generators that depression of key f^2 will connect positive current by the sleeve of the plug and spring e^1 of the jack, to line 2, and so ring plus bell at station A. In the same manner key f^3 will connect positive current by the tip of the plug to line 1, and so ring plus bell at station C. Similarly f^1 will ring bell at station B and f^4 that of station D.

When the receiver is taken off the hook at any station the ground connection is cut off and the telephone instruments are bridged across

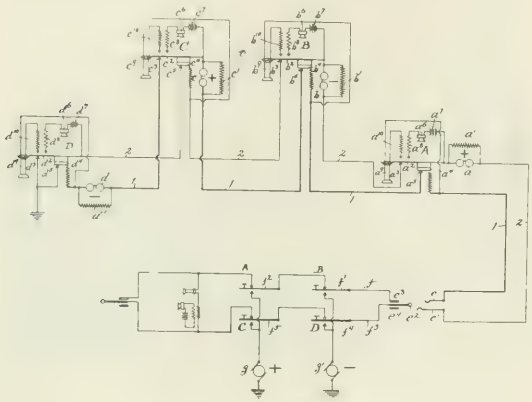
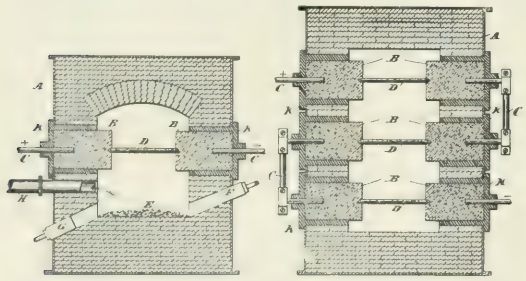


DIAGRAM OF DEAN SELECTIVE BELL SYSTEM.

the metallic circuit; in fact, as will be noticed by reference to the diagram at station A, removal of the receiver cuts off the line entirely beyond the station by the breaking of the line contacts at a^3 and a^5. This feature might be expected to cause some trouble in actual working.

Electric Furnace.

A very simple electric furnace, covered by patents issued Oct. 22, to William T. Gibbs, of Buckingham, P. Q., Canada, is illustrated herewith, Figs. 1 and 2 showing the construction in vertical and horizontal section, respectively. The heating chamber *A* is a built-up structure of firebrick or carbon blocks, formed with a reflecting dome, and provided with suitable charging and discharging openings *F*, *G*. The heating means comprises one or more carbon resistance rods *D*, clamped between carbon abutments *B*, which in turn fit into cast iron



FIGS. 1 AND 2.—ELECTRIC FURNACE.

sockets *K*, built into the walls of the furnace. Electrical connection is made through the conductors *C*, and in case volatile products are sought, these are withdrawn through the pipe *H*.

The distinctive feature of the furnace is the position of the heating resistance, out of contact with the charge under treatment, and immediatley beneath the reflecting dome. This general arrangement is similar to that adopted by Moissan for his earlier work on the chemistry of high temperatures, except that Moissan relied upon the arc as the source of heat. The furnace recalls, also, the early arrangement proposed by Bradley and Crocker in which a conductor is inserted in the top of the furnace chamber, the charge being heated, as in the present case, solely by radiation. But for general work the new furnace presents several clear points of advantage over prior forms, chief among which are the absence of the carbon dust and vapor which always emanate from the arc and which enter as a disturbing element into many reactions, the ready regulation of the temperature, and the adaptability of the furnace for currents of any character by connecting the resistance rods in series, as shown in Fig. 2.

Electric Street Railways for St. Petersburg, Russia.

For some little time past, it has been known that Mr. Murray A. Verner, of Pittsburg, Pa., who has been actively engaged in American electric railway enterprises for some years past, is endeavoring to change over the street railways of St. Petersburg to electricity. A special correspondent of the *New York Times*, under date of Oct. 15, writes in regard to this matter as follows:

The Municipal Council has been discussing the matter for several years, but Mr. Verner's offer is the first genuine step towards the introduction of electricity. The city owns three lines, and a number of other lines are owned and operated by two private companies. The city has begun legal proceedings against these companies, with a view of unifying all the surface traction companies. Mr. Verner's offer stipulates that the city shall turn the private lines over to him when the matter has been settled.

Mr. Verner's offer is regarded by the press as straightforward, businesslike and fair. It is too early to predict success, since many cooks help make a broth in this city, but the Municipal Council was not approached until Mr. Verner, who has been to St. Petersburg three times within 14 months, had carefully studied the whole problem from a financial and technical point of view, and, through his local representative, Mr. Heydecker, the American Vice Consul, had sounded various authorities about the matter. Mr. Verner's proposal is, briefly stated, to organize a company under the laws of Russia, with a capital stock of 50,000,000 rubles, and the right to issue bonds to the same amount. He states that he and his friends can supply the money. He would agree to complete the transformation of all existing lines into electrical lines within four years from the date of the franchise, and would so arrange the traffic that no needless change of cars would take place in going to and from the center of the city.

He would employ girder rails weighing 96 lbs. (English) to the lineal yard, except in the suburbs, where 80-lb. rails would be used. Overhead trolley wires would be employed, but the feed wire would be carried in conduits. Double-deck cars would be abolished and replaced by trains with three separate classes. The platform of the winter cars would be inclosed.

Bridges would be widened and strengthened where necessary at the company's expense, and the company offers to assume the burden of building a stone or steel bridge across the Neva near the palace, to replace the present wooden structure, the cost of the bridge to be deducted from the annual compensation payments. This is a point of great importance to the city, which is considering the issue of bonds for this purpose.

It is stipulated that Russian materials and Russian engineers and workmen shall be employed as far as available. The compensation clause stipulates the immediate payment by the company of the actual cash value of the inventory of the existing lines, the payment to the city during four years of the previous net revenue of the various lines, and the payement annually thereafter of a percentage of the gross receipts to be agreed upon by mutual consent.

The municipality shall enjoy the right of purchase at the end of 25 years, again after lapse of an equal period, and thereafter every 10 years. Bonds shall be paid for at par, and the net earning capacity of the shares shall be capitalized for purposes of purchase. The municipal lines have not been paying satisfactorily, owing, presumably, to increased cost of operation under municipal control. A decrease of about 50,000 rubles in the net revenue is anticipated for 1902.

Recent Figures of American Trade.

The United States continues at the head of the list of the world's exporting nations. The comparative figures prepared each month by the Treasury Bureau of Statistics, exhibiting the imports and exports of each of the principal countries of the world, and the average per month during a given period, show that the domestic exports from the United States are greater than those from any other country, and that the monthly average during the year 1901 has been higher than that of any other country. For the nine months ending with September, our exports of domestic products were $1,024,605,181, against $1,018,845,768 from the United Kingdom, the next largest exporter of domestic products in the same period. While a comparison during the same period with Germany, France, Russia, Netherlands and India, which follow in the order named in the magnitude of their exports, is impracticable, because their fiscal years are not conterminous with that of the United States, the totals of their exports during the latest available years show not only that the United States is clearly in the lead as an exporter, but that the growth in her exports has been more rapid than that of any other great exporting nation. In the calendar year, 1900, for which the statistics of most exporting countries are now available, the figures for the United States were $1,453,013,659 of exports of domestic products, against $497,263,737 in 1875, an increase of nearly 200 per cent during that period, while those of Germany were in 1900 $1,050,611,000, and in 1875 $607,096,000, an increase of 73 per cent, and those of the United Kingdom, in 1900, $1,418,348,000, and in 1875 $1,087,497,000, an increase of about 40 per cent.

The very latest available data for comparing the commerce of the United States with that of other countries, however, are furnished in a statement just prepared by the Treasury Bureau of Statistics, which shows the monthly exports of domestic merchandise from each of the principal countries of the world during that period of its fiscal year for which statistics are available. This shows that the monthly average for the United States is greater than that of any other country, and that the figures of 1901 show in the case of the United States a material increase over those of 1900, while those of the United Kingdom and Germany show a decrease. The average monthly exportation of domestic merchandise from the United States in the nine months ending with September, 1901, was $113,935,020, against $112,529,440 in the corresponding months of last year, an increase of about $1,500,000 per month, while those of the United Kingdom were in the same months of 1901, $113,205,085, against $118,132,533 in the same months of 1900, showing a decrease of about $5,000,000 per month, and those of Germany were $87,831,833 per month for the six months ending with June, 1901, against $88,520,833 for the corresponding months of the preceding year, showing a decrease of a little less than $1,000,000 per month.

Average monthly export from.	1900.	1901.
United States	$112,529,440	$113,935,020
United Kingdom	118,132,533	113,205,085
Germany	88,520,833	87,831,833
France	64,299,143	66,447,000
Netherlands	53,018,558	56,790,923
India	26,382,142	31,233,845
Austria-Hungary	31,573,017	30,290,724
Belgium	28,710,857	27,994,285
Russia, European	22,608,600	26,036,200
Italy	21,124,529	21,943,518

The above table shows the average monthly exportation of domestic merchandise from the 10 principal exporting countries of the world for such portions of the fiscal year as the statistics are available, and compares the monthly figures of 1901 with those of 1900.

Transandine Railway Projects.

Receipt of inquiries from subscribers as to the Transandine Railway offering an opportunity for the securing of various mechanical and electrical contracts, has led Electrical World and Engineer to make a somewhat exhaustive effort to locate parties who are primarily interested in the enterprise. A representative of this journal has seen several prominent people, including bankers, railroad officials and exporters, who are in close touch with Chili, and the sum and substance of the information that could be gathered is that the railway will not be built. Some 15 years ago Clark Brothers, a large contracting firm, obtained a concession from the Chilian and Argentine governments for the purpose of constructing a road between Los Andes, a Chilian town at the foot of the Andes range, near Valparaiso, and Menoza, on the Argentine side of the mountains. The road as surveyed would be about 70 miles in length. It was proposed to construct a spiral railway up the Andes to an altitude of some 4000 ft., then pierce an 8-mile tunnel—4 per cent grade—through the mountain, and then build a spiral road down to Menoza on the Argentine side, at which point the road would connect with the Argentine railways. Up to 1896 little or nothing was done, except build the road from Los Andes about 15 miles in length in the direction of the mountains. This road, owing to the floods which occur frequently in that region, is now practically entirely destroyed. In 1896 the firm of Clark Brothers was declared bankrupt, the principal creditors being the Bank of Chili and the Bank of Tarapaca. From the date of the Clark failure up to three months ago nothing more has been heard here of the Transandine scheme. Last July a press dispatch dated London stated that J. Pierpont Morgan and others were interested in the concession for which £90,000 had been paid (presumably to the Clark creditors). Mr. Morgan, however, denies any knowledge of such transaction, while W. R. Grace & Co., who were reported to be interested in the deal, have nothing to say, except that such a matter would have been handled by their London interests, Grace Brothers & Co., Limited, of Ladenhall Street, London, E. C.

Burlington Suburban Service at Chicago.

Quite a stir was created last week by the publication in a Chicago newspaper and also in an electrical journal of the intention of the Chicago, Burlington & Quincy Railroad to operate electrically its suburban service out of Chicago, using the third-rail system, which has been patented by E. W. Farnham, superintendent of car service of the Burlington road. Mr. Farnham emphatically denied the story to a representative of Electrical World and Engineer, and says that his company has never even considered the electrical operation of its suburban service. A number of engineers and others interested, have been invited to witness a demonstration of Mr. Farnham's third-rail system, which is termed "The Electric Traction Power Feeder," at the Burlington freight yards at Clyde, west of Chicago, on Saturday, Nov. 2.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN ITALY.—A Paris dispatch states that a private wireless telegraph system has been established between Spezzia and Sardinia, a distance of 122¼ miles.

STUDYING RAPID TRANSIT.—A special cable dispatch from London, Oct. 29, says: Messrs. August Belmont, John B. McDonald, Bryan, Deyo, Van Vleck and Stillwell, having completed their survey of the underground railroads of Europe, start on their return to New York to-morrow on the White Star liner "Oceanic." They have obtained much useful information for the benefit of New York City's underground road. Mr. Belmont said to-day: "We met with the greatest courtesy everywhere, and all possible opportunities of seeing what we wanted to see were granted to us. We secured much valuable data, especially regarding stations and power houses. It would not be courteous if I made comparisons of the various roads we went over. You cannot compare London's 'tube' with the New York road, for our line is being constructed on a different principle."

CZOLGOSZ EXECUTED.—On Oct. 29, at Auburn, N. Y., the assassin Czolgosz, who shot President McKinley, was "gerrycided," or subjected to the process of execution by electricity at Auburn, N. Y., State Prison. Electrician Davis administered an alternating current at 1700 volts for seven seconds, reducing it slowly for 45 seconds, and then turning it on full again for eight seconds. At the suggestion of one of the doctors, he then switched the current on once more for a few seconds, although "the lack of resistance proved that life was extinct." One of the official witnesses summoned to serve on the jury was Mr. C. R. Huntley, the well-known manager of the Buffalo General Electric Company, formerly president of the National Electric Light Association, and a friend of the McKinley family. Another juryman was Mr. Ashley W. Cole, the State Railroad Commissioner.

WIRELESS TELEGRAPHY.—It is alleged that while the "Campania" and "Lucania" were passing on the Atlantic last week, they exchanged wireless telegrams at distances up to 170 miles. The "Campania" also signaled the Nantucket lightship when 100 miles away.

HOUSE ELECTROPHONES.—It is reported in the newspapers that the London Electrophone Company has offered a tariff of $12 per annum for electrophone house service. The company, it is stated, now transmits from the Grand Opera House and the leading amusement halls and churches in the city.

DON'T BE THANKFUL.—Lord Rosebery made a speech in Birmingham, England, on Oct. 15, in which he complained of the complacent apathy of the people of Great Britain. He said they needed to be inoculated with the nervous energy of the Americans. "Be thankful," he added, was a motto that spelled decay. A satisfied nation was a lost nation.

ELECTRIC TRACTION IN SWEDEN.—The Swedish Government has ordered the directors of the State railways to prepare plans for converting the steam railways of the kingdom to electrical traction. Power will be provided by numerous waterfalls, the Supreme Court having recently decided that most of the river waterfalls belong to the crown, and not, as commonly believed, to the riparian owners.

RENOVATING BUCKINGHAM PALACE.—In the renovation of Buckingham Palace, 500 artisans are engaged. Besides repainting and redecorating the building, important structural alterations are being made in the interior. Among many other improvements are elevators, telephones and electric lights. The elevators are elctrical of American make. King Edward, while a stickler for medieval splendor and etiquette, is in many ways a man of progressive ideas.

DEVICES FOR PARISIAN POLICE.—That their heavy tread may no longer give alarm to Parisian malefactors, M. Lepine, Prefect of Police, has decreed the abolition of the top boots of policemen in favor of light, noiseless shoes. Another startling innovation is announced in the form of a so-called "lighthouse cop," with red and white incandescent bulbs on his kepi and at the end of his baton to enable the traffic brigade to convey orders at dusk to coachmen by pressing a button.

PHILIPPINE TELEGRAPHS.—Brig.-Gen. A. W. Greely, chief of the United States Signal Office, has arrived in London after five months spent in Japan and the Philippine Islands, inspecting the army and navy telegraphs and cables. After making some official investigations in London, in connection with the cable service, he will return to Washington. General Greely is well satisfied with the efficiency of the 6000 miles of cable and telegraph lines now working in the Philippines. He considers that the country and people both offer great possibilities, and he is enthusiastic over the Japanese telegraphic systems.

SUBMARINES FOR ENGLISH CHANNEL.—The question of submarine transit of the Channel is occupying the minds of inventors. M. Goubet, inventor of an electric submarine boat, has made a perfect model of a passenger boat, 25 meters long, to run by electricity on a steel wire cable at a uniform depth of 15 meters. Passengers can be carried in salon compartments, with electric light and every convenience. The passage would be as easy as a railway, with no vibration. Perfect safety is insured by an iron weight, which in case of need can be dropped, and the boat will rise to the surface. The estimated speed is 20 knots. Capital is the only thing required, says the inventor.

THE BALLOONIST SANTOS-DUMONT, who has recently attracted so much attention with his dirigible balloon in Paris, has been an active automobilist, and is now an advocate of the electric vehicle. In an article in the November *Century Magazine* he is quoted as saying: "I was once enamored of petroleum automobiles, because of their freedom. You can buy the essence anywhere, and so, at a moment's notice, one is at liberty to start off for Rome or St. Petersburg. But when I discovered that I did not want to go to Rome or St. Petersburg, but only to take short trips about Paris, I went in for the electric buggy." He uses "a dainty light-running, American buggy," for all his traveling around Paris on solid ground.

WIRELESS, ET CETERAS.—Recently the newspapers have contained cablegrams concerning what is called the Orling-Armstrong system of wireless telegraphy and telephony, in which earth currents are said to be used, and also a system of the same inventors for the wireless control of torpedo boats. This latter system appears to be the one which was exploited in the cable columns of the newspapers about four years ago, the inventor being a Swede, and apparently the same man, Orling, whose name is mentioned in the English dispatches. The "Armorli" system—as it is called—is stated to employ merely a spike at the receiving and transmitting ends in sending telephonic and telegraphic messages. Newspaper accounts refer to experiments in which, with bases 1500 ft. distant, telephonic conversation was held.

HEAVY TRACTION TESTS.—The dynamometer car owned jointly by the Illinois Central Railroad and the University of Illinois arrived in New York this week, and will be run over different divisions of the New York Central Railway. The car is in charge of Professor Edward C. Schmidt, of the University of Illinois, who is assisted by Mr. Snodgrass, one of his students. The tests are being directed by Mr. B. J. Arnold in connection with his investigation for the New York Central on the subject of heavy railway electric traction. Considerable data was obtained on the trip of the car from Chicago to New York, and a large number of tests will be made on the New York Central lines with different weights of trains. In connection with these tests information will be obtained as far as practicable on wind resistance.

A TESLA WIRELESS TELEGRAPH PATENT.—In his investigations Marconi discovered that it was desirable to have the aerial wire used in wireless telegraph in inductive relation with the transmitter or receiver circuit instead of connecting it directly thereto. A patent granted Oct. 22 to Nikola Tesla relates to such a form of inductive arrangement, and also provides for subjecting the same to a low temperature. As illustrated, the inductive element of the aerial wire is in the form of a spiral of many turns, and is immersed in a vessel containing a refrigerant. Surrounding the vessel are a few turns of conductor, which may be connected at will either to the transmitting or receiving circuit. In the specifications and claims the above arrangement is referred to as a circuit adapted to vibrate freely, and it is stated that the inventor has discovered that when such a circuit is maintained at a low temperature, the oscillations excited in the same are magnified and prolonged to an extraordinary degree. This is attributed to the increased intensity of current in the primary circuit, as well as to the greater number of oscillations obtained in the secondary circuit.

WATERWHEEL GOVERNING MECHANISM.—A patent issued Oct. 22 to Paul M. Lincoln and Lewis B. Stillwell relates to a type of hydraulic governing mechanism based to some extent upon the principle employed in the mechanism of steam steering gear, but with an important addition to provide for the case of alternators running in parallel. As illustrated, the core of a solenoid is connected to one end of a lever, the other end of which, in its normal position, is midway between two contact disks. When through a change of speed this end of the lever makes contact with one or the other of the disks, the circuit of a magnetic clutch is closed, and one of two gear wheels thereby thrown into mesh, the result being that the waterwheel gate is either raised or lowered. The solenoidal coil is mounted on a vertical shaft geared to the shaft actuating the waterwheel governing gates, so that as soon as motion is given to the latter shaft, the solenoid core is raised or lowered until it reaches such a position with respect to its core as to cause the lever to change its position and disengage the contact from the disk. When this occurs equilibrium is restored. To provide for the necessary conditions incident to parallel operation, the two contact disks are also subject to change of position with respect to the fulcrum of the contact lever. The disks are mounted in connection with governor balls on a vertical shaft receiving motion from the organization, whose speed is to be regulated. By this latter means any necessary relation between speed and load may be obtained.

LETTERS TO THE EDITORS.

The Josse Waste Heat Engine.

To the Editors of Electrical World and Engineer:

Sirs.—The article on the Josse binary vapor engine in your valuable paper of Aug. 10, I perused with great interest. The closing remarks, wherein you cite an instance of a refrigerating engine being destroyed by the action of sulphurous acid, may give rise to the belief that such destruction is unavoidable. Regarding this, I beg to remark that sulphurous acid ice machines have been built and operated for decades, especially in France, and for many years in Germany, without causing any trouble, nor has any destructive action been apparent.

When employing a machine of proper and suitable design, using pure sulphurous acid, a difficulty of the kind referred to is entirely out of the question, for SO_2 attacks metals only when water or air is present. As all pressures in the binary vapor engine are above the atmospheric, the entrance of water or air into the engine, as may be the case with refrigerating machines, is entirely exluded. In point of fact, binary vapor engines have been running the past year and a half without any difficulty of the kind arising.

EMIL JOSSE.

TECHNICAL HIGH SCHOOL, BERLIN, GERMANY.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the letter of Dr. Roeber in your issue of Oct. 12 in regard to concentration changes in the pores of the plates of the Edison accumulator, and also your suggestive editorial comment on the letter.

Undoubtedly such changes take place. Whenever a current passes through an "electro-chemical field" from anode to cathode, as is well known, there is a concentration of the kations at the cathode and anions at the anode. This can be explained by the ionic theory on the ground that the ions bear electric charges and the electrostatic attraction due to the potential drop causes them to move slowly through the electrolyte. This electro-chemical movement is comparable to the falling of fine particles through a retarding medium under the influence of gravity. For example, there is a complete analogy between the mechanical falling of precipitated chalk through water and the electro-chemical transport of copper from anode to cathode in electro-plating. The friction of the particles is so great that they move not with accelerated motion, but at a constant velocity.

Granted, however, that there are such concentration changes and that the caustic potash solution becomes more concentrated at the nickel superoxide plate and more dilute at the iron plate, such changes would have small effect on the voltages of the cell.

The e. m. f. of the nickel superoxide plate against hydrogen would be at different concentrations,

$$e_1 - e_2 = \frac{0.058}{2} \log \frac{p_1}{p_2}$$

where p_1 and p_2 are the aqueous tensions of the two caustic solutions. A similar formula comes in for the positive plate. This would show that the change from a 20 per cent solution to a 1 per cent solution would make very slight difference in the voltage of the cell (not much over 0.03 volt), and not at all sufficient to account for the steady drop of voltage of the new accumulator. In the lead cell we have, however, for acid of density 1.496 a voltage of 2.29, and for acid of density 1.028 a voltage of 1.83—a difference of 0.46 volt.

So this drop in voltage due to concentration changes in the Edison cell is not at all comparable to the change of voltage due to concentration of acid in the lead accumulator, where a more complicated formula, due to the fact that both the dissolved substance and the solvent take part in the electro-chemical reaction,

$$(Pb\,O_2 + Pb + 2\,H_2 - SO_4 = 2\,Pb\,SO_4 + 2\,H_2\,O)$$

must be deduced. We also see from the above equation that the changes in concentration in the pores of the plates are much more important with the lead cell than with the new Edison accumulator, as well as producing more effect on the voltage.

The change in the resistance of the Edison electrolyte in the pores of the plate is negative; that is, the resistance of the positive increases more than the negative decreases. This will account for some of the fall in the discharge, but not for all.

The drop is probably due in great part to the fact that at first the current acts electro-chemically on the particles of oxide in the best electrical contact with the plate, and at the end of discharge must find as its depolarizer, oxide electrically remote from the plate. A corresponding drop will be found also at the iron plate. The most important consideration is the resistance of the briquettes as affected by changes of the discharge and charge as well as by changes of the resistance of the electrolyte. Certain compounds as NiS, FeS, PbS, Fe_3O_4, PbO_2, and CuO act as fairly good conductors of the first class. In the Edison cell, the oxides must be conductors to some extent.

The probable reason for the so-called electro-chemical "passivity" is the fact that the products of the electrolysis are insulators, and so protect inside layers. The strength of the lead cells is in the Pb and PbO_2 as metallic conductors, while conversely its weakness lies in the lead sulphate. The strength of the new Edison accumlator partly lies, no doubt, in the fact that the products of the electro-chemical action conduct, but largely also in the skillful combination of mechanical and electro-chemical treatment in the manufacture of the plates by the inventor.

WOOLSEY MCA. JOHNSON.

TRINITY COLLEGE, HARTFORD, CONN.

Some Elementary Requirements in Export Trade.

To the Editors of Electrical World and Engineer:

Sirs.—We are readers of your valuable "Export Issue," and have acquired some first-class sole selling agencies for this country through it. We are go-ahead people, but we cannot run our heads through a wall; that is to say, the people and business usages of different countries must be taken into consideration, which very few manufacturers do.

America is no doubt ahead of any country as far as inventions and manufacture go, also as to prices and time of delivery, and this country is about the slowest, but pays best prices for electrical appliances and novelties, of which we make distribution. Everything new is looked upon with suspicion here, even if testimonials from another company's experts are produced.

We do not exactly know the commercial way of working in the United States of America, but must infer that there are different methods from those here. The experience we have in dealing with American manufacturers has been the following, which are no doubt drawbacks that could be done away with if manufacturers on your side would know and notice them:

It generally takes three weeks before we can get an answer to our letters, but if the mail steamer's name is put on outside of the envelope on each side of the pond and it is posted on mail days, at least four to five days' time can be saved. Most manufacturers do not answer letters on day of receipt, and we have had instances where we have had to correspond and wait for replies, etc., so that it has taken us three and four months to fix up an agency, and we believe outside the loss of time many firms here would have given it up. The correspondence has also mostly been to point out how business could and ought to be done here, while United States of America manufacturers only seem to judge by their country's methods.

An agency for the sole sale of a manufacturer's specialties is the best here, and to the manufacturer's interest, because if he allows several jobbers to export, price-cutting will soon spoil the sale of the article and nobody can make any profit. We find that American manufacturers are very slow to understand this, and that they ought to protect their sole agent or contractor, and at least tell all buyers on your side that goods cannot be shipped to Great Britain, as the sole-selling right has been granted to a London firm, and also all inquiries and orders from this country ought to be sent back to the agent.

Hardly any firm here will buy merely from illustrations and samples, but if orders are given they want goods at once delivered and will either pay cash with order or against documents, but only after they have seen the goods. The manufacturers do not want to sell except on one of the above terms, and therefore no business can result unless the agent or contractor does it. For this and the expenses to introduce and promote the manufacturer's goods, the strict enforcement of the sole selling rights, we think, ought to be granted. Of course, the agency is only given for a certain time to give the manufacturer as well as the agent chances both ought to have.

Further, the United States of America manufacturer expects orders at once, and in many instances imposes certain conditions, but he will not protect his agent as mentioned above, and tries to make

his only object to force orders, and often in unfair ways. If orders are not forthcoming at once, answers to letters may not be expected any more.

Another point, nearly half of the United States of America firms do not frank their letters sufficiently. This is a common complaint here. We have paid from 10 to 50 cents a letter, simply because we expected some important news, and if we were to let the letter go back three weeks' time would be gone. The contents were often circulars, which could have been sent for 2 cents "per bookpost" up to 2 ounces. Letters ought to be weighed, the postage being 5 cents *for every half* ounce weight. Post cards 2 cents.

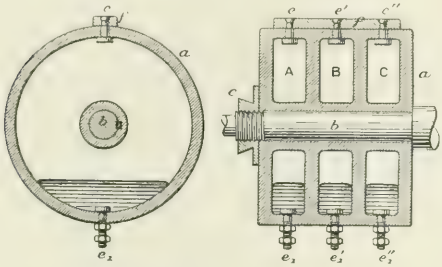
We must say that we are surprised that most of your manufacturers lack such commercial smartness as against their other cleverness and superiority. But they ought to remember other countries' usages and have more patience, else they will "kill the goose that is expected to lay the golden eggs" and do no business.

THE EXCELSIOR ELECTRIC COMPANY,
LONDON, ENGLAND. J. ALEXANDER, *Manager*.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Starting Three-Phase Induction Motors.—An illustrated description of a device of a French company for starting three-phase induction motors, a resistance being in the secondary circuit when the motor is started, and being automatically cut out when the motor has run up to a certain speed. The device can be seen from the adjoining figures. A cylinder *a* of insulating material is mounted on the axle *b*



STARTING THREE-PHASE INDUCTION MOTORS.

of the secondary of the induction motor and revolves with it. This cylinder is divided into three parts *A, B, C,* insulated from one another. In the walls of each of these three parts, there are two metallic screws at two diametrically opposite points, e and e_1, e' and e_1'', e'' and e_1''. The three screws e, e' and e'' are connected together by the metallic rod f; on the other hand, the other three screws e_1, e_1', e_1'', are insulated from one another and are connected to the three points in which the star connected armature windings of the motor are connected with starting resistances, placed in the armature. It is evident that as long as the three screws e_1, e_1', e_1'' are insulated from another, the starting resistance is inserted in the armature, but when these three screws are connected together by a conductor, it has the same effect as if the starting resistances were cut out. For this purpose a certain amount of mercury is placed in the drum. When the motor starts and runs up to full speed, the mercury is revolved, and, on account of the centrifugal force, finally forms itself into a ring, so that it covers the whole of the walls of the three compartments. The screws e', e_1, e_1'', are thus connected through the mercury to the three screws e, e', e'', and as the latter are connected together by the conducting rod f, the former three screws are short circuited. By adjusting the amount of the mercury, the moment at which the starting resistances become inactive may be varied.—*L'Ind. Elec.*, Oct. 10.

Operation of Alternators in Parallel.—A report on the discussions of a section of the Int. Soc. of Elec. in Paris on this subject. The coefficient of irregularity of a steam engine is defined as the difference between maximum and minimum speed, divided by double the average speed during one revolution. It has also been proposed not to give the coefficient of irregularity, but the maximum angular deviation of the crank from an ideal crank which revolves with uniform speed, the latter value is more important than the coefficient of irregularity. Electrical engineers are asked to give their opinion on the greatest value which should be allowed for the angle, representing the maximum angular deviation, or rather for the product of this angle with half the number of poles of the alternator. Labour allows an upper limit for this product of 45 degs. Under these conditions he was able to operate in parallel alternators driven by steam engines with others driven by turbines which were at a distance of 48 miles from the former. When an alternator with a frequency of 50 is in service alone, the above mentioned product may be 60 degs., without affecting the apparent constancy of the voltage. He also suggests a method for determining the mass of the flywheel which limits the above angle to 45 degs., for alternators of a frequency of 50. Some data are given by Chevrier, Loppe, and David on the behavior of steam engines.—*L'Eclairage Elec.*, Sept. 21.

Synchronous Converters.—THORNTON.—The conclusion of his paper on synchronous converters and phase-swinging. He gives the mathematical theory of the energy dissipated in the core and then discusses the effect on the generator. The immediate effect of phase-swinging on a generator is to vary periodically the retarding torque. If the disturbances are synchronous with the fluctuations of crank effort, there is a cumulative oscillation imparted to the magnet wheel which aggravates the current fluctuations in the circuit and may in time lead to one or all of the converters breaking step. A somewhat sluggish governor is thus an advantage, for the electric disturbances are rapid impulses rather than sustained loads. Flywheel design for synchronous motor driving is really a question, in the first place, of motor design, so that the moving parts may not be subjected to synchronous oscillations of load between governor and motor. There will, however, be a minimum weight of wheel for each motor or converter on the circuit. This will depend on the variations of the engine power, and on the mechanical disturbances experienced during the phase-swinging of the rotaries, though these may not be synchronous. He discusses this question mathematically.—Lond. *Elec.*, Oct. 4.

REFERENCES.

Induction Motors.—TRYLSKI.—An illustrated description of large three-phase induction motors, built by Alioth Co. for driving air compressors. Each has a capacity of 500 horse-power, the speed being 100 r. p. m., the voltage 5000, the frequency 25.—*L'Eclairage Elec.*, Aug. 31.

Graphical Theory of Synchronous Motors.—VERHOEKX and BLONDEL.—A communication by Verhoekx referring to a special point of Blondel's paper on the graphical theory of synchronous motors (Digest, Aug. 10). He gives a graphical method for determining the wattless current as a function of the excitation at constant power. Blondel replies that Verhoekx's method, although interesting, does not accomplish more than his own method.—*L'Eclairage Elec.*, Sept. 14, 28.

POWER

Large Transmission Plant.—A note on the projected large power transmission plant at the Urft, for supplying electricity to Enskirchen, Dueren and Aachen in Germany. There will be eight 1280-hp turbines, direct coupled with dynamos, and they are expected to yield 8000 horse-power in the winter, and in the summer at most 6000 horse-power. The cost of 1 horse-power-hour has been calculated at 0.125 cent at the turbine, but by transmission the cost will increase to 0.25 to 0.38 cent. The cost of the dam is calculated at $920,000, and the cost of the whole installation at about $1,250,000.—Lond. *Eng'ing*, Sept. 27.

REFERENCES.

British Three-Phase Colliery Installation.—An illustrated description of the system of power transmission at the Denaby and Cadeby

collieries which have recently installed a very satisfactory three-phase power station and haulage plant. The haulage plant is driven by two 110-hp induction motors, while other induction motors are used for driving pumps, a pug-mill and a stone breaker.—Lond. *Elec. Rev.*, Sept. 27.

Wind Turbines for Generating Electrical Energy. Corz.—An account of a test made during a whole year. The trial station consisted of a wind turbine of a maximum capacity of 50 horse-power, a 30-hp dynamo, a large battery, a switchboard, a power transmission for supplying 7 horse-power daily for 10 hours, and a lighting installation of 20 incandescent lamps of 16 cp. The trial station was in a windy country, and the 7 horse-power for power and 3 horse-power for light were obtained every day without exception.—*Elek. Anz.*, Sept. 29.

Electric Pumps.—Hicks.—A paper read before the Pac. Coast Elec. Transm. Ass'n on possibilities and limitations of electric pumping. He deals with feed and circulating pumps, the use of Stork pumps, deep well pumps, pumps for irrigation, the operating of mining pumps and centrifugals for water works. He gives brief descriptions of several pumping installations. He is somewhat in favor of a rotary or centrifugal type, because of the advantages and possibilities offered by reason of the single revolving element in direct connection with electric motors. An account of the discussion which followed is also given.—*Jour. of Elec.*, Sept.

Electric Equipment of Cranes.—Rung.—A continuation of his illustrated article. In this part he deals with controllers for both direct and alternating-current motors for cranes.—Lond. *Elec. Rev.*, Sept. 27.

Climate and Power Transmission.—McAdie.—A long and well illustrated paper, read before the Pac. Coast Elec. Transm. Ass'n, on "Climatological influences and electric transmission." He deals especially with the influence of fog and with the climatological conditions at the Pacific Coast.—*Jour. of Elec.*, Sept.

California Power Transmission.—Galloway.—A well illustrated article on the 142-mile electric power transmission plant of the Bay Counties Power Co., Calif.—*Eng. News*, Oct. 3.

Dutcher.—A long abstract of his Pac. Coast El. Transmiss. Ass'n paper on the transmission line construction of the Bay Counties Power Co.—*Eng. News*, Oct. 3.

Traction.

Conduit Railways.—Three profusely illustrated articles, one anonymous, the second by Connett, the third by Philipps. There are three different systems of conduits, the side slot throughout, as in Brussels; or the side slot deflected to the center at track points, as in Paris; or the center slot, favored mostly in the United States. Of these three the deflected side slot is thought to be the best, as there is not such a heavily iron-clad road surface as with the center slot, and the interconnected track and plough points, unavoidable with the undeflected side slot, are obviated. There are now 270 miles of conduit tramways in the world. A few details of construction on the most important lines in different cities are given. Connett's objections to the conduit are: The cost of installation; dependence upon the municipality for a fairly effective system of sewers; the change from trolley to plough or vice versa to allow through cars to run over both; increased cost of maintenance and renewals of special track work due to the slot frogs and switches; greater care and attention necessary in the maintenance of the plough than of the trolley. But he adds that "despite these objections, the open slot conduit is in his judgment by far the best and most economical method of operating a metropolitan street railway in the present stage of electrical development, when overhead rights cannot be secured. From estimates of the cost it appears to be possible to construct rather more than twice the mileage of overhead trolley for the money required by the conduit."—*Traction and Transm.*, June; abstracted in Lond. *Elec. Rev.*, Oct. 4.

Electric Railway Matters.—An editorial summary of several new schemes and developments. In Great Britain the contract for the electrical conversion of the Mersey railways has gone to the Westinghouse Co. The cost of operation, which is now 31 cents per train-mile for steam traction, is expected to be reduced to 13.5 cents with electric working. One section of the Behr monorail system is expected to be completed in the spring of 1903; but the entire road between Manchester and Liverpool may not be ready before 1905. The Prussian R'y Administration has reported on the electric railway equipments on the Wannsee line (third-rail suburban line), and elsewhere. While electricity is considered to have many advantages, it is said to compare very unfavorably with steam in regard to cost. Quite a number of electric railway schemes which are so far only propositions, are also mentioned.—Lond. *Elec. Rev.*, Oct. 4.

Electricity on the Belgian Light Railways.—A note on the introduction of electric traction on the Belgian light railways. The rolling stock consists of 22 motor cars and 22 trailers, the former carrying 35 and the latter 40 passengers. The current is supplied to the cars by overhead trolley wires supported on side poles. To reduce risk of electrolysis, there is a return conductor consisting of old rails laid in concrete, which is connected up to the main rails at every 85 meters. The motor cars each have two 30-hp motors. Since the change was made the patronage of the lines has increased 40 per cent. —Lond. *Eng'ing*, Oct. 4.

New York Rapid Transit Subway.—A description of the work now being carried on in New York City for the construction of the new Rapid Transit Subway. Drawings are shown of the type of construction used. For the greater part of the distance the Subway is but a short distance under the streets, and the work proceeds by excavation, although in a few places deep tunnels are being run where the distance below the surface is too great to use the usual method. At one place a depth of over 100 ft. is reached. Compressed air is used extensively in operating hoists and rock drills. In numerous places the excavation is in solid rock. Electric cranes are used in some places instead of compressed air. The fixed charges in this Subway will probably be approximately the same per mile of track as on the Manhattan Elevated Railway in the same city, although as yet there is no means of determining this definitely.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Some Railway Problems of Brooklyn.—Greatsinger.—A discussion of the various local conditions adverse to the proper supplying of transportation facilities in the Borough of Brooklyn. By far most passengers use the lines for transportation to Manhattan. One of the greatest obstacles to good service on the through trains is the limited capacity of the bridge across the East River. This bridge is now loaded to its utmost capacity, but two other bridges are in prospect and a tunnel will soon be commenced. Plans were made some time ago for the enlargement of the generating capacity and work has been commenced upon a large new power station. The supply has been so small, however, that the electrical operation of trains on the elevated railroad has been suspended, and the company has bought high-tension current from the lighting company, a separate concern, which it has transformed into its ordinary railway direct current. It is expected that when the power development contemplated has been completed, a sufficient supply will be obtained to last until 1906, the power being doubled from what it is at present by the addition.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Barbillion and Griffisch Traction System.—Reyval.—An illustrated description of this system which is intended to combine the advantages of the conduit system with those of the surface control system, to be less expensive than the conduit system and safer than the surface contact system. There is an entirely closed conduit below the track. A small motor carriage runs in this conduit with a speed which is always above that of the motor car on the track. The small carriage in the conduit makes contact between the contact blocks and the main, and is arrested on its way by a series of catching devices, each corresponding to a surface contact plug. When the motor car on the track reaches such a point, it releases the small carriage in the conduit so that the latter then continues its run and goes ahead to the next surface contact plug, and so on. The arrangement of the system is described in detail and illustrated.—*L'Eclairage Elec.*, July 20.

References.

Tram Car Motors.—Collischonn.—A description of motors of Lahmeyer & Co. The air-gap between the pole pieces and the armature is 4 mm. The engravings show that all parts are easily accessible. The number of armature coils is between 33 and 37. The motors are rated on the basis of continuous run under full load for one hour, with a rise in temperature not over 70 degs. C. above the surrounding temperature. Particulars are given of three of the types of the motors made by the company.—*St. R'y Jour.*, Int. Ed., Oct.

Surface Contact System.—Reyval.—An illustrated description in detail of the surface contact system of Felice, Tosi and Parboni. The feature of the system is a special commutator or contact box claimed

to be of solid and simple construction, so that the system is said to be less expensive than other surface contact systems. The system has been experimented with for six months in Rome on a trial line with good results.—*L'Eclairage Elec.*, Aug. 10.

Rolling Stock.—Chamberlin.—An illustrated article on the rolling stock of Greater New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Car Maintenance.—Millen.—An illustrated article on car maintenance on the Metropolitan Street Railway in New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Tramway Transfers.—Root.—An article on transfers and transfer problems with special relation to New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Street Railway Convention.—A full account of the proceedings at the recent convention in New York is given in the daily editions of the *St. R'y Rev.*, Oct. 9 to 12.

Installations, Systems and Appliances.

Gas and Electricity.—Martin.—A paper read before the Pac. Coast Gas Ass'n on "Practical power transmission." He first speaks of the limitations of water power transmission, due to the lack of uniform flow of water in the streams during the different seasons of the year. He then speaks of combined gas and electric plants. He recommends that managers of gas plants also to take up electric distribution. Whenever current can be had from an electric power transmission company he recommends buying it instead of generating it in a local station, even though the cost may be 15 or 20 per cent greater. His argument is that the capital which would be spent for building a generating station can better be expended in developing an electric distribution system. He has followed this course in the plants which he manages, with good success. In his plant in Marysville the electric department is the more profitable for two reasons: Because he does not have to carry the cost of a generating plant, and because he recommends gas only for fuel purposes, but he "pushes it hard" for that. He is in favor of flat rates for electricity, to educate the people. He lights a three or four-room house for one dollar a month. With this class of small consumers he gets more money from a block of ground than he does in the better residence districts.—*Jour. of Elec.*, Sept.

Wires, Wiring and Conduits.

REFERENCE.

Potential of Insulated Cable Networks.—Guyer.—A French Society note on "The absolute value of the potential in insulated networks representing capacity." This absolute value of the potential is of importance for determining the insulation required for the different parts of the network against earth. He gives the general mathematical solution of the problem and applies it to special cases.—*Comptes Rendus*, v. 133, p. 388; abstracted in *L'Eclairage Elec.*, Sept. 21.

Electro-Physics and Magnetism.

Reality of Atoms.—Ruecker.—The conclusion of his presidential address to the Brit. Ass'n, the first part of which was abstracted in the Digest, Oct. 12. He explains why it is necessary from the outset to assume that atoms have properties different from those of matter in bulk. He says that though the fundamental assumptions of the atomic theory receive overwhelming support from a number of more detailed arguments, they are themselves almost of the nature of axioms, so that the simplest phenomena are unintelligible if they are abandoned. He then speaks of the atomic theory of magnetism, and of the theory of ions in gases. It is "from the theory of ions that the most far-reaching speculations of science have recently received unexpected support." He then speaks of the magnitudes and mean free paths of atoms. The question whether the model of the atomic theory is unique, is answered by the statement that the atomic theory must hold the field until another can be found which is not inferior as an explanation of the fundamental difficulties as to the constitution of matter, and is, at the same time, not less comprehensive. He then speaks of the phenomena of life and of the limits of physical theories. He concludes that "in spite of the tentative nature of some of our theories, in spite of many outstanding difficulties, the atomic theory unifies so many facts, simplifies so much that is complicated, that we have a right to insist—at all events, until an equally intelligible rival hypothesis is produced—that the main structure of our theory is true; that atoms are not merely helps to puzzled mathematicians, but physical realities."—Lond. *Elec., Elec. Eng.*, Sept. 20.

Change of Conductivity of Metallic Particles Under Cyclic Electromotive Variation.—Bose.—A long Brit. Ass'n paper, illustrated by diagrams. Under the action of electric radiation the conductivity of metallic particles exhibits variation. In the positive class like iron, there is an increase, and in the negative, like potassium, a diminution of conductivity. Each class again falls into two sub-classes: Sensitive substances which undergo self-recovery, and such which do not. In the case of self-recovery substances the conductivity distortion varies with the intensity of radiation. Under the continued action of radiation, the distortion attains a maximum, balanced by force of restitution, and on the cessation of radiation there is an elastic self-recovery. The three classes of substances, positive, negative and neutral, may be distinguished by their peculiar characteristic curves. The change produced in the sensitive substance by the action of radiation is not, normally speaking, chemical. The conductivity change is produced not only by very rapid, but also by comparatively slow electric variation. Generally speaking, all the conductivity variation effects, produced by electric radiation, can be reproduced by comparatively slow cyclic electromotive variation. These conductivity changes under cyclic e. m. f. variation may be continuously recorded by means of the conductivity curvograph. Electric conduction in metallic particles sensitive to electric radiation does not obey Ohm's law. The conductivity is not constant and independent of the e. m. f., but varies with it. In the positive class the characteristic curve, in which the ordinates represent the currents and the abscissæ the e. m. f., is concave to the axis of the current. The conductivity increases continuously with increasing e. m. f. The variation of conductivity in the lower portion of the curve is small, but increases with great rapidity in the upper portion. The curve obtained with a strong initial current, is steeper than with a feeble one. There is found, especially when the initial current is feeble, a critical e. m. f., at which the conductivity change becomes so rapid as to produce an almost abrupt bend in the curve. Stronger initial current appears not only to lower the critical point, but also to mitigate the abruptness of this change. The effect of e. m. f. in modifying the conductivity of the conducting layer, is well seen in self-recovering substances. There is a definite conductivity corresponding to a definite e. m. f. As the e. m. f. is increased, the sensitive molecular layer is strained, and a definite increase of conductivity produced. When the increase stress is removed, the corresponding strain also disappears, and there is an elastic recovery to its former molecular and conductive state. Hence when it is carried through a complete cycle of e. m. f. variation with moderate speed, the substance is at the end again in its original molecular condition. This is the case where there is a complete cyclic recovery on the removal of the stress. With non-recovering substances an outstanding residual effect is found, like hysteresis.—Lond. *Elec.*, Sept. 20, 27.

Vibrations of Incandescent Lamp Filaments.—Kempff-Hartmann.—The filament of an incandescent lamp is thrown into rapid vibrations in the cold state by the slightest disturbance. If it is held to the ear, a metallic note is heard, which appears to consist of several notes not harmonically related. When the lamp is burning, the oscillations die away rapidly. This is not due to a loss of elasticity, but probably to a magnetic damping effect. The incandescent filament may be kept in a state of vibration by the simple device of bringing a magnet into its neighborhood, provided that either the lamp or the magnet are fed by an alternating current.—*Phys. Zeit.*, Aug. 24.; abstracted in Lond. *Elec.*, Sept. 20.

Magnetism and Viscosity.—Gray.—An abstract of a Brit. Ass'n Adv. of Sc. paper on "The influence of a magnetic field on the viscosity of magnetizable liquids and solids." The liquids used were ferrous sulphate and ferric chloride. A diminution in the viscosity was observed when the flow of fluid was along the lines of a rather weak magnetic field. With the flow of the fluid at right angles to the magnetic lines, however, no change in the viscosity was observed. The experiments on solids were made by observing the variation in the torsional damping of a loaded vertical wire when longitudinally magnetized. Soft iron wire exhibited marked reduction in its viscosity as the magnetic induction was increased. Precisely the opposite result was obtained with nickel.—Lond. *Elec.*, Sept. 20.

REFERENCES.

Duality in Electricity.—De Vilar.—A continuation of his former researches (Digest, Aug. 3). He applies this principle of dualism to

the theory of sinusoidal alternating currents and discusses at some length the "reciprocity between generating circuits and receiving circuits" for several special cases. The results obtained by his analysis are illustrated by diagrams.—*L'Eclairage Elec.*, Aug. 17.

Electric Spark.—Neculcea.—An illustrated article on the electric spark, on the part of the self-induction in an oscillating discharge, and on spectra produced by the electric arc.—*L'Eclairage Elec.*, Aug. 10.

Photo-Electric Cells.—Minchin.—A very brief note on a Brit. Ass'n Adv. Sc. paper in which he described the manner in which the selenium cells are made, and the way in which they may be used for measuring the radiant energy of the stars.—Lond. *Elec.*, Sept. 20.

Electro-Chemistry and Batteries.

Stassano Electro-Metallurgical Process.—Fumero.—An article on this process which aims at replacing the heat of combustion of the coal in the ordinary metallurgy of iron by the electric arc, and should be advantageous in countries where fuel is costly and water power cheap. The roasted and powdered ore is first of all passed through a magnetic separator in order to prepare a material rich in iron. This is then analyzed and the amount of carbon required for its reduction, calculated. The mineral is then mixed with the necessary amount of powdered wood charcoal and tar, whose percentage of carbon is known, and a slag-forming material, and made into briquettes. These are then introduced into the electric furnace. The chemical reaction is at first very lively, but becomes quieter after a time, and the amount of heat necessary continually decreases. A furnace of 150 horse-power yields in 1½ to 1¾ hours nearly 30 kilograms of wrought iron. By varying the amount of carbon added according to the previously made analysis, it is possible to prepare a cast iron with a certain fixed percentage of carbon. The plant at present working is at Darfo in the province Brescia in Italy, and uses a fall of 30 meters of 5 cubic meters water per second.—*L'Elettricita*, v. 20, p. 161; abstracted in *The Elec. Chem. and Met.*, Sept.

Polarization and Internal Resistance of Electrolytic Cells.—Atkins.—The conclusion of his paper in which he reaches the following conclusions. Electrodes of copper in copper sulphate, and amalgamated zinc in zinc sulphate, when freshly placed in their respective solutions, give, with varying currents, curves completely satisfied by a formula of the Bartoli-Wiedeburg form, and its derived equations. Electrodes of silver in silver nitrate and zinc sulphate, as a rule, give curves satisfied by such a formula. Electrodes of polished platinum in sulphuric acid do not, as far as investigated, conform to the formula. The maximum value for the polarization, however, is in agreement with that found by other methods. Electrodes of all these metals in their respective solutions, show upon standing a marked increase in apparent resistance. All results obtained concur in their testimony that this is not an increase in the real resistance of the cell. While the theory of Wiedeburg is not sustained as to its constants by the results of this research, an equation of the same general form would seem to be suggested as satisfying the curves for internal resistance and polarization of electrolytic cells.—*Phys. Rev.*, Sept.

REFERENCES.

Storage Batteries.—Brief illustrated descriptions, taken from patent specifications, of the following batteries: Loppe, Morin, Martin and Griner, Luzard, Wiegand, MacRae, Bowker, Goldstein, Bary.—*L'Eclairage Elec.*, Sept. 14.

Platinum Electrode.—A description with illustration, of the Heraeus platinum electrode, recently noticed in the Digest.—Lond. *Elec.*, Oct. 4.

Training of an Electro-Chemist.—Hutton.—A communication in which he points out that the would-be electro-chemist should, to start with, have a first-class chemical training.—*The Elec. Chem. and Met.*, Sept.

Units, Measurements and Instruments.

Alternating-Current Terminology.—An editorial note criticizing the use of the term "wattless," especially in the connection "wattless power" and "wattless watts." It is proposed to use instead the term "fictive power," while "real power" is the product of e. m. f., current and the cosine of the phase difference. As the cosine of the phase difference between e. m. f. and current is called the power factor, it is proposed to call the sine the powerless factor or co-power factor (*facteur d'impuissance* or *facteur de copuissance*). For the two components of the current it is proposed to use the terms: Current in phase and current in quadrature.—*L'Ind. Elec.*, Oct. 10.

Localizing Faults.—Murphy.—An illustrated article on a modification of the Blavier test. He has worked out a method for localizing a fault with minimum assistance at the further end. This assistance at the distant end consists in depressing and raising a key every alternate minute, for about 10 minutes. By depressing the key the line is directly earthed; by raising it, it is earthed through a certain resistance. He shows that if the normal resistance of the line is subtracted from the results obtained with the key at the distant end depressed in the first place and with the key raised in the second, and the ratio of the differences ascertained, a simple formula enables the distances of the fault from the far end to be quickly and easily calculated.—Lond. *Elec.*, Oct. 11.

Disk Interrupter for Alternating Currents.—Ruhmer.—A description of some improvements in the liquid interrupter with exchangeable perforated plates. The electrodes are introduced through the sides, thus obviating gliding sparks which might lead to explosions. By making one electrode of lead and the other of aluminum, he has succeeded in producing an apparatus which only interrupts the alternating current in one direction. This is of special utility in Röntgen ray work. The life of an aluminum electrode is about 500 hours.—*Phys. Zeit.*, Sept. 21; abstracted in Lond. *Elec.*, Oct. 4.

REFERENCES.

Alternating-Current Measuring Instruments.—Addenbrooke.—His paper in full, presented to the Internat. Elec. Congress in Paris last year, on electrostatic voltmeters, ammeters and wattmeters for alternating currents.—*L'Eclairage Elec.*, Aug. 24.

Galvanometers.—Mendelhall and Waidner.—An illustrated description in detail of a new galvanometer of high sensibility, devised by them. It is of the ordinary four-coil Thomson type, the materials used being brass and glass, with insulating fiber supports for the coils.—*Am. Jour. Sc.*, Oct.

Phase Meter.—Letheule.—An illustrated description of the Holden phase meter for three-phase currents and for single-phase currents.—*L'Eclairage Elec.*, Aug. 3.

Maximum Demand Indicator.—Armagnat.—An article giving brief illustrated descriptions taken from British patent specifications of new maximum demand indicators of Barker and Ewing, Rimington, Wright, Fish; two devices due to Cox and Dick, respectively, for using a single maximum demand indicator on a three-wire system; also a meter of Macdonald for variable tariff, the tariff varying continually according to a law taken from the average daily load curve.—*L'Eclairage Elec.*, Sept. 14.

Telegraphy, Telephony and Signals.

Simultaneous Multiplex and Ordinary Telegraphy.—Mercadier.—The simultaneous transmission of telegraphic and telephonic messages over the same wire is rendered possible by the difference in the effects produced by continuous and oscillating currents, respectively. It follows that any system of telegraphy in which oscillating currents are used, offers the possibility of a simultaneous transmission of continuous and oscillatory messages. Such a system is that of Mercadier who operates with electric tuning forks. He has tested the possibility above indicated in a practical way and on a large scale, and has succeeded in completely establishing it. The line worked with was that between Paris and Bordeaux. Among the various forms of auxiliary apparatus devised by Van Rysselberghe, Maiche, Cailho, Picard, etc., that of Cailho was chosen and 12 simultaneous messages were transmitted by Mercadier's system, together with signals, with the House, Hughes or Baudot transmitter. Since messages can be sent in both directions, this means that one wire can carry 25 messages at a time, together with extra messages between intermediate stations.—*Comptes Rendus*, Sept. 16; abstracted in Lond. *Elec.*, Oct. 4.

REFERENCES.

Submarine Cables.—Larose.—A long article on the dragging for submarine cables in great depths. He discusses the difficulties and gives practical rules for the best methods of dragging.—*L'Eclairage Elec.*, Aug. 10.

Telephone and Telegraph Wires.—Lawrence.—A mathematical article, with diagrams, on tension and sag in telephone and telegraph wires.—*Tele. Mag.*, Sept.

Wireless Telegraphy.—Johnson.—A purely mathematical article on the Hertz exciter and its application in wireless telegraphy.—*L'Eclairage Elec.*, Aug. 3.

Wireless Telegraphy.—Turpain.—An article giving illustrated descriptions, taken from United States patent specifications, of several new inventions and improvements in wireless telegraphy. Quite a number relate to Kitsee, Collins' coherer and oscillator; Walter's transmitter and receiver for assuring the secrecy of message.—*L'Eclairage Elec.*, Sept. 21.

Telephone System for Railways.—Barbillion.—Several diagrams showing a modification of a system of telephonic connection between several stations along a railway, for the special purpose of facilitating the direct intercourse between two important stations, like those at the two terminals of the line.—*L'Eclairage Elec.*, Aug. 24.

Railway Signals.—Pigg.—The first part of an illustrated article on English and American railway signaling.—Lond. *Elec. Rev.*, Sept. 27.

MISCELLANEOUS.

REFERENCES.

Manufacturing Plant.—A continuation of the well illustrated serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany. This part deals with Schuckert's works, and especially a revolving light synchronizer and a transformer switch for switching out the primary circuits of transformers as soon as the secondary circuit is open, and switching in again as soon as it is closed.—Lond. *Elec.*, Sept. 27.

Glasgow Exhibition.—An illustrated description of exhibits of Mather and Platt. Direct-current dynamos and motors, motor-driven pumps, an electric drill and an electric conveyor.—Lond. *Elec. Rev.*, Sept. 27.

A brief illustrated review of a few electro-metallurgical exhibits at this exposition, the only metals concerned being nickel, copper and zinc.—*The Elec. Chem. and Met.*, Sept.

Paris Exposition.—Reyval.—An illustrated description of a 132-kw, 120-volt direct-current generating set for ship lighting exhibited by Sautter and Harle.—*L'Eclairage Elec.*, Sept. 7. An illustrated description of a 122-kilovolt-ampere, three-phase alternator of the induction type of Siemens & Halske, of Vienna, the voltage being 2100, the frequency 50, the speed 759 r. p. m.—*L'Eclairage Elec.*, Sept. 14. Illustrated description of a 350-kw, 250-volt direct-current dynamo, exhibited by a French metallurgical company; of a 260 kilovolt-ampere, 200-volt Kolben three-phase alternators, exhibited by the Decauville Co., and of a 175 kilovolt-ampere, three-phase alternator and a 60-hp, three-phase induction motor of the Cie. de Fives-Lille.—*L'Eclairage Elec.*, Sept. 21. Illustrated descriptions of a 375-kw and a 75-kw, 550-volt, direct-current dynamo, exhibited by the Postel-Vinay Co.; also of direct-current machines of the Cie. de Fives-Lille; a 220-kw, 550-volt and a 100-kw, 500-volt traction generator, and a 36-kw, 120-volt dynamo; also of a 400 kilovolt-ampere, three-phase alternator of Rieter & Co., the voltage being 220, the frequency 45.—*L'Eclairage Elec.*, Sept. 28.

Tripier.—The first part of a very long and detailed description of the electric railway used at the Exposition. The track construction and the signal system are described in the present part.—*L'Eclairage Elec.*, Sept. 7.

New Books.

Recording and Integrating Electric Meters. How to Inspect, Repair, Test, Calibrate, Read and Compute Meters. By Robert Ferris. Monmouth, Ill.: Robert Ferris. 47 pages, illustrated. Price, $1.

This treatise is a gem. Not for an instant could the reviewer hesitate to heartily recommend the purchase of a copy to every one who even imagines that possibly some day they will be interested in electricity. Those who have as yet foregone a technical education will find the statements in the book so curiously and wonderfully involved that they cannot possibly learn anything from it that would hurt their minds (we say nothing about helping them), while those who are a little further along can get a fair average of two laughs per page out of it, not to mention the aggressively apparent moral of the whole: Refrain from attempting to say what you cannot express, and don't imagine that a smattering of knowledge means mastery of a subject.

Like Gaul, the volume is divided into three parts. Unlike it, the parts are not named, but start in with numbered paragraphs reading as follows:

"Any man of the average intelligence can become an expert meterman." "A short run through the primary of electricity will now be in order," and "The points to consider in selecting a meter are the particular points we want to be able to test. They are as follows: Accuracy on non-induction load, accuracy on induction load, ordinary volt-ampere accuracy, etc., respectively."

We might suggest that the parts be given the titles "Hickory," "Dickory" and "Dock," which would describe the contents as well as anything else and have the advantage that their familiar sound would make the readers feel at home at once. Part I. is explained in paragraph 6 as being "a little run through arithmetic—on the principle that we have forgotten"; the "run" could be more properly called a sprint and its incalculable value can be faintly imagined from some of the following paragraphs which are abstracted in full, but with the strange mixture of capitals and small letters not indicated:

"8. The value of signs in artithmetic should be thoroughly appreciated. The student should learn to use them exclusively." "21. To multiply mixed numbers. Rule: Whole numbers × whole number. Upper digit × lower fraction. Lower digit × upper fraction. Fraction × fraction. Product of all added together." "25. Base × rate equal percentage. (Point off two places from the right.)" "35. The study of involution and evolution is one of necessity. The writer recommends that the student who is not familiar with it can best get results by securing the services of one who does understand it and can teach another." "50. The term aggregation means collection."

As Part II. is a "run through the primary of electricity," it is only fair to expect that the definitions of units should be of the "ampere is the flow of electricity produced by the pressure of one volt on a resistance of one ohm," and "volt is the pressure required to drive one ampere through one ohm resistance" order. A few of the luminous paragraphs in it cannot fail to be of interest, and we quote the following: "31. By right or left-hand armature is meant the relative position of the commutator to coils." "37. When an armature is at rest the ohm resistance is very low, usually less than one ohm." "41. The Wheatstone bridge system of measurement (of resistance) is based on the fall of tension of the current." "61. The voltage of a transformer must be proportional to the windings." "66. Magnets for retarding purposes * * * are first formed, then * * * magnetized, boiled and cooled the latter process, freeing them from loose magnetism. * * * The boiling and cooling causes an expansion and contraction causing the magnet to be freed from loose magnetism." "86. By efficiency of a meter is meant the comparative amount of energy it consumes in itself." "92. A short circuit on line when meter is in use will 'knock down' the magnet strength. This is due to magnetic circuit being increased in size so that magnets come within its range."

Perhaps the best portion of Part III. is its opening paragraph, which has already been cited. The reviewer will, however, not anticipate the pleasure of readers of the whole volume by giving more selections, but thinks that the ones that are abstracted above will in some measure recompense those who for lack of time or other reasons find themselves unable to peruse in full this truly remarkable treatise.

The Construction of a Gasoline Motor Vehicle. By C. C. Bramwell. New York: Emil Grossman & Bro. 149 pages, 86 illustrations. Price, $2.

This book comprises 14 chapters, and not the least of its recommendations is that it is written by a man whose experience with motor vehicle work has been gleaned from practical experimental design and construction.

In the first chapter the author devotes a few paragraphs to the operation of a four-cycle engine, and attacks the important problem of the proper mixing of gasoline and air. Then follow detailed descriptions of the action of numerous practical devices for this purpose. In the next chapter, beginning with generalization about combustion, he narrows the subject down to its application to combustion of gases in the internal combustion engine. Chapter IV. is devoted to hot-tube ignition, and incidentally discusses conditions which obtain in the cylinder of the engine at various parts of the stroke, especially at the critical points of compression and ignition. The next chapter is devoted to electric ignition both by primary and secondary

spark, the principle of the electric circuit and its application to gas engine being ingeniously illustrated by hydraulic analogies.

Sources of electric current for internal combustion engine ignition are then discussed and illustrated by numerous diagrams. The subject of transmission devices occupies the next chapter and after carefully considering a number of different methods, the author concludes by recommending spur gearing or a sprocket and chain. In succeeding chapters he devotes a few words to the principles of power computation, and the multiplying effects of mechanisms, and then begins a description of a motor-vehicle motor of his own design which has been built and given satisfaction. In this design he goes into considerable detail and illustrates parts by scale drawings whenever necessary, and he intersperses his text with practical reasons for the construction adopted.

In chapter X. he introduces a few words with reference to the general design of a vehicle, in which he gives first place to the motor, second to transmission gear and controlling levers, and last of all to the body. Although the author recognizes that there is much to be done before the best form of motor vehicle can be determined upon, yet he recommends the standardization of many parts and devotes some paragraphs to that subject. In succeeding pages he continues the illustration of the construction of his motor vehicle and the design of its parts, and his description not only gives dimensions and materials, but goes into details of procedure on the lathe and planer. He then takes up the subject of mounting the motor in the frame, and discusses wheels, pivot hubs, and steering gear. The closing chapter is devoted to the subject of transmission gears, and describes, illustrates and discusses the manufacture of speed, changing and compensating gears, and friction clutches, concluding by illustrating the complete vehicle and the arrangement of the machinery.

It is easy to see on reading the book that the statements are the result of practical familiarity with the described design, and the book should be well received by those who wish to experiment with the construction of the gasoline vehicle for their own pleasure, and also by those who desire to become acquainted with the details of the mechanics and practical operation of such vehicles.

Electromagnets. Their Design and Construction. By A. N. Mansfield, S. B. (Science Series.) New York: D. Van Nostrand Company. 155 pages, 36 illustrations. Price, 50 cents.

This little book is No. 64 of "Van Nostrand's Science Series," and takes the place of the old work of Du Moncel on the subject, bearing the same number. The publishers are to be congratulated on the change, for the old book was hopelesly behind the times, while this gives a presentation of the present state of the art so far as the limited space will allow.

All the fundamental principles are treated, including a short discussion of alternating currents and their effects upon electromagnets. There are tables giving the relation between U. S. metric systems, the properties of copper in wire in terms of B. & S. and B. W. gauges, temperature coefficients of resistance and weight of copper in 100 lbs. of insulated wire. These tables are not as full as could be wished, but it is perhaps not fair to expect very extensive ones in a book of this size.

In the third chapter there are some remarks about square and conical winding. By square winding is meant winding where any wire in one layer lies squarely on top of a wire in the layer below, while by conical winding is meant winding where any wire in one layer lies in the groove formed by two wires in the layer below. The book states "In practice something between these extreme cases is obtained." This statement is not quite satisfactory. Inasmuch as ordinary magnet winding consists of alternately superposed right and left-handed helices, it is impossible that a wire in one layer should lie either on a wire or in a groove between two wires in the layer below, all the way round the circumference. There must be two places in each convolution where the wires cross, and are therefore piled squarely, and two other places midway between these where the wires lie in the grooves, or conically. Obvious as is this fact, it is either imperfectly stated or altogether ignored by the majority of writers.

Les Automobiles Electriques. By Gaston Sencier and A. Delasalle. With a preface by Charles Jeantaud. Paris: Vve. Ch. Dunod. 390 pages, 192 illustrations. Price, 15 francs.

This is an excellent book on the subject of which it treats, and we are not surprised that it has brought to the publisher a silver medal, awarded by the influential Automobile Club of France. The first chapter deals historically with the development of the automobile and includes a comparison between the cost of animal and electric traction. A table supplied by the Parisian Electric Vehicle Company puts the cost of operation of a public vehicle at $4.60 for a daily service of 24 to 30 miles, this including depreciation, service and all other items entering into complete cost. The depreciation in the case of the storage battery is given at 70 cents per day, and that of the pneumatic tires 60 cents per day.

The second chapter gives the definition and explanation of electrical and mechanical terms, and in the third chapter the primary battery is wisely disposed of in a few pages. The three following chapters—undoubtedly the most valuable in the book—deal with the storage battery. In one chapter the theory of the storage battery is given, another deals with their charging and the third describes in detail the various batteries used in European automobile service. Nineteen batteries are described and the full data of each are given. The most valuable part of this chapter is a table giving the results of tests of eight different makes of storage battery, made by the Automobile Club of France. The tests made by the Automobile Club are accepted as above suspicion, and as they are very thorough and made under the conditions of practice, the data here collected are of the greatest value.

A short chapter on telpherage motors is followed by a long one on automobile motors. Much of the matter here contained, such as that on the design of motors, appears to be out of place in a book of this character. A chapter is devoted to electric braking, another to gearing, one to controllers and methods of control, another to instrument equipment and one to vehicle bodies, wheels and tires. The penultimate chapter, and one of the longest in the book, contains descriptions of more than two score electric vehicles, among which are included several of American manufacture. The half-tone illustrations are very poor—as is usual in French publications; the descriptions, however, are concise and to the point. The final chapter is on combination gasoline and electrical vehicles, which the authors appears to consider have a bright feature. The work can be recommended to those interested in the automobile, the chapters on the storage battery and the descriptions of types of vehicles alone giving it great value.

The "Engineering" and Electric Traction Pocket-Book. By Philip Dawson. Second edition, revised and enlarged. New York: John Wiley & Sons. 1305 pages, illustrated. Price, $4.

Extensive comment is perhaps unnecessary in reviewing a book which has reached its second edition, as has this. That fact alone shows it has met a demand and has a useful place in the world. This pocket-book is not claimed by its author to be anything more than a compilation from various authorities, of figures and tables on all matters pertaining in any way to electric traction. As such it is voluminous, and as complete as it appears possible to make it in the 1300 pages of a pocket-book. In many cases the source or authority from which the figures were obtained is given, and might well have been included in all cases.. There is considerable value in such a compilation. The data are presumably the best obtainable, and even though their correctness may be questionable in some instances, the fact that often a number of sets of figures are given applying to the same thing tends to reduce the probability of being led astray by individual errors. The wiring tables might well have been more carefully scrutinized and edited before being inserted.

It is impossible in a brief review of this kind to give more than a bare idea of the great number of subjects on which data are given. The data cover every engineering detail that goes into the make-up of an electric railway system. The figures include dimensions, costs and performance data. Being an English book, and primarily intended for English engineers, it gives, of course, much engineering data applicable only to English practice, though the compiler has drawn very extensively from American experience. Mr. Dawson has shown himself in the past to be a very able collector of data on American street railway practice, and in this pocket-book confirms that reputation. He gives, in fact, the most complete collection of engineering data on electric railway work to be found outside the pages of the technical journals, and has placed it in compact available form.

How to Become a Good Mechanic. By John Phin. New York: Industrial Publication Company. 68 pages. Price, 25 cents.

There are different opinions as to what constitutes a good mechanic, a very prevalent one being that manual skill in the use of

tools is all that is necessary. Our author, however, takes the broader view that a good mechanic is a man who has trained his mind as well as his hands. The contemporaneous tendency is toward euphemism in appellations, and any one who is familiar with all the subjects that the author recommends for study, would stand a very good chance of being dubbed engineer, even if he did not aspire to that title himself.

We agree with the author that a *good* mechanic ought to study all the subjects that he recommends, though the list includes algebra, geometry, trigonometry, physics and even chemistry. It is not expected or intended that he should be a mathematical luminary or an accomplished chemist, but it is growing to be almost a necessity that he should be able to interpret simple algebraic formulæ, and a sound, although elementary knowledge of chemistry, is a great help to him. We remember a discussion in a mechanical periodical a quarter of a century ago anent the tempering of tools, where one writer explained that the colors successively assumed by the steel in the tempering process, which are usually the sole criterion by which the workman knows when the proper temper has been reached, are due to thickening films of oxide. Another correspondent said that "oxides would better be kept out of the workshop," meaning that the workman would get along better if he were ignorant of chemistry. And yet a man who knows a little chemistry would know that a film of oil, by retarding the access of atmospheric oxygen to the surface of the steel, will make the color indications fallacious, which his rule-of-thumb shopmate does not know.

The author takes a straightforward, common-sense view of things, as in the other books that he has written. He recommends—thinks of it, oh, ye Heavisides and Perrys!—the study of Euclid, Euclid rather than Legendre, to working mechanics who toil through the day and study at night, and yet we are strongly inclined to his view. We hope that a great many mechanics and young people who intend to become mechanics will read this little book and profit by the very sound advice therein contained.

The Nash Gas Engine.

By James M. Cremer.

Among the large gas engines installed in the power court of the Machinery and Transportation Building, at the Pan-American Exposition, Buffalo, N. Y., which were notable for their size and their service in regularly operating the rotary pumps supplying water for the fountains about the grounds, the National Meter Company, of New York, exhibit a 125-hp Nash gas engine. This engine operated the pump that supplied the large volume of water for the electric tower and also three of the largest jets in the basin of fountains. In another part of the Machinery Building a 50-hp gas engine of the same make operated a 35-kw belt-driven dynamo, furnishing electric current for power purposes to numerous exhibitors who showed electrically-driven machinery in operation. In an accompanying illustration a 50-hp engine of the latter type is shown, but direct connected to a dynamo for electric lighting. Fig. 2 gives a cross sectional cut of the 125-hp engine above mentioned and shown in Fig. 1, which will serve for the 50-hp one as well, both being of the same general design, and both working on the four-cycle principle.

Referring to the cross section (Fig. 2) it will be noted that the engine is of the vertical, enclosed, self-oiling type. The cylinders are all separate castings, independent of each other, and are mounted on the crank case forming the upper part of frame which encloses the pistons, main bearings, connecting rods and other parts. All of these parts are lubricated by the oil contained in the base being dashed over them when the engine operates. Provision is made also for lubricating them independently by an automatic sight feed oiler.

The cylinders, which are so constructed as to be easily repaired or replaced, are water jacketed on the sides, heads and valve cases, and are drained at the lowest point. Trunk pistons, single-acting, of simple form are used, and since these act as cross-heads as well they are made of proportionately great length to diameter. The crank shaft is in one piece of forged open hearth steel, and runs in adjustable bronze boxes, so arranged that each crank has a bearing on each side. The connecting rods have crank ends of the marine type, with adjustable bronze boxes; the end connected to the trunk piston is formed into a solid eye and fitted with a renewable bronze bushing.

It will be noted in the cuts that all the valves and the whole valve motion are conveniently located on the working side of engine. A single cam-shaft driven by a pair of spur gears operates all the valves through levers and rollers. Each cylinder has its own admission, gas and exhaust valves, the admission valve being shown with its cam, roller and lever, and the gas valve with a pawl, engaging a toe carried on the admission valve stem. Either both of these valves open together to admit a charge for the power stroke, or else the governor acts to disconnect the pawl, when the gas valve remains closed and no charge enters, until standard speed is restored. Whenever a charge is missed, the admission valve still permits air to enter, which is compressed, expanded and exhausted, thereby cooling the cylinder and cleaning it of any remaining products of combustion.

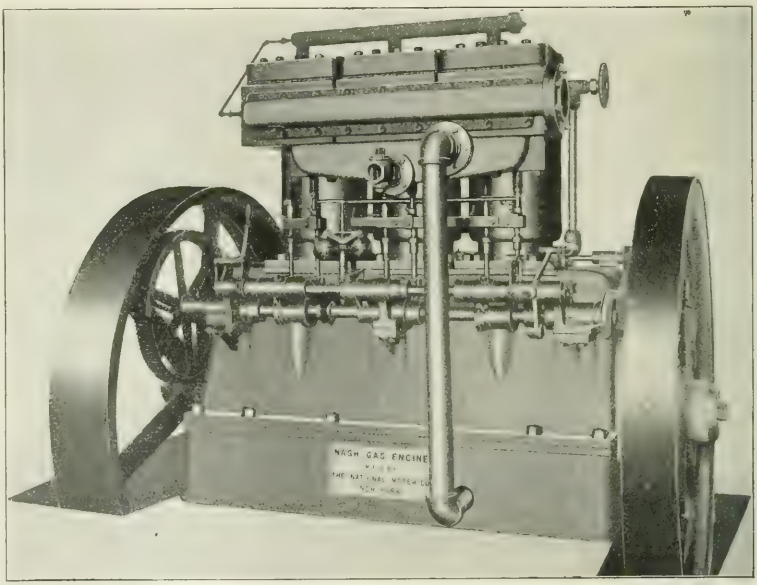


FIG. 1.—125-HP NASH GAS ENGINE.

The exhaust valve is located immediately behind the admission valve, the exhaust connection with its flange appearing at the upper right-hand of the cylinder. Immediately below this is the flanges opening by which gas enters the mixing chamber, and surrounding the upper part of the gas connection is an annular opening through which air passes and is mixed with the entering gas for a charge.

The valves have long stems, carefully fitted to bearings, and guided at the top and bottom, thus securing an accurate seating without any side springing to occasion wear and leakage. Electric igniters of the make-and-break type are attached to each cylinder, as shown in the cut, being operated by separate eccentrics carried on a shaft located on the side opposite to the valve motion, and driven from the cam shaft by means of a cross shaft and two pairs of miter gears. The igniters are independent of each other, and are provided with

means of adjustment to accurately time the ignition, as desired, without stopping the engine.

A special form of fly ball governor, driven by bevel gearing from the cam shaft is used with these engines. It operates by the method of missed ignitions and secures a remarkable steady speed, even under wide variations in the load. The governor is very sensitive, and more especially so because it does not operate the gas valves directly, but simply indicates by the position of the lever to which it is connected, whether or not the lifting pawl shall act to open the gas valves or keep them closed as demanded by the load upon the engine. Each cylinder has its own gas valves, and is governed independently of the others.

The 50-hp engine illustrated has three cylinders, each 9 inches diameter and 11 inches stroke, the speed being 270 r. p. m. The 125-hp engine has three cylinders, each 13½ inches diameter and 16 inches stroke, opening at speed of 225 r. p. m. It will be observed that these speeds are quite moderate, although the vertical type of engine would safely permit considerably higher ones.

Each of the engines is provided with a suitable self-starting device, operated by compressed air, since they are too large to be conveniently started by hand. The air starter consists essentially of an air compressor, an air reservoir and suitable valve mechanism to operate one of the cylinders by compressed air. The action is as follows: A single movement of the starting lever throws into action supplementary cams, so that the right-hand cylinder operates as a single-acting compressed air engine, while the other two are placed in position ready to start up with gas. As soon as speed is attained, by means of the first cylinder, and ignitions occur in the other two cylinders, the starting lever is moved back to its normal position, the air-starting mechanism is disconnected, and the machine operates as a gas engine. The whole device is simplicity itself, and very satisfactory in operation.

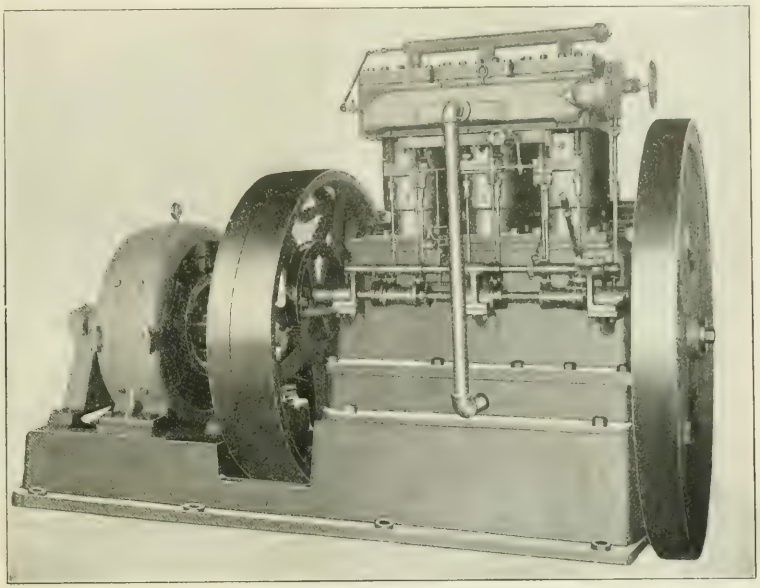


FIG. 3.—50-HP NASH GAS ENGINE WITH GENERATOR.

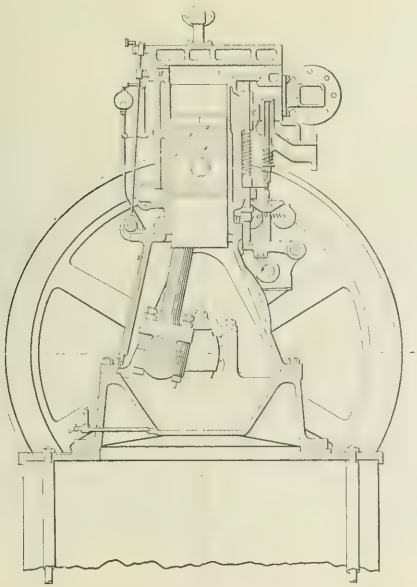


FIG. 2.—CROSS-SECTION OF GAS ENGINE.

The Electrical Equipment of the Largest White Goods Factory in the World.

The Defender Manufacturing Company, the largest manufacturers of sheets and pillow-cases in the United States, has recently installed a complete electric power equipment in its factory building on Avenue C, between Thirteenth and Fourteenth Street, New York. The building (Fig 1) is six stories high, inclusive of basement, which is 3 ft.

FIG. 1.—FACTORY EQUIPPED WHOLLY WITH ELECTRIC POWER

below the street surface. The raw material, as it comes from the mills, is delivered in the receiving department, located in the basement, whence elevators deliver the goods to the cutting department for the underwear and the tearing department for the sheets and pillow-cases on the third floor.

After passing through the stamping department, the material is sent to the operating room on the fifth floor. At the north end is the sheet department (Fig. 6), with hundreds of sewing machines making a hum like a gigantic beehive. No belts or shafts are seen overhead, each set of machines being driven by a 2-hp C & C motor making 500 r. p. m., and being direct connected to the common shaft. There are in all 22 tables, each equipped with a motor at the one end resting

on the floor (Fig. 4), and there are 20 to 25 machines on each table. The company thought it advisable to sub-divide the power in this way so that any one table might be shut down in case the type of machines mounted thereon were not required. The motors are covered by ornamental boxes which rest on wooden tracks, so that they can be pulled out for convenience of cleaning and inspecting the motors. At the south end of this floor is the muslin underwear operating department, and a thoroughly equipped machine shop, where all repairing is done, is also located on this floor. All the machine tools in this shop are driven by a C & C electric motor.

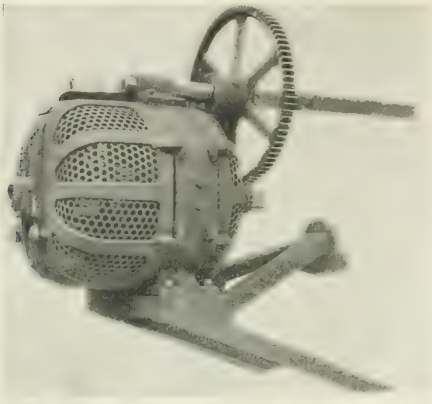


FIG. 2.—SINGLE REDUCTION MANGLE MOTOR.

Throughout the entire building a system of chutes has been installed for the handy conveyance of goods from floor to floor. Two of these chutes extend from the fifth to the second floor, the percentage of its grade being sufficient to cause the goods to slide downward. At the southern end of the fourth floor is the lace and embroidery stockroom. On this floor are located the lace running, tucking and hemstitching departments for which purpose several high grade and specially constructed sewing machines are employed, some of which contain five needles operating simultaneously. These machines are mounted on tables, and are driven on a common shaft by a 2-hp C & C motor.

After the completed work has passed through the inspecting department, it is then ready for the final operation of ironing, and is sent to the finishing room. Here, on the second floor, girls stand on each side of the mangles or ironing machines (Fig. 5), passing sheets and pillow-cases through the steam heated, revolving cylinders. A sheet is started evenly on one side of the machine, coming out on the other, beautifully ironed, in less than half a minute. The mangles, of which there are six, are equipped with 108 inch rollers, and are driven by C & C motors (Fig. 2). The latter are direct connected, the single reduction method being applied for the first time in this installation, where it has given entire satisfaction. The muslin underwear is ironed by handirons, which are heated by gas at present, but will probably soon be electrically heated.

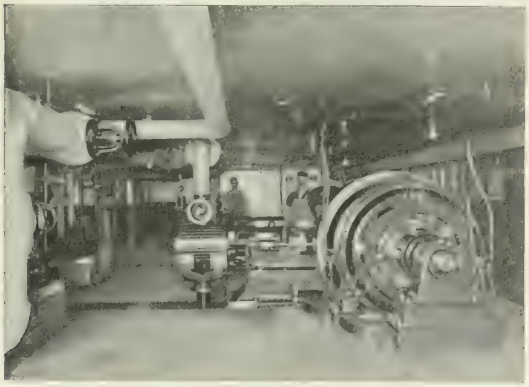


FIG. 3.—DYNAMO ROOM

After the ironing operation, all the finished material is neatly labeled, wrapped and packed ready for shipment. By means of a link-belt conveyor, manufactured by the Link Belt Engineering Company, the finished goods are conveyed from the second floor to the shipping department on the first floor, where they are automatically unloaded. This conveyor is operated by a 2-hp C & C motor. By means of an apron conveyor composed of slats, and 50 ft. in length, the finished material is conveyed to the huge stockroom on the first floor.

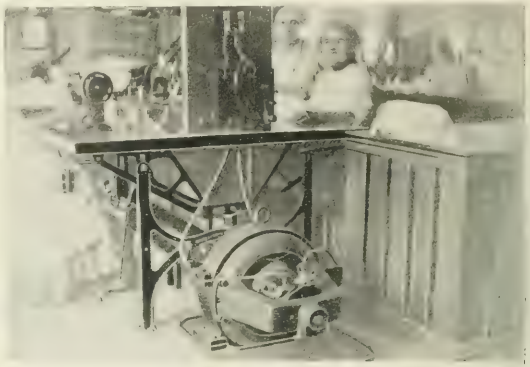


FIG. 4.—END OF SEWING MACHINE TABLE.

A well equipped dynamo room generates current for the 33 C & C motors, 60 enclosed arc lamp and 750 incandescent lamps scattered through the building. In the dynamo room (Fig. 3), which has a tiled brick flooring, are two 80-kw C & C Electric Company's 250-volt direct-current generators, direct connected to two 125-hp Harrisburg standard engines, the speed of which is 275 r. p. m. These units are almost noiseless in their operation, and are remarkable for their accurate regulation. The marble switchboard measures 6 by 12 ft. On it are mounted 12 light and 7 power switches, 2 main dynamo switches, 2 automatic circuit breakers, 2 each Weston volt and ammeters and 1, Weston direct-reading ground detector. This board is one of the handsomest ever turned out by the C & C Electric Company.

The two boilers were furnished by Sam Smith & Sons, Paterson, N. J. They carry a pressure of 90 lbs., and have a capacity of 125 horse-power each. A narrow track coal and ash conveyor leads from the boiler room to a point beneath the sidewalk. The exhaust steam heating system throughout the building was installed by John D. Clark. The other auxiliary apparatus consists of a feed pump, extractor and feed-water heater. The building was wired by the Elec-

FIG. 5.—SECTION OF FINISHING DEPARTMENT.

tric Construction & Supply Company, New York. One set of two-wire lighting mains are run to each floor of the old and new buildings, and one set of power mains to the first, second, fourth and fifth floors of the old building, and to the second, fourth and fifth floors of the new building. A panel board serves as a center of distribution on each floor of the two buildings. All mains are run in Electroduct

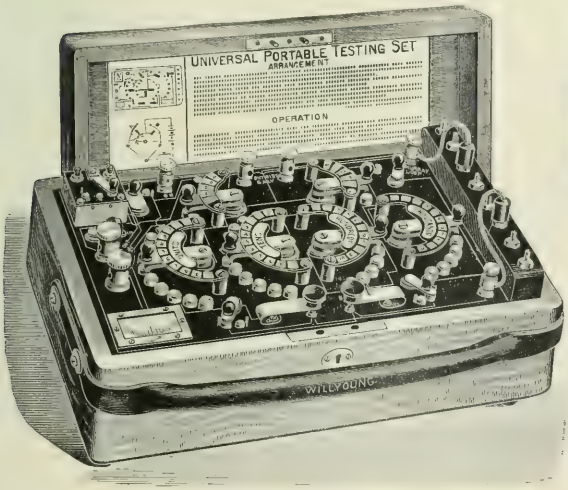
FIG. 6.—ONE OF THE FOUR OPERATING ROOMS.

conduit. There are in all 104 branch circuits emanating from the 13 panel boards.

In concluding, words of praise are due to the general manager, Howard B. Keppel, who designed and supervised the construction of this up-to-date establishment, and to whom we are indebted for the above interesting details.

An "All-Switch" Portable Test Set.

In our issue of Sept. 14 was illustrated a new type of test set made by Elmer G. Willyoung, New York. The same manufacturer has just announced another new set, a sort of companion to the other. This latest set is known as the "Universal," and is shown in the illus-



PORTABLE TESTING SET.

tration herewith. It is the exact equivalent of the other in practically every particular, save that the rheostat and bridge coils are regulated by switches instead of by plugs. In laying out the rheostat coils, the "decade" plan is used, there being four groups of coils, viz., 10 units, 10 tens, 10 hundreds and 10 thousands, instead of the 1, 2, 3, 4, 10, 20, 30, 40, etc., scheme of the other set. The bridge arms are 10, 100, 1000 and 10,000 on each side. There is a special switch permitting use of an outside galvanometer instead of the sensitive D'Arsonval. There is also a switch for the Varley and Murray loop tests, and a switch for permanently closing either the galvanometer or battery circuit (often useful in special tests). In the left-hand upper corner of the illustration is seen the galvanometer shunt box which is interchangeably built so that it may or may not be purchased with the set in the first instance as desired. In the battery there are eight cells, and provision is made for attaching any number of extra outside cells for special tests at any time.

The switches are of a special design, and have been in experimental use for nearly two years. Each switch is made of a number of leaves of phosphor-bronze which are turned over at the end so as to make "end-on" contacts with the studs. Each leaf of every switch is entirely independent of all the other leaves, so that each stud has four separate contacts in multiple.

Owing to the decade plan being used, this set is necessarily larger and heavier than the earlier one, measuring $13\frac{1}{2} \times 8 \times 5\frac{3}{4}$ inches deep over all, and weighing 11 lbs. The set makes all the tests for resistance, insulation by the direct deflection method, self-induction, location of faults by the Murray and the Varley loop method, checking ammeters and voltmeters, internal resistance of batteries, etc., etc. It should be mentioned that there is absolutely no loose part to become detached and mislaid. Even the binding post tops are spun in so that they cannot fall out.

The North Bay Power House at the Pan-American.

Occupying one of the prettiest sites on the Pan-American grounds, on the west side of North Bay, stood the neat little power house of the E. G. Bernard Company, of Troy, N. Y., where was located the motor generator which received the 500-volt current from a power

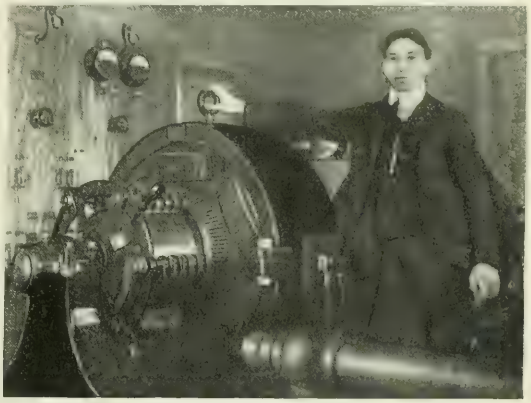


FIG. 1.—MOTOR-GENERATING SET.

house on the grounds, transforming it to a 125-volt current for use in illuminating the electric fountain located in the center of the bay.

Fig. 1 shows the motor generating set, with its attendant. In Fig. 2 are shown the three panels and starting rheostat for this set. The motor starting box, shown in the left corner of the illustration, is one of the special features of this plant. It is 24 inches wide, 32 inches high, and 12 inches deep. The main arm of the rheostat contains heavy copper leaf contacts. These, when the arm reaches its upper position, making contact with the two terminals shown, short circuit the resistance box.

Upon the first panel of the switchboard for the large motor are a direct-current ammeter, a voltmeter, the main switch and a Ward Leonard no-voltage and overload circuit-breaker. The no-voltage part of the circuit breaker opens when the supply of current is for any reason cut off from the motor. The overload part, like any similar circuit breaker, opens from excessive current. Current passes through the no-voltage coils while the current is on the line, and its armature is consequently held up; but the moment the circuit is opened, the armature drops, releasing the breaker. The overload breaker opens by drawing up its armature from excessive current.

A rheostat wheel and distributing board switches occupy the dis-

tributing panel, while the third panel is for the generator, with a voltmeter reading from 0 to 150 and an ammeter reading from 0 to 1000, and rheostat F. B. 110. There is also an 800 ampere double-throw single pole switch fused. The switchboard frame is 3-inch T iron, and its supports 3-inch channel iron. Vermont marble is used throughout.

It is an interesting fact that the bus-bars on these panels are formed of aluminum, which has several advantages over copper for use in this work. One is, that while copper bars will often crack in forming, especially if bent when cold, the aluminum can be bent cold without fracturing, the surface barely roughening. Special work can thus be

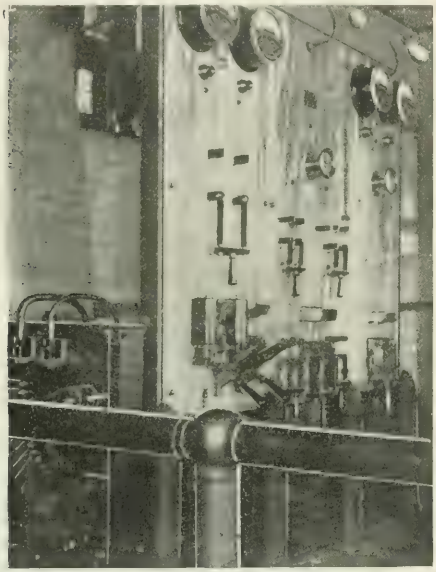


FIG. 2.—SWITCHBOARD WITH ALUMINUM BUS-BARS.

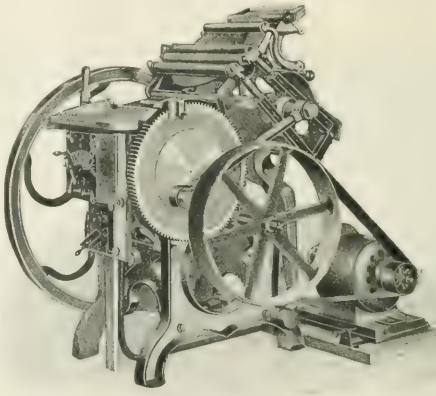
gotten out in very short order. Short bends can be made, and in various shapes, with comparatively no trouble. Should there be any doubt about the continuity of the grain, heating the bar to a low temperature will at once restore it. With the method of soldering employed by the E. G. Bernard Company, there is no trouble from this source.

A smaller motor generator supplies current for the arc and incandescent lamps about the building, and has a separate switchboard for its control.

The E. G. Bernard Company has also other motors on the Exposition grounds, one operating the grate bars for the Eames grate bar exhibit, and two at the Vermont Farming Machine Company's exhibit

Motor-Driven Job Presses.

Printing offices have been a field peculiarly favorable to electric power, and presses were among the first mechanisms to be operated by the electric motor. Possibly one of the reasons has been that little or no change in any of the machines was required in order to adapt them to the new conditions, and this fact is illustrated in the little combination shown herewith, in which is seen one of seven 12 by 18 job presses installed by the Thompson Electric Works, of 350 Dearborn Street, Chicago, for the Fac-Simile Company in the Unity Building, that city. The motor is of the Thompson iron-clad type, moderate speed. The ¼-horse-power at 1500 r. p. m. weighs 100 lbs. The 10-horse-power at 120 r. p. m. weighs 900 lbs. The features of construction are sound. The magnetic frame is one circular ring without joints. In the compound-wound machines the shunt and series coils are separately wound. The bearings are supported by brackets bolted to each end of the magnetic frame, and are of the self-oiling type, and made of babbitt. They have large surfaces to insure cool running and are lubricated automatically from oil wells and revolving rings. The oil wells are absolutely tight so as to prevent leakage, no matter what the position of the motor. The end brackets supporting the bearings are so placed that the machines may be quickly arranged to operate in an upright, inverted or semi-in-



ELECTRICALLY-DRIVEN PRINTING PRESS.

verted position, that is, may be set on the floor or bolted to the ceiling or wall. All parts in the motors have a liberal allowance of metal, and are interchangeable.

Novel Methods of Electric Drive.

The loss of power due to the use of long lines of main shafting and countershafting, the use of pulleys and belts, and the idle running of large portions of the power transmission system, has been mainly responsible for the promptitude with which the electric motor has been welcomed in mills, factories, mines, etc. It has found special favor when instead of being attached to a line of shaft, it can be closely associated with the driven machine or tool, and it is in this method of direct driving that some of the most notable economic triumphs of the electric motor have been realized. No little special ingenuity and engineering skill in this department of direct electric driving has been displayed by the Northern Electric Manufacturing Company, of Madison, Wis., and the smaller examples we present of their work here do not begin to do justice to the wide range of size, work, etc., in which Northern motors have supported the strongest claims ever made for the efficiency and applicability of electric power.

FIG. 1.—VERTICAL MOTOR.

In Fig. 3 is shown a Northern Electric grinder complete, arranged for variable speed. The motors in these and in the analogous buffing outfits are of the dust-proof type, mounted on special stands which contain the starting and speed regulating rheostats. They are self-oiling, self-aligning and run smoothly and cool. They are wired ready for use before shipment.

In Fig. 1 is illustrated an application of the Northern Electric vertical motor, of the open type, direct connected by flexible coupling with a propeller pump. Installations of this character have been carried up to 90 horse-power. In Fig. 2 is shown a 2-hp motor driving a portable drilling outfit from a flexible shaft. These outfits are useful in a great many places, and have been found specially convenient in the Government navy yards in the execution of repairs. The motor swiveling on a ball-bearing base can be operated at any vertical or horizontal angle.

Quite aside from this and their heavy work, running up to motors

of the largest capacity, the Northern Company has supplied motors for electric launch work, and its latest catalogue shows two in service which have been equipped each with a 4-hp motor of 570 r. p.

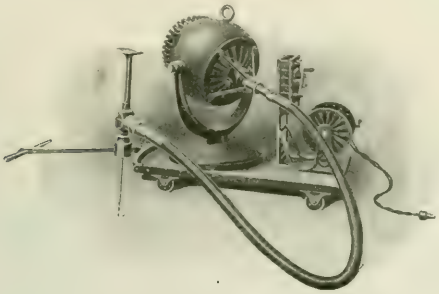


FIG. 2.—PORTABLE DRILL.

m., operated with a Northern reversible speed controller. The boats are 30 ft. in length, and are equipped with sets of 44 Willard storage batteries made by Sipe & Sigler.

Motor-Driven Matrix Machine.

An interesting motor combination is that shown in the accompanying cut, which illustrates a matrix machine direct driven by a Roth motor. These motors are of the enclosable or protected type of machine, all the vital parts of the machines being inside of the frame. The armatures are built of laminated iron, slotted to receive the form-wound conductors. The field frame is novel, in that the entire frame and bearing supports are cast in one piece, making a very substantial and rigid form. The poles are of cast steel, of round section, and are provided with pole shoes. These poles are deeply embedded into the yoke, by a special casting process, and are held in place by a large screw, being readily removable for the purpose of taking off or putting on the field coils.

The bore for the armature and for the bearing boxes is of one size, all the boring being done at one setting. The boxes are supported so as to be always concentric with the bore of the poles. The boxes are movable shaftwise to give the proper amount of end play, and also movable radially to keep the oil well in a proper position for wall or ceiling suspension.

Another feature of these machines is their symmetrical outside form, this being obtained by shifting the poles to one side of the frame, and by the use of a peculiar form of pole shoe, which gives a center line for the armature core considerably away from the center line of the frame, giving the proper room for the commutator. These machines are wound for the standard voltages at standard speeds, and also at special speeds for the various uses to which motors are put.

The illustration shows, as noted, the application of one of the motors to a stereotype matrix rolling machine. The combination of motor and machine presents some features not commonly found in power applications. The matrix rolling machine is designed for and successfully takes the place of a former method of making a matrix, from which to cast a stereotype plate. This method necessitated the beating of the paper in with a hand brush. On this machine the "form" of type and cuts is placed upon the bed of the machine and the wet matrix paper is put thereon. On top of this is placed a felt blanket about ⅜-inch thick. The machine is then started up and this is rolled forward and back, which effects the result formerly secured by hand. The construction of this machine is such that its movement must be under absolute control by the operator at any point, and stops automatically at each end.

To all large newspapers, the saving of a few minutes is of great importance. This machine does the work in about one-fourth of the time formerly taken by the old hand process. As before stated, the running of the machine must be under the absolute control of the operator. The motor is compound-wound, and also reversible, and made for quick starting. In operation, the handle or rod, shown on the machine, is pulled or pushed according to which direction the table of machine is to move. This throws in the reverse switch, thus completing the circuit through the automatic starter, which is adjusted for quick acceleration of speed. The table then moves until a stop automatically trips off the reverse switch and also sets the brake on the matrix machine. It is necessary to start the machine by hand, but it stops automatically at each end of its movement, unless stopped before by hand.

The shunt fields of the motor are energized when the main switch is on. The motor shown is of 3 horse-power, and runs at a speed of 900 r. p. m. It is provided with a rawhide pinion for noiseless operation. These motors are built by Roth Brothers & Co., of Chicago.

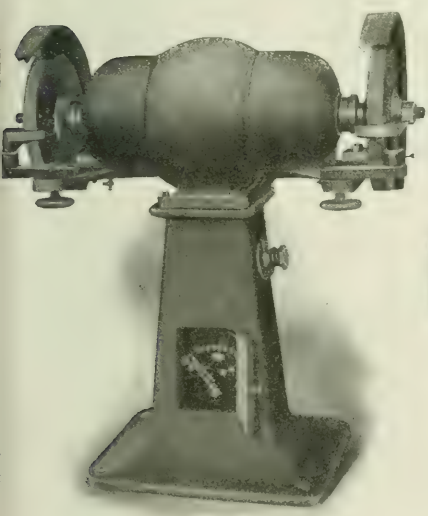
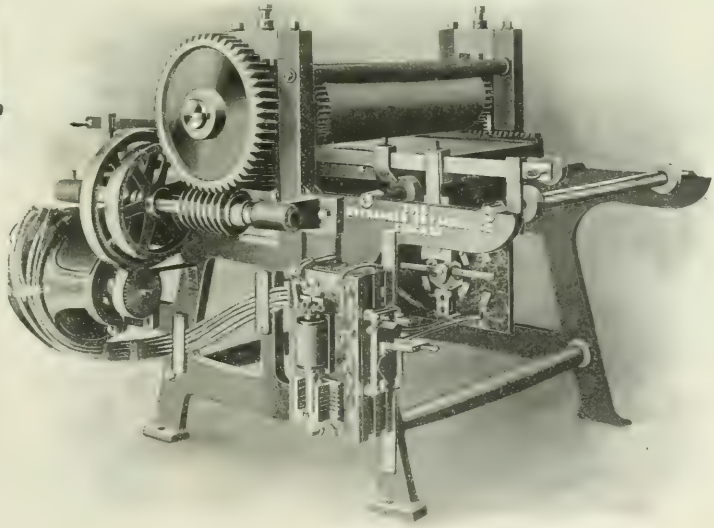


FIG. 3.—ELECTRIC GRINDER.



ELECTRICALLY-DRIVEN MATRIX MACHINE.

Portable and Desk Lamps.

McLeod & Ward, the patentees and manufacturers of the Kinsman desk lamp specialties, 27 Thames Street, New York City, have introduced a number of modifications and improvements in this line of work, one or two of which are here illustrated. The Kinsman portable for use on pianos, desks, etc., shown in Fig. 1, can, of course, be used in any place where an elevated fixture of the kind is required. It is made in polished brass, nickel plate, old brass or oxidized copper. In Fig. 2 is shown the Ward orchestra lamp, of similar finish. It is used for music stands, and can be readily clamped to the rack. It is adjustable as to the size of the opening, which controls the quantity of light. The cylinder may also be moved in a rotary direction to throw the light as desired. Of the same type is the Ward picture lamp, now being extensively used to light fine oil paintings, and which can be made with one, two or more lamps in accordance with the size of the canvas. The supporting arm is adjustable and can be easily fastened to the picture frame.

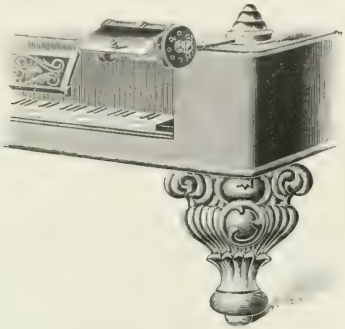


FIG. 1.—PIANO PORTABLE.

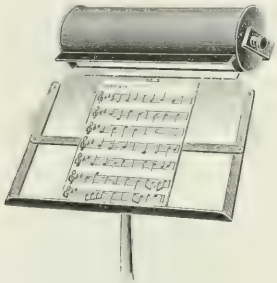


FIG. 2.—MUSIC STAND LAMP.

Fig. 3 shows the Ward pulpit lamp, which, in addition to the regular finishes, is made also in green enamel. It can be neatly arranged on a pulpit so as to throw the light on book or manuscript without allowing any stray light to escape beyond the regulated field of vision of the speaker. Its method of affixing to the desk or lectern is shown.

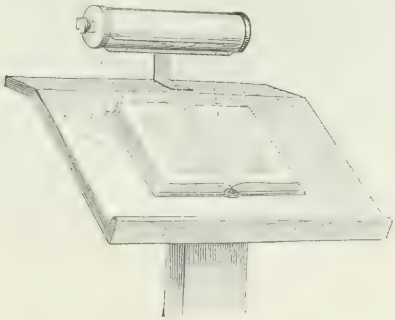


FIG. 3.—PULPIT LAMP.

Bullock Motors.

A number of recent power installations of an interesting nature have been made by the Bullock Electric Mfg. Company, of Cincinnati, Ohio, which has paid attention to direct driving and to securing speed variation. The range of work is well exemplified in the accompanying cuts. Fig. 1 shows a Brown & Sharp grindstone outfit driven by a Bullock motor, forming an extremely compact outfit, in which the motor is thoroughly protected against ill usage, moisture and dust. In Figs. 2 and 3 are shown a group of Fitchburg engine

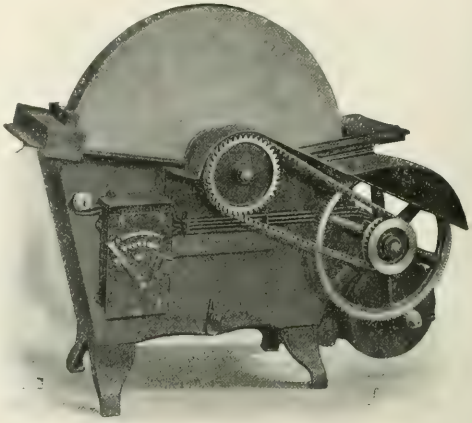


FIG. 1.—GRINDSTONE OUTFIT.

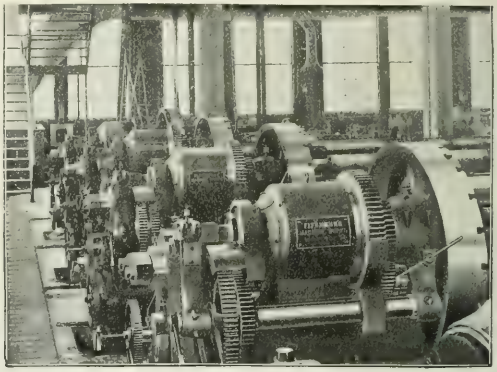


FIG. 2.—ELECTRICALLY-DRIVEN ENGINE LATHES.

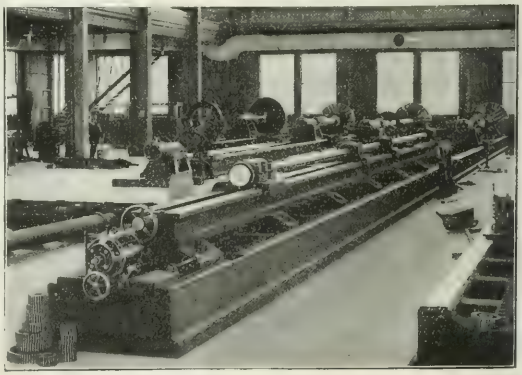
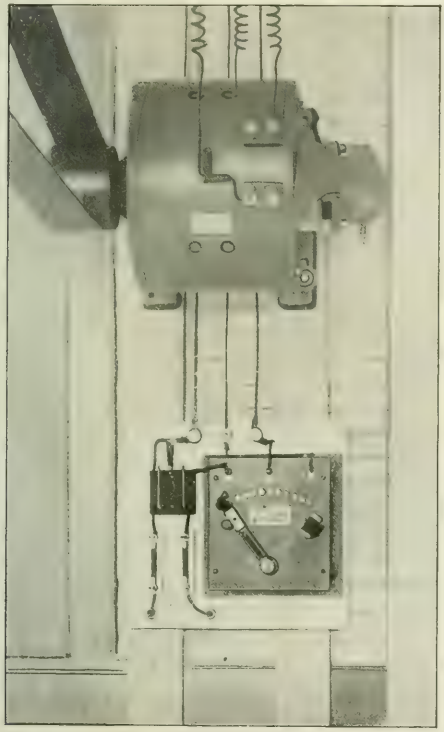


FIG. 3.—ELECTRICALLY-DRIVEN ENGINE LATHES.

lathes installed at the shops of the Fore River Engine Company, Quincy, Mass. They are driven by Bullock motors on the head and tail stocks. The largest lathes have beds 110 ft. long. The motors are controlled by the Bullock multiple voltage system affording six speeds in either direction without armature or field resistance.

Wall Suspension Motor in Rochester, N. Y. Mechanics' Institute.

In the manual training department of the Rochester, N. Y., Athenaeum and Mechanics' Institute, a wall suspension motor has recently been installed by the Rochester Electric Motor Company. It is their regular motor, with the end plates swung round for wall suspension. It was installed in the wood-turning section, belting direct to the line shaft, under guarantee to deliver 7½ horse-power on the belt continuously, and to stand 50 per cent overload for one-half hour, with a rise of temperature, above the surrounding air, not to exceed 110 F. The motor is shunt wound for 900 r. p. m. constant speed at 230 volts, and is a four-brush multipolar, having an efficiency of 87 per cent at full load and 85 per cent at 50 per cent overload. The magnetic frame is cast, and the poles and armature are built up of thin sheet steel, which is so firmly pressed together as to make practically a solid, uniform mass of metal.



WALL SUSPENSION MOTOR.

The poles are bolted to the frame in such a way as to have a perfect fit, and leave it possible to remove a pole and coil without removing the armature. The armature is provided with both radial and longitudinal ventilating ducts. The windings are machine. The commutator bars are held by a double clamp so as to render it impossible to get either a high or a low bar.

Both the brush surface and the wearing depth are of liberal design. The brush holder is of the well-known reaction type, and needs no adjustment. Still, if desirable, by the loosening of one set screw, the brushes may be moved backward or forward simultaneously. The bearings are boxes of the ball and socket type, and provided with ring oilers.

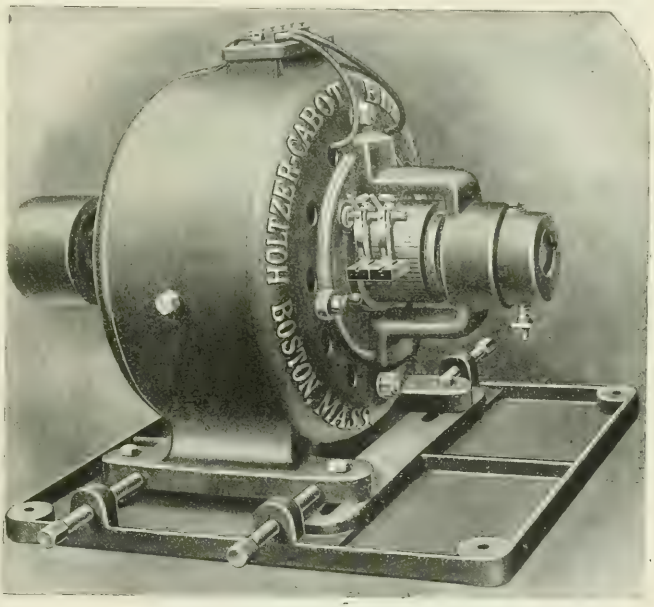
New Universal Enclosed Motors.

The Holtzer-Cabot Electric Company, of Boston, Mass., has recently placed upon the market a line of universal enclosed motors, designed more particularly to meet various special requirements. They range in size from 1-6 horse-power to 10 horse-power, are simple and compact, and easily adaptable to wall or ceiling suspension. This is accomplished by giving the end cases which hold the ring a quarter or half turn, as the case may be. Up to and including 3 horse-power the machines are bipolar, and above that multipolar.

The field frame, which is of cast iron, is circular in shape, as shown in the accompanying cuts. Thus the magnetic circuits are of equal cross-section and equal length, therefore necessarily of equal reluctance, so that there is no unbalancing of the armature circuits.

In the enclosed motor there is, of course, little or no chance for radiation from the inner portions of the machine. It is therefore of great importance that all electrical and magnetic losses be reduced to a minimum. Both armature core and pole pieces are therefore carefully laminated to break up metallic continuity and to reduce the iron losses, as much as possible. By careful copper allowances in the conducting portions of the machines, the losses due to heating effects of the current are kept well within the limits of safety. The manufacturers claim an unusually low temperature elevation for machines of this type.

The poles fit into curved seats in the field ring where they are held by bolts extending through the ring. They are built up of laminations of soft sheet steel, and are provided with projections or shoes of such shape as to form a properly shaded magnetic fringe. Shifting of the diameter of commutation is done away with and sparkless commutation secured through all changes of load.



UNIVERSAL ENCLOSED MOTOR.

The armature is also built up of laminations of annealed steel. It is of slotted type and the coils are held in place and protected from mechanical injury by maple wedges which run the entire length of the slot. It will be noted that the rocker arm is entirely dispensed with, and the brushes are held by a ring which fits snugly into a machined seat in the front end case. This may be moved in either direction to place the brushes at the proper commutating point, being then clamped by two special screws.

The terminal board is placed conveniently on top of the machine, two special bosses being provided for that purpose. The connections are all made on the inside, and are thus entirely out of the way, although they may be reached easily if necessary by slipping off the

front end case. The commutator and brushes may be cleaned or adjusted without danger or inconvenience to the attendant. The brush holders of the larger sizes are of the standard radial type, and are the same as used on the Holtzer-Cabot multipolar machines of the open frame type. The brushes themselves are clamped solidly to a machined surface on the holders which are reinforced by a number of flexible copper strips, so that no springs or sliding contacts are depended on to carry current. In the smaller sizes, where the motors are likely to be run a considerable length of time without attention, a box brush holder is used with a parallel feed, which will allow a long period of wear without any attention.

These motors may be readily modified to meet almost all the conditions that arise in engineering practice. For buffing, grinding or polishing, or in cases where the motor is apt to be exposed to an unusual amount of dust and dirt, a housing is fitted over the commutator, completely enclosing the motor. For electric launches, where minimum weight is desired, the non-magnetic or non-conducting portions of the machine are made of aluminum. The motors are readily adapted for direct connection to fans, blowers, presses, etc. The manufacturers claim unusually high efficiency for units of this size, varying from 63 per cent in the smallest to 89 per cent in the larger sizes, with a relatively high efficiency on light loads.

The Mayer Dynamos and Motors.

On this page are illustrated some new dynamos and motors now being built by the Maxwell M. Mayer Electric Company, of New York. Their chief feature of construction is a magnet frame consisting of a

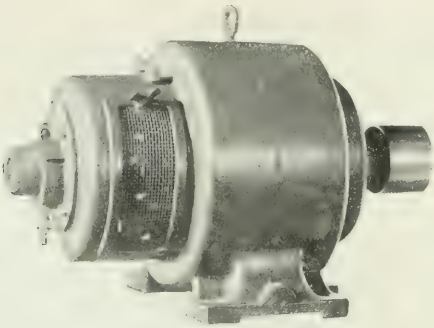


FIG. 1.—DYNAMO AND MOTOR.

cast iron ring having steel magnet cores cast into the ring. The end faces of this ring are finished and have end plates carrying bearings bolted to them. The back plate has four holes for ventilation, and the front plate has two hinged doors to admit of free access to the brushes. By this construction, the end plates can be turned either

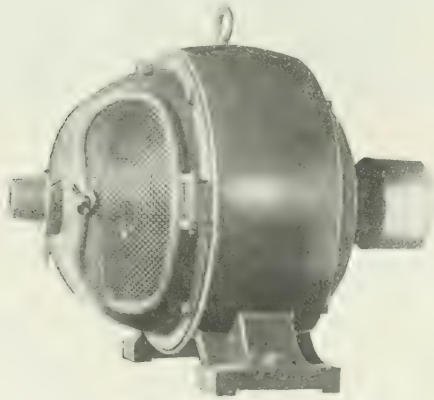


FIG. 2.—DYNAMO AND MOTOR.

90 or 180 degs., so that the motor can be adjusted for floor, wall or ceiling suspension. Fig. 1 shows a slightly different type used for 1 horse-power only; Fig. 2 shows type used for from 2 to 10 horse-power. The armatures of the slotted drum type are of large diameter, and mica is used throughout for insulation.

The commutators, which are of ample size, are made from best copper insulated with sheet mica throughout. The bearings are phosphor bronze and self-oiling, and special grooves in the end plate are provided to prevent slinging of the oil. The field coils are wound on removable fiber bobbins, and are carefully taped with heavy linen tape. They are held in place on the magnet cores by removable pole shoes. The brush holders are of the well known reaction type.

Direct Current Motors of the Lundell Type.

The design of the Lundell type of motor makes it particularly adapted to special applications, of which we illustrate an example, showing a Lundell motor geared to a Saunders' pipe cutting and threading machine. Fig. 1. This equipment consists of the Lundell standard round type, compound-wound motor operating at standard rated speeds. It is entirely enclosed, having suitable trap doors at commutator end to enable access to brushes and commutator. Upon the motor shaft is mounted a suitable steel pinion, which meshes in a cast-iron cut-gear wheel located upon the main driving shaft of the machine.

The motor is substantially mounted upon a cast-iron bracket, which is rigidly fastened to the frame of the pipe-cutting machine. Beneath this bracket is fastened the necessary resistances which are used in connection with the controller for operating the motor at its various speeds. For controlling the motor there is used the Sprague Company's standard rotary controller, which permits the motor to be operated at eight different speeds in both forward and reverse direction. The reversing of the motor is accomplished by an extra reversing cylinder which is mounted alongside of the main cylinder in the controller. This controller is so arranged as to enable a speed regulation of motor between normal and maximum of 20 per cent by inserting resistance in series with the shunt field winding of motor, and 50 per cent reduction in speed obtained by means of armature regulating resistance inserted in series with the armature. The arma-

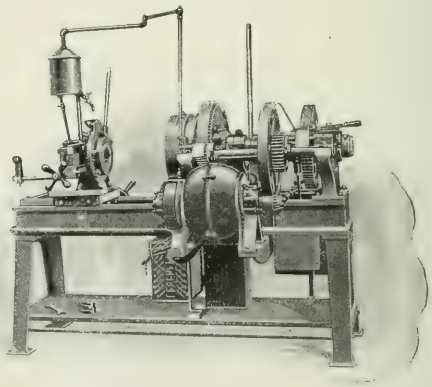


FIG. 1.—ELECTRICALLY-DRIVEN PIPE CUTTING AND THREADING MACHINE.

ture and shunt field resistance is self-contained, and is so constructed that it is practically indestructible, the resistance wires being entirely enclosed in special iron box castings, making them both oil and fireproof.

For protecting the motor from severe overloads, there is used a standard circuit breaker which is connected in the main line circuit, and which will automatically interrupt the circuit if a severe overload is put on the motor. There is also used in addition to this a separate knife blade fused switch which is enclosed in an asbestos lined wooden box and fastened to the frame of the machine. This switch is used for controlling the main line circuit to the rotary controller. The above appliances make a very satisfactory operating equipment and are so arranged as to operate at their highest efficiency when the motor is at its normal capacity.

Another interesting application of an electric motor is shown in Fig. 2. A 1-hp Lundell motor, mounted on a universal bracket and equipped with a flexible shaft, has been successfully used in the

Presbyterian Hospital, New York, for working the surgical instruments in such operations as trepanning the skull, drilling and sawing bones, etc. By using the motor operations have been performed in a much shorter time and with less pain to the patient than is possible

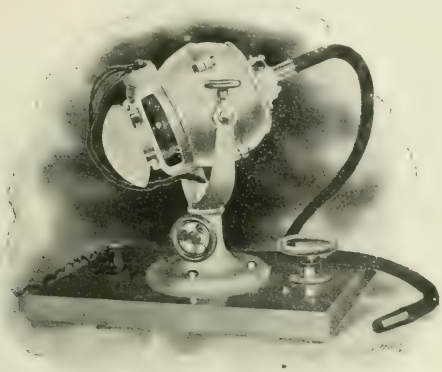


FIG. 2.—MOTOR WITH FLEXIBLE SHAFT.

by the old method of chopping with chisels and using ordinary hand saws. The general arrangement of supporting the motor and the method of attaching the shaft enables the motor to be operated at a very high speed with maximum power, and with no vibration when guiding the instrument with the hand.

The New Eck Motor.

Mr. C. A. Eck, the proprietor of the Eck Dynamo & Motor Works, of Belleville, N. J., has just designed and brought out a new type of motor, which embodies a number of features of interest and is herewith illustrated. The field consists of a circular yoke of such section as to secure the most efficient working and best regulation without being unduly heavy. The cores are round, thereby involving a minimum of copper in the field, and are made of soft wrought iron set

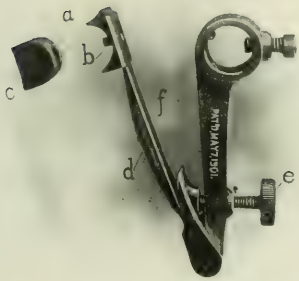


FIG. 1.—BRUSH HOLDER.

deeply in the magnet frame to insure a perfect joint and a large contact surface. The pole shoes are carefully shaped so as to produce a uniformly distributed field in the air-gap, which, with careful proportioning of the winding, secures sparkless operation under all changes of load without shifting the brushes.

The armature core is of the slotted or toothed type, built up of thin annealed sheet steel. The winding is first baked to remove all moisture, then dipped in best insulating varnish and again baked. The commutator is large and of great radial depth. Special provisions are made for additional fastening of the armature winding beside soldering it to the commutator segments. The patented brush holder, is shown herewith. The brush, which has a convex curve, *a*, that fits a concave curve, *b*, in the holder, is allowed to turn slightly and to adjust itself to the periphery of the commutator at point, *c;* and the semi-circle having its center near the periphery of the commutator, the tendency of the brush to turn and to wear on one side only is eliminated. A flat tempered steel spring, *f*, presses the brush holder against the brush, the tension being adjusted by a screw, *e*, made so as to prevent it from turning through vibration. Two or more copper strips, *d*, running alongside the steel spring carry the current. After being used on the Eck motors continuously for over one year the brushes have demonstrated that they give perfect contact between brush and commutator, and brush and holder, with a total absence of any disagreeable chattering or squeaking noise, while their easy self-adjustment to the commutator reduces the wear on the brush and commutator to a minimum, giving the latter the much desired polished mahogany appearance.

The Eck semi-enclosed and enclosed type dynamos and motors are provided with patented swiveling shields which expose the interior of the machines to view and permit easy access to the brush holders and brushes by simply turning the shield one-quarter of a turn in the fashion of an ordinary stove damper until it stops, and vice versa. Mr. Eck finds this to be more economical than shields fastened with small screws, the unfastening of which always means more or less time lost, and it is more convenient than hinge doors which require almost as much space as the machine itself when opened. Tension springs, producing the proper friction, keep the shields tight, dispense with locking and prevent noise that might be caused through vibration. Another fact not to be overlooked, is that no matter whether opened or closed, the machines always present the same symmetrical and complete appearance.

As some insurance companies insist upon tin pans being placed under the machines in order to prevent the oil from running upon the floor, the concern has designed and furnish with its machines a combination sliding base and oil pan. This not only saves the cost of a pan, but also adds to the safety from fire, as many users of dynamos

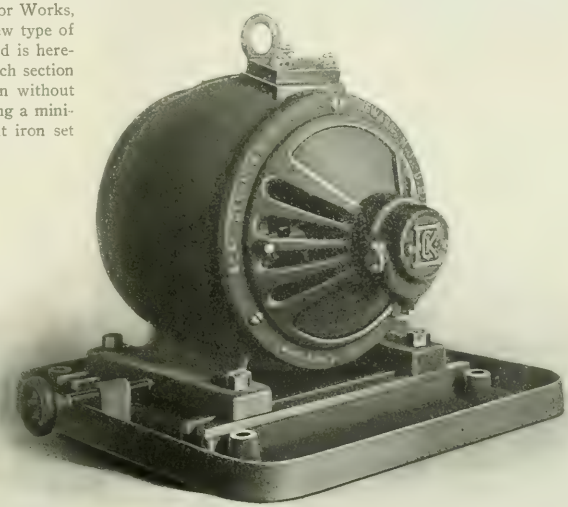


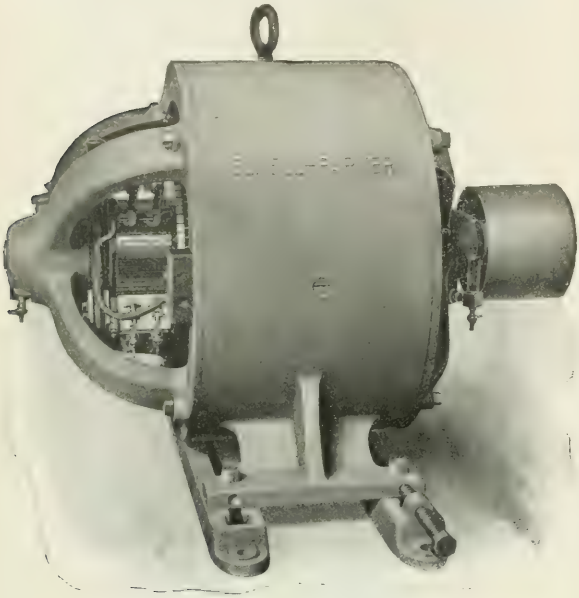
FIG. 2.—MOTOR.

and motors make a practice of screwing the machine and pan to the floor with lag screws, perforating the pan, and thus permitting the oil to leak through the openings around the screws.

The Eck Works make three different styles of machines, viz., the protected type, without swiveling shields, with a strong cast iron bracket joined to the frame; the semi-enclosed type, with apertures in the swiveling shield, permitting ventilation; and the enclosed type with swiveling shields made solid, recommended for machinery put in inaccessible places, where they can receive little or no attention, or where they are exposed to dust, dampness, flying chips, etc.

Round Pattern Motors.

The round pattern power motor herewith illustrated in being built by the Elwell-Parker Electric Company, of Cleveland, Ohio, on low and moderate speed ratings, in sizes from 1 horse-power up to and including 40 horse-power. In the type shown, Mr. F. C. Phillips informs us, they are able to get from a machine weighing 925 lbs. an output of 12½ horse-power without sparking or heating beyond the normal, customary limit, i. e., a 75 deg. F. rise. The efficiency of



ROUND PATTERN POWER MOTOR.

this motor, when giving the above output at from 1150 to 1175 r. p. m. would not be less than 82 per cent. The bearings of the motor are made in one piece of special bronze, and are seated in the motor heads so as to be self-aligning; and can be taken out for repair or replacement in a few minutes. There is a spacious oil chamber with two oil rings for each bearing. A special feature is the simple but efficient brush gear, in which the brushes can be quickly replaced, and on which the tension can be adjusted to a nicety. This motor represents the latest type of the company's round pattern product.

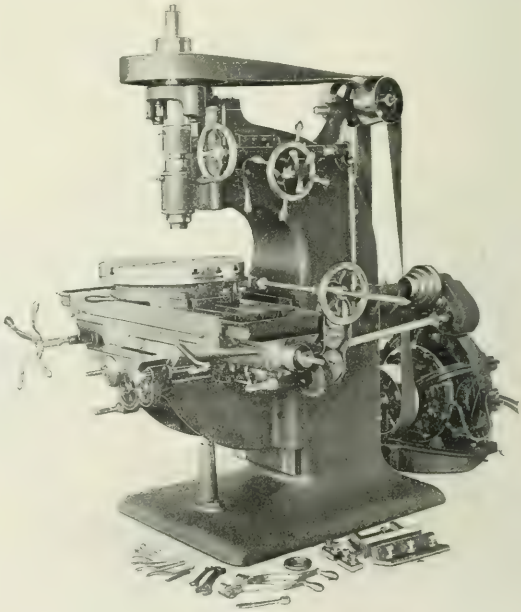
A Motor Driven Miller.

An interesting exemplification of modern American ingenuity in machine tools, and the driving of such tools by motors, is afforded in the Becker miller illustrated herewith, made by the Becker-Brainard Milling Machine Company, Hyde Park, Mass. This tool performs a very wide range of work, and is of the most convenient size for the majority of machine shops and factories. This particular tool has lately been on view at the Pan-American, where it has attracted considerable attention. The spindle has long bronze bearings made adjustable for wear. The mills are secured rigidly by means of a draw-bar. Large surface mills are fitted to the threaded nose of the spindle. The spindle driving pulley, mounted upon an adjustable auxiliary bearing (Becker's patent), is back geared 5 to 1; the spindle pulley is 16 inches diameter, 4 inches face. To balance the action, back gears are made in duplicate. The head has automatic or hand movement of 9 inches, and an automatic stop-dog which will throw out the feed at any point within the limit of its vertical movement, thus making this tool an excellent vertical-boring machine. A micrometer stop-gauge located at the upper left-hand side of the frame accurately gauges the depth of any cut. The platen is 51½ inches in length over all and 14 inches wide, with 42 inches automatic feed in either direction. It has quick return motion, geared 3 to 1; oil channels conduct the oil to removable oil pockets. The saddle is the same length as the platen, with automatic feed in and out of 16 inches. Both feed screws are dialed. The knee has automatic vertical feed; the extreme distance between spindle and platen is 21½ inches; between spindle and rotary table, 16 inches.

The rotary attachment has graduated table, 22 inches diameter. It is fed automatically in either direction. Adjustable dogs are attached to the periphery of the table to automatically trip the feed. The table feeds are derived from compounded gears giving eight changes for each change of spindle speed. The intermediate gears on rotary feed bracket are interchangeable, increasing the speed 6 to 1, thus providing 16 changes of feeds for the rotary attachment. The arbor support is attachable to the knee, and is used only when side milling with long and slim cutters necessitates such support. The vise jaws are 9 inches long, 2½ inches deep, working in connection with the T slots of the table.

The Sturtevant motors used with this tool are designed specially for direct connection to this type of milling machine. The variation of speed required for different sizes of cutters where working different metals is very great and on the type of machine referred to with its usual back gearing the range of speed required of the motor is from about 250 r. p. m. to 750 r. p. m. The usual method of reducing the motor speed by means of a rheostat in armature circuit cannot be used on this class of work, as the speed, being dependent upon the load, varies with the depth and width of every cut and increases when the cutter is running out, thereby burning the cutter teeth and ruining it. On this account rheostatic control as usually considered is not attempted at all, the various speeds being obtained by means of a special armature having two commutators, the two separate windings of which are used either independently or together in conjunction with a variable field. All of these changes are made by a simple controller of the enamel type which is placed upon the side of the machine.

The motor is of the eight-pole type, with tripod bearing hangers, and is either open or enclosed as specified. An enclosed motor is perferable on the score of safety from flying chips, etc. The frame of the motor is a steel casting having the tripod hangers bolted to it. The armature is of the toothed drum type, having a commutator on

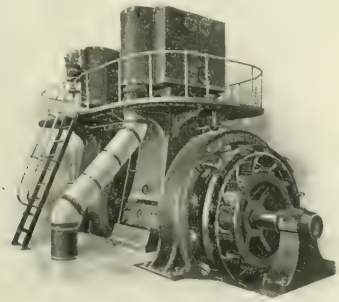


MOTOR-DRIVEN MILLING MACHINE.

each side. Carbon brushes are invariably used. The method of speed variation employed is such that the motor can be used in any shop having either 110, 220 or 500-volt power service, and does not require any special complex generating plant or wiring system to make it operate satisfactorily.

Crocker-Wheeler Engine Type Generator.

The accompanying illustration shows a Crocker-Wheeler railway generator direct connected to a vertical engine. In designing this machine the Crocker-Wheeler Company was mindful of the exacting requirements of railway work, and particular care was bestowed in its production to combine in it all the time-tried elements of dynamo electric machinery that have proven to be of value. Among the special features of design and construction, as set forth by the company, may be mentioned low-current density in windings, commutator, brushes and other conducting parts; adequate means of ventilation; a substantially flat efficiency curve and a nearly straight compounding curve. The magnet frame is a cast iron ring of girder construction, divided horizontally, the two halves being fastened together by bolts and kept in accurate alignment by dowels let into the frame. The



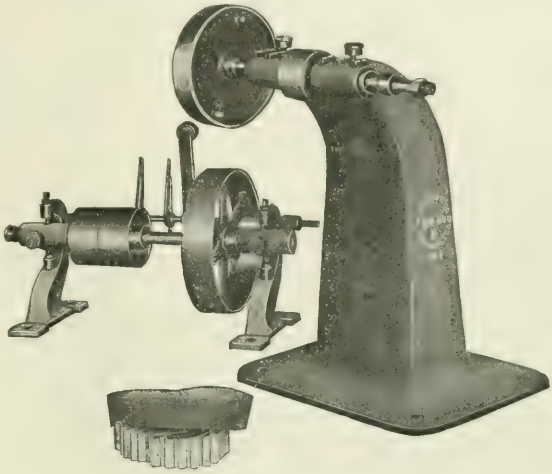
ENGINE TYPE GENERATOR.

round steel poles are cast-welded into the frame in such a manner as to insure a perfect magnetic joint. Each pole is fitted with a removable shoe, designed to produce the best distribution of the magnetic flux where it enters the armature, and to give a comparatively large air-gap between the armature and field. The armature is of the iron-clad type, the core being formed of toothed laminations made of mild steel. The field coils are easily removable from the poles. The machine throughout has been given the closest attention as to details and quality of material and finish, and in every way represents the high standard of this company's work.

Band Polishing Machine.

We illustrate herewith a new "sit down" band polishing machine just being put on the market by Charles H. Besly & Co., Chicago, Ill. This form of stand is very desirable, as it permits the operator to be seated while at work. The Besly band wheels used on this machine are made of semi-steel castings, and when an elastic surface is required they are covered with felt. The emery or other abrasive material is applied to the wheel on a cloth band, which may be tightened firmly around the wheel. To reset the wheel, or change the grade of emery, it is necessary only to remove the band, and replace it with another—an operation requiring only one or two minutes of time.

One of these wheels will take the place, and do the work, of a large number of polishing wheels. The wheels when used with emery bands are always balanced and ready for use. This machine is suitable for shops where skilled polishers are not employed, as well as in those



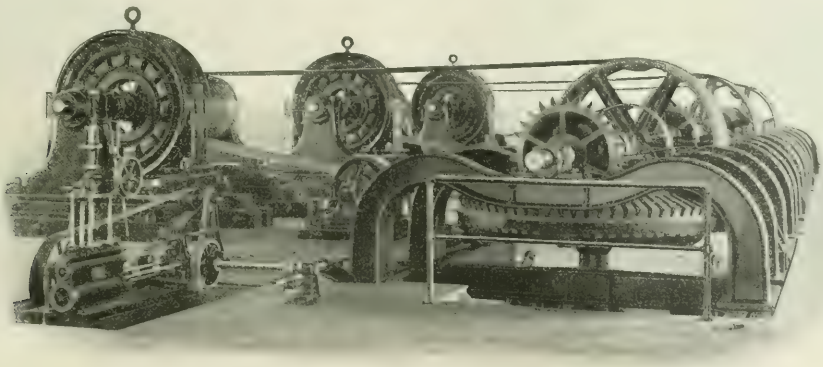
BAND POLISHER.

employing skilled labor. An ordinary shop boy with a little practice can do the work of a skilled polisher.

These grinders are made so that a single Besly band wheel can be used; or with double spindle, two band wheels may be used, or a band wheel at one end, and a regular buff or emery wheel at the other end of the spindle. Besly wheels are made with cushioned or with hard finish.

Water Power Plant at Silver City, Idaho.

The Trade Dollar Mining Company, of Silver City, Idaho, has lately installed a hydro-electric plant to operate its machinery by electric power at that place. The plant is illustrated herewith. It comprises three belt-driven Westinghouse generators operated by four vertical shaft 72-inch McCormick turbines, developing 3600 horse-power under 19-ft. head, the turbines being furnished by the S. Morgan Smith Company, of York, Pa. The gates of the four water-wheels are operated by means of one Lombard governor working in connection with a lever gate hoisting device, which makes it possible to dispense with all such gears as are used in ordinary practice.



Silver City Mine Power Plant.

A New Consumer of Niagara Power.

A new consumer of Niagara power, on the land of the Niagara Development Company, at Niagara Falls, N. Y., is the McPherson Switch & Frog Company, W. B. Rankine, manager and director, whose new plant on Iroquois Street is rapidly nearing completion. This company will use intermittently 130 horse-power of current, in operating motors ranging from 5 to 75 horse-power capacity for individual machines and Ingersoll air compressors. Its specialty is the McPherson safety switch and frog—a patent which has been before the public for nine years. It is not yet in as general use as it deserves, but doubtless will be soon. The switch consists of a device which lies inert along the main track, making no break whatever in the line, until a train goes into the siding. Ninety per cent of the trains in daily operation use only the main track, yet the switches and frogs in common use receive the wear and tear of every train, necessitating frequent renewal and constant supervision, as well as a slowing down of trains when the switch is approached. With the McPherson switch, there being absolutely no wear and tear upon it, excepting by the 10 per cent of trains, which use the siding, 90 per cent of saving is effected by their use. There is also a saving in fuel since no slowing down of trains is required, and a better speed is thus attained.

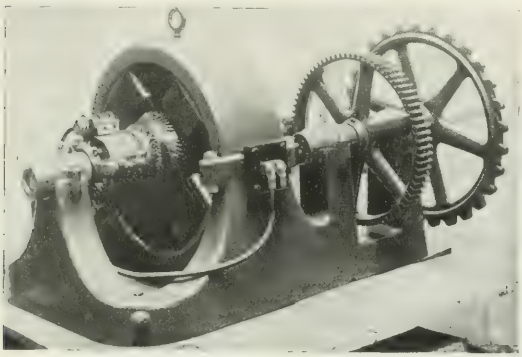
On a short line of the Canadian Pacific Railroad, the McPherson switch and frog are in use on a track having 90 miles of continuous main line without a break, though sidings occur at average intervals of six miles during the entire length of the road.

This company has another plant in process of erection on the Canadian side of the river, to meet the demands of the Canada trade. The plant at Niagara Falls, N. Y., will be completed and in full operation within five weeks, and ready to fill orders, of which it has a large number already on hand.

New Back-Geared Motor.

Slow-speed machinery requiring minimum driving speed at moderate cost has found a desideratum in the back-geared motor, through which it is possible by means of perfect alignment, rigidity, well-oiled bearings and smooth running gears to reduce the extra friction to a minimum. The illustration shows a type of such a motor intended for general work, made by the E. G. Bernard Company, of Troy, N. Y., and installed at the Dobler Brewing Company, Albany, N. Y. Fitted with sprocket wheel, as shown, it is used to operate a keg elevator, to which it is attached by means of an endless chain.

This motor is 10 horse-power, 675 r. p. m., back-geared to 135 r. p. m. The entire base and pedestals are cast in one piece and are exceedingly rigid. The bearings are in perfect alignment. The gear

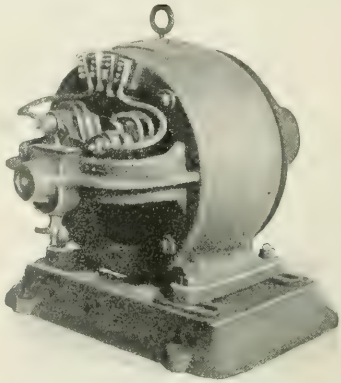


BACK-GEARED MOTOR.

bearings are the same as the motor bearings, and are those regularly used by the Bernard Company, made of one solid piece of chemical bronze, with self oiling rings. All shafting is made of hammer-welded steel at a pressure of 75,000 lbs. per square inch. The gears are Brown & Sharp machined. The spurs are of cast iron, the pinion of leather, having brass flanges, insuring ample strength and absence of noise in operation. All possible speeds are obtained by using the proper ratio of gears.

Aaron Multipolar Dynamo and Motor.

In the type of machine illustrated herewith, manufactured by the Aaron Electric Company, 141 South Clinton Street, Chicago, all connections are made on the outside of the machine, which is an evident advantage. The motors are designed for either wall or ceiling suspension, and their construction is stated to embody the latest



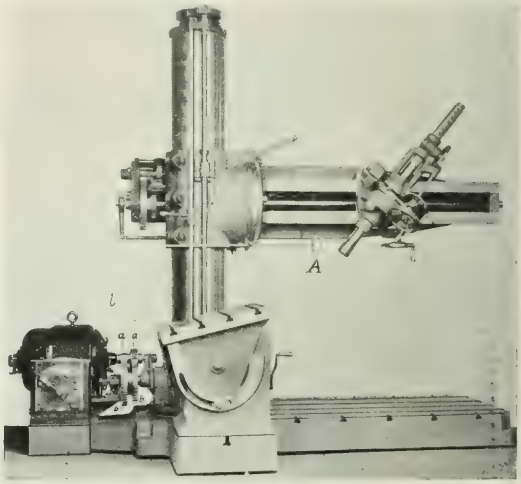
MULTIPOLAR DYNAMO AND MOTOR.

and best engineering practice. The commutators are made exceptionally large, insuring long, cool running of the machines. The new and improved brush holder also aids in keeping down the heat. Dynamos of this type are made in 10 sizes, ranging in capacity from ¾ to 7½ kilowatts, and motors in the same number of sizes, ranging from 1 to 10 horse-power, the machines being wound for all standard voltages.

Motor-Driven Radial Drill.

A compact form of radial drill is shown in the cut herewith of the 6-inch full universal radial drill, motor driven, of Dreses Mueller & Co., Cincinnati, Ohio, which they have lately introduced.

The speed variation obtained in a four to five step cone of the ordinary machine tool is about in the proportion from 4 to 5 : 1. Motors



ELECTRICALLY DRIVEN DRILL.

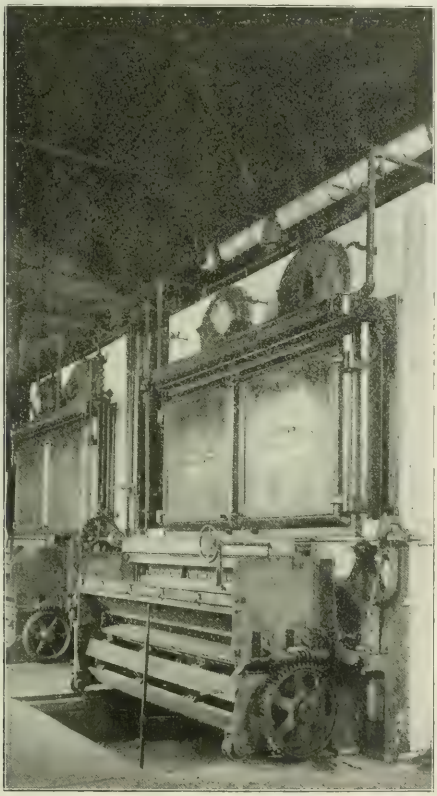
of this difference in speed are not only high in price, but undesirable. To overcome this objectionable feature to a great extent the firm uses a motor with a speed variation of only 2 : 1, and makes up the difference in the attaching gearing. The pinions *a a* are of rawhide, and are fast on the armature shaft. They mesh with the large gears *b b* running loose on the shaft carrying otherwise the cone pulley. By means of a friction clutch, operated by lever *l*, these gears are alternately clutched to their shaft, and so, by their proper proportion, make

up the difference. In use, the gearing is covered by a bonnet to keep the dust out and avoid accidents.

For convenience of the operator, the driving gearing of this machine is so arranged that by means of the adjustable rod *A* the drill can be started, stopped, the back gears engaged and the spindle reversed quickly without going to the rheostat or speed controller.

The McKenzie Traveling Grate Stoker.

Among several types of automatic stokers which in the past few years have been placed upon the market, is one originated and patented by Mr. Dougal J. McKenzie, of Chicago, Ill., which is illustrated herewith. One great advantage claimed for this stoker relates to the disposal of clinkers, which, in the case of the McKenzie stoker, are disposed of automatically without any annoyance and expense by having this refuse travel back and over what is known as a clinker apron, which fits snugly to the rear end of the traveling grate, and which in turn is kept cool by means of a cold water circulation. Proper ventilation is provided for by having the whole stoker tightly bricked in and the ash receiver at the rear end, in which the ashes



TRAVELING GRATE STOKER.

and clinkers are dumped, kept closed automatically except when refuse is occasionally dumped, which is once every four or five hours. An improved brick coking arch, with adjustable tiles at the front end of the furnace, facilitates the coking of fresh coal as it enters from the coal hopper. Another marked advantage claimed for the McKenzie stoker is the fact that a fire can be easily started or banked as in the old style of hand-fired furnace.

The stoker, with which any type of boiler can be equipped, is built upon the principle that coal fired automatically can be so correctly and perfectly suspended in the atmosphere as to admit the necessary amount of oxygen to every square inch of coal over the entire grate surface, and thus produce perfect combustion. In carrying out this principle a grate bar of great strength has been constructed with only 50 per cent of metal to the square foot on the surface. The thickness of the fire bed is automatically controlled according to the power required and the amount of coal to be consumed, and at the same time there is no excess of air.

This machine is not what is called a "chain grate stoker," consisting simply of a series of small pieces connected together with rods, and forms a belt or chain upon which coal is burned. In the case of the McKenzie stoker, the chains are not subjected to the abuse of the fire, and when anything happens to them, they can be repaired leisurely and without serious interruption of the plant. It is claimed that with this type of stoker a saving in fuel of from 15 to 25 per cent over the ordinary method of firing can be made. The McKenzie stoker is manufactured by the McKenzie Furnace Company, Chicago.

Electrical Drive for a Stereotype Plate-Shaving Machine.

We show herewith an illustration of a Hoe plate-shaving machine equipped by the Jenney Electrical Manufacturing Company, of Indianapolis, Ind., with a Jenney universal type motor and a special starting and stopping switch designed for the machine.

The motor is compound wound, and is rigidly mounted on the end of the machine by special castings. The power is delivered through a rawhide pinion engaging a cut gear mounted on the worm shaft of the shaving machine. This gear and pinion is fully protected by a cast-iron guard. The starting and stopping switch is mounted on slate just above the motor in convenient reach of the operator. The stud supporting the lever of this switch is attached to the end of the shaft that carries the shaving knife.

After the plate has been placed in position ready for shaving, the operator pulls the lever towards him against the limit stop, when the motor starts gradually, and the motion of the shaving knife cuts the resistance out of the armature circuit; so that when the knife commences to shave the plate, the motor is running at full speed, and

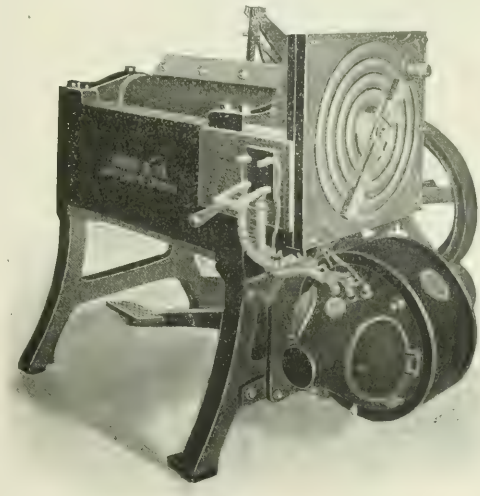


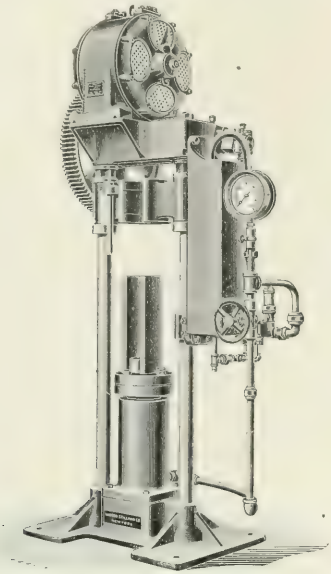
PLATE-SHAVING MACHINE.

continues to do so until the plate has been shaved. The momentum of the machine then carries the switch lever around to a point where connections are made that convert the motor into a generator through a light resistance load, which load is gradually increased until the motor is brought to a standstill at exactly the proper position for the operator to remove the shaved plate.

This equipment, and those provided by this company for other stereotyping machinery, not only result in a substantial saving of time for the operator, but accomplish a very material reduction in cost of operation, economize floor space, and, being self-contained, allow the machine to be located in the most convenient position and to be easily moved when desired.

Thirty-Ton Motor Driven Armature Press.

The small press shown in the accompanying cut is patterned after a larger 60-ton tool shown, but modified at the top to secure a good foundation for a motor. The upper beam revolves upon ball bearings to permit of its being easily pushed out of the way to allow of armature being built up or more disks being put on the shaft without removing it from the press. The motor shown is one manufactured by the Westinghouse Electric & Manufacturing Company. It has a



30-TON MOTOR-DRIVEN ARMATURE PRESS.

4-inch rawhide pinion on the armature shaft meshing with a cut gear 24 inches by 3 inches in diameter. This is upon the pump shaft. The pump has a piston ¾ inch in diameter, and is double acting. The press ram has a motion of 9 inches. The distance between rods is 15½ inches. The removable "U" block is 18 inches high and its top 9 inches from the lower side of the swinging beam. The jaw of the beam and the block are large enough to permit of the pressing of work on a 3-inch shaft. The press complete as shown weighs 2200 lbs., including the motor. The press is made by Watson-Stillman Company, 204 East Forty-third Street, New York City.

Ferracute Machine Company's Pan-American Exhibit.

The Ferracute Company's Pan-American exhibit consists of 12 presses for various kinds of sheet metals, also a number of attachments and dies, and a large collection of samples of sheet metal work and photographs, etc. The machinery exhibited includes two foot presses, one small, used for very light work, and the other, larger, especially adapted for can making and various other sheet metal work up to 6 inches diameter. There are a number of special features in these presses in the way of treadle stop, rubber pumpers, special adjustments and clamping arrangements, etc.

Among the power presses is shown one with dial feed attachment. The legs are arranged so that the center of oscillation is directly under the bed, with an improved screw arrangement for running down or lowering the bed from level to inclined position. The dial-feed attachment is arranged for feeding various kinds of work rapidly into the press, the work being carried around by the dial and holders under the dies and delivered at the left side of the press. This attachment provides an accurate and simple method of feeding.

Two heavier power presses are shown. One is a plain punching press and embodies a number of valuable features in the arrangement of the ram adjustment and eccentric and is fitted up in such a manner that the stroke is changeable. The ram bearings are unusually wide and long, and there are special arrangements for clamping and holding the dies, and a number of other features which are not found in other makes of presses. The larger press is fitted with a double feed roll attachment for feeding strips of metal into the dies in cutting blanks and for various other work. This feeding attachment is very simple and accurate, and can be detached quickly, and the press can be used without it. These two presses are of a series of presses, six sizes of which are without gearing and six sizes with, and they are used for a variety of work in thick metals, for sewing machines, hardware and typewriters, etc., in cutting, shearing and forming.

Another press is a special machine provided with an index feeding attachment which is used for cutting armature disks, the feeding arrangement being changeable for a great variety of notching on any size of work from 3 inches to 48 inches diameter. This style of press is used in electrical factories largely.

A number of the presses are provided with dies showing the operations of making small souvenirs, pans or plates, with an artistic design representing the progress of the country and a Buffalo in the

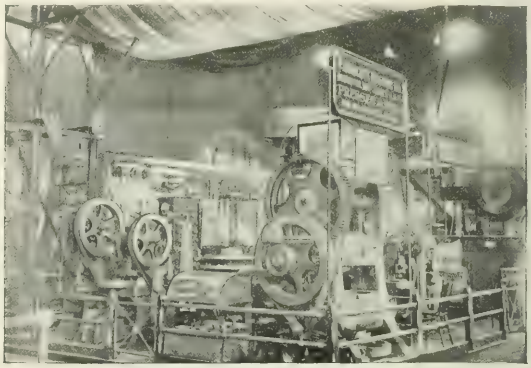


EXHIBIT OF PRESSES, DIES, ETC.

center. A number of dies are also shown illustrating the various processes in the manufacture of sheet metals.

The general design of the machines and the neatness of the whole exhibit has attracted considerable attention, and a gold medal has just been awarded the Ferracute Machine Company, Bridgeton, N. J., for its exhibit. It may be added that all the operative machinery in this fine exhibit is driven by electric power, whose use it illustrates admirably.

Belting at the Pan-American.

Charles A. Schieren & Co. have been awarded a gold medal at the Pan-American Exposition for their oak bark tanned leather belting and belt leather. The exhibit is in the machinery section, and it consists of an Oriental kiosk, made from the same material that the Exposition buildings were made, one of the artistic features of the decoration being the wainscoating reaching from floor to ceiling on all sides, and made from samples of leather belting, showing the various grades of leather and fastening at laps of belting used by the house. The exhibit proper consists of a 72-inch, 3-ply leather belt, 165 ft. in length, made for the People's Tramway Company, of Putnam, Conn., which is undoubtedly the largest 72-inch belt ever made in this country. In addition to this large belt they have exhibited rolls of smaller sizes, showing the different grades manufactured, and in the electric power plant of the Exposition they have had a 20-inch double and seven or eight 12-inch double leather belts running ever since the Exposition began. These belts are treated with "Leatherine," a composition which renders the belts impervious to dampness and water, and gives the belt more dynamic power than a belt which is not so treated.

A practical demonstration of the value of "Leatherine" occurred during the heavy storm recently, when the roof of the Exposition power house leaked and wet all of the belts in operation. The only belts that held together at the laps, it is said, and were not rendered useless were the Schieren ones filled or dressed with "Leatherine."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 3 per cent. Time money, which was easy throughout the week, closed at 4¼@4½ per cent for high grade loans, and 4¾@5 on mixed collateral. The stock market exhibited a tone of firmness and advances were recorded. A feature was the investment buying of high-grade dividend stocks, in some of which new prices were recorded. In the industrial list, United States Steel Corporation securities were very dull, and sold off a little. The favorable accounts of the condition of the steel trade tended to check any disposition to sell steel stocks. Metropolitan Street Railway and Brooklyn Rapid Transit were both heavy, the former closing at a figure 2⅛ points below that at the close of the previous week, and the latter ⅛ point below. Comparatively little business was done in Metropolitan, the sales aggregating 8600 shares. The sales of Brooklyn Rapid Transit were 29,860 shares, the quotations ranging between 60¼ and 62½, closing at 60¾. General Electric was firm on narrow trading, the sales amounting to only 1400 shares. The price ranged between 256 and 259½, closing at 258, a net advance of 1 point. Western Union lost ⅛ point on sales of 2300 shares, the closing figure being 91½. American Telephone & Telegraph lost 1 point, closing at 158½. American District Telegraph closed at 37, which is a net gain of 5 points. In the market for outside securities there was no special feature. Copper stocks were quiet, and Electric Lead was steady, with sales of 800 shares on Saturday at 2¾ to 3. Following are the closing quotations of Tuesday, Oct. 29:

NEW YORK.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
American Tel. & Cable..	—	—	General Carriage.....	¾	⅞
American Dist. Tel.....	—	37½	Hudson River Tel.....	112	112
Brooklyn Rapid Transit..	61½	62	Illinois Elec. Veh. Trans.	½	—
Commercial Cable.....	—	—	Metropolitan Street Ry..	157¾	156
Electric Boat.....	18	19½	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	45	40	N. Y. Elec. Veh. Tran....	6¾	7
Electric Lead Reduc'n...	2½	2⅝	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	1¾	1½	Tel. & Tel. Co. of Am....	—	—
Electric Vehicle pfd.....	3½	3½	Western Union Tel.....	91½	91¼
General Electric.....	258	256			

BOSTON.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
Am. Tel. & Tel.....	158¾	158	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light....	—	—	Westinghouse Elec.....	—	72*
Erie Telephone.....	36	—	Westinghouse Elec. pfd.	78	78*
General Electric pfd.....	—	—			

PHILADELPHIA.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
American Railways.....	40	39½	Phila. Traction.....	95¾	95½
Electric Storage Battery.	60	65	Philadelphia Electric.....	5⅛	5
Elec. Storage Batt'y pfd..	60	65	Pa. Electric Vehicle.....	½	½
Elec. Co. of America.....	6⅝	6⅜	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
Central Union Telephone.	—	—	National Carbon pfd.....	84	84
Chicago Edison.....	165	160	Northwest Elev. com.....	39	39
Chicago City Ry.....	201	200	Union Traction.....	17	15¼
Chicago Telep. Co.....	250	235*	Union Traction pfd.....	58½	53
National Carbon.....	19⅝	20⅜			

* Asked.

CENTRAL UNION TELEPHONE.—The financial affairs of the Central Union Telephone Company are now placed in an improved condition. Previous to the recent two meetings of the stockholders the capitalization of the company was: Stock, $6,000,000; bonds, $6,000,000; floating debt, $1,000,000; the stock selling at 40. Under these conditions it was impossible to raise one dollar of money for extensions. Competition had seriously invaded the territory and money was absolutely necessary to save the property. The condition of affairs was fully set forth in President Sabin's circular calling for funds, but the stockholders failed to respond to this appeal. Finally the American Telephone & Telegraph Company said that if the stock was cut in two, each stockholder surrendering one-half, in all $3,000,000 and increased again $3,000,000, this going into the treasury, it would take all of the new $3,000,000 not taken by stockholders at par, notwithstanding the market price for the new stock was but 80. The plan was accepted and carried out. The company now has $2,000,000 new money for development. It operates 80,000 telephone stations in the Middle West. The last sale of the old stock was 42, which is equal to 84 for the new. The $2,000,000 treasury money will provide funds to complete this year's extensions, but the affairs of the company must be financed again in 1902, as fully $2,500,000 of money will be necesary for extensions, unless the parent company again takes stock at 100.

DIVIDENDS.—The directors of the American Light & Traction Company have declared a quarterly dividend of 1½ per cent on the preferred stock, payable Dec. 2. The United Electric Securities Company has declared a semi-annual dividend of $3.50 on the preferred stock. The directors of the Denver City Tramway Company have declared the usual quarterly dividend of 1 per cent, payable Nov. 15. The directors of the American District Telegraph Company have declared a semi-annual dividend of 1½ per cent. Six months ago 1 per cent was declared, and a year ago 1¼ per cent. The dividend is payable Nov. 15. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on its assenting stock, payable Nov. 15. The Edison Electric Illuminating Company, of Brockton, has declared a regular semi-annual dividend of 2½ per cent, payable Nov. 1. The Lowell (Mass.) Electric Light Corporation has declared a regular semi-annual dividend of 2½ per cent, payable Nov. 1. The New England Telephone & Telegraph Company has declared a regular quarterly dividend of $1.50, payable Nov. 15, to stockholders of record, Oct. 31. The Pennsylvania Telephone Company has declared a quarterly dividend of 1½ per cent, payable Oct. 28. This places the stock on a 6 per cent dividend basis instead of 5 per cent, as formerly.

AMERICAN LIGHT & TRACTION.—The Southern Light & Traction Company, San Antonio, Tex., controlled by the A. L. & T. Co., is likely to pass the dividend, payable about Nov. 20. The directors must either take this course or else issue bonds. The company has rebuilt its tracks in the last year or two at a cost of over $100,000. When the franchises were renewed in April, 1898, it was stipulated that the company must pave certain streets in which the tracks are laid, and this work has cost about $150,000. A number of new cars have been purchased. The company will consolidate its electric lighting and traction plants at a cost of about $20,000, and will rebuild the distributing system of the traction company at a cost of over $50,000. Large sums of money will thus be required. Southern Light & Traction bonds are selling at 82, and some of the directors think it would be preferable to discontinue dividends rather than to sell bonds at such a price. It is stated that the net earnings of the American Light & Traction Company for the quarter ended Sept. 30, 1901, amount to $119,184, an increase of about 11 per cent, as compared with the corresponding quarter in 1900. After deducting from this sum $99,615 to pay the quarterly dividend of 1½ per cent on $6,641,000 of preferred stock, a surplus remains of $19,569.

HELENA POWER & LIGHT.—Application has been made in the United States Court for the appointment of a receiver for the Helena Power & Light Company. The proceeding is commenced in the interest of the Central Trust Company, which holds bonds of the company. The court signed an order appointing H. L. Walker, secretary of the company, as receiver. The trust company is trustee for the bondholders. For some time the company has defaulted on interest on its bonds. The company owns the gas, electric light and street car plants in Helena. According to last reports, it had issued only $600,000 of bonds. The capital stock is $1,000,000. The company has a 14-mile transmission plant.

A WESTINGHOUSE COPPER RUMOR.—A report current in Wall Street, but not confirmed, as explanatory of the weakness in Amalgamated Copper, is that the Westinghouse Company, which is one of the largest consumers of copper in the country, has just concluded the purchase of a large independent copper mine, which the Westinghouse people purpose to work from this time on, withdrawing their custom from the Amalgamated. The report is denied, while similar rumors are current as to the General Electric Company.

ERIE TELEPHONE.—Dudley E. Waters, president of the Grand Rapids National Bank, is at the head of a syndicate of Michigan capitalists, who have secured a 30-day option from the executive committee of the Erie Telephone & Telegraph Company to purchase from that company all its holdings in the Michigan Telephone Company, 30,000 shares, a controlling interest.

Commercial Intelligence.

THE WEEK IN TRADE.—The volume of business during the past week was so great that the railways complained of car shortage, this condition existing in all parts of the country, and reports from the principal centers state that transportation facilities for the business offered the several lines are inadequate. This is particularly true in the case of iron ore and steel, lumber, grain and coal. Wholesale and jobbing trade generally is characterized as fair to moderate the country over. Collections are generally good, except at the South,

where slower movement of cotton has tended to retard business. As for some weeks past, the iron and steel trade returns the best reports. The largest steel rail order of the year was placed during the week, aggregating 160,000 tons, being taken at the ruling rate of $28 per ton by the Pennsylvania Railroad Company, and some other large orders from other companies are now under negotiation. In all, 1,500,000 tons for 1902 delivery have been booked. Special activity is noted in structural material at Pittsburg. The market for wire products is lagging, but special activity is noted in hardware at all markets. The gross railway earnings of all roads so far as reported for October, aggregate $27,486,795, a gain of 8.3 per cent over last year. The business failures during the week, as reported by *Bradstreet's*, aggregated 223, as against 198 the week previous, and 161 the same week last year. In copper, the situation is practically unchanged, notwithstanding the press reports regarding large sales and increased activity. The reported sale of 30,000,000 lbs. of Lake copper for home consumption is generally discredited. None of the large consumers are buying into the future, present prices being considered too unsafe. Quotations are 16.85 to 17 cents for spot Lake; 16.30 to 16⅝ for electrolytic; 15⅝ and 16.30 for casting stock.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Oct. 23: Antwerp—Material, 17 packages, $952; electrical machinery, 1 case, $45. Argentine Republic—Electrical machinery, 42 packages, $2,607. British West Indies—Electrical machinery, 3 packages, $351; copper wire, 10 bundles, $674. Brussels—Electrical machinery, 2 cases, $300; material, 1 case, $40. Bilbao—Machinery, 1 case, $200. Brazil—Material, 27 packages, $2,476. Bremen—Material, 3 cases, $76. British Australia—Material, 7 packages, $77; machinery, 149 packages, $33,053. British Guiana—Material, 93 packages, $2,923. Copenhagen—Material, 6 packages, $153. China—Material, 16 packages, $461. Chili—Material, 13 packages, $263. Central America—Material, 22 packages, $262; copper wire, 8 bundles, $99. Cuba—Electrical machinery, 8 packages, $300; material, 125 packages, $4,112. Dutch East Indies—Electrical material, 1 package, $14. Ecuador—Material, 3 packages, $70. Florence—Material, 5 packages, $442. Gottenburg—Material, 7 packages, $150. Glasgow—Material, 9 packages, $410; machinery, 3 packages, $720. Havre—Electrical machinery, 48 cases, $5,975; electrical material, 47 packages, $5,431. Hamburg—Material, 19 packages, $745. Japan—Material, 15 packages, $716; electrical machinery, 18 packages, $3,800. Liverpool—Machinery, 191 packages, $17,385; electrical material, 33 packages, $1,454. London—Electrical machinery, 119 packages, $2,902; electrical material, 197 packages, $6,281. Liege—Material, 1 package, $45. Newcastle—Electrical machinery, 27 cases, $7,000. Peru—Electrical material, 22 packages, $348. Riga—Material, 1 case, $50. Rome—Material, 4 cases, $483. St. Petersburg—Material, 13 cases, $405. U. S. Colombia—Material, 6 cases, $509. Venezuela—Material, 1 case, $41. Vienna—Electrical machinery, 33 packages, $3,950. Wiborg—Electrical material, 1 package, $14.

AUTOMOBILES WANTED FOR CRYSTAL PALACE, LONDON.—Mr. Ernest Schenk, president of the London Crystal Palace Company, who, as noted in our columns, has been in the United States for the last few weeks in connection with the American exhibition, to be held at the Palace from May to September, 1902, sailed last week for home. On the eve of his departure Mr. Schenk said to a representative of ELECTRICAL WORLD AND ENGINEER: "I have every reason to be well satisfied with the result of my visit. My chief object in coming here was to lay the matter before the United States Government, with a view to obtaining its co-operation by way of government exhibits. My suggestions were very cordially received by the members of the Cabinet with whom I had interviews in Washington, these gentlemen being evidently alive to the commercial value to the manufacturers of this country of an exclusively American exhibition on an extensive scale during the coronation year. A number of the largest representative firms have applied for space, and it is evident that there will be no difficulty in filling the entire available area of 100,000 square feet." In conclusion, Mr. Schenk said that it was proposed to have a cable tramway constructed from the Low Level station to the exhibition grounds. The distance is about 300 yards, and the gradient is some 8 per cent. It has been further determined to run a service of automobiles, each vehicle having a capacity for 10 passengers—around the beautiful grounds, which are about 200 acres in extent. The route would be nearly 1½ miles in length. Mr. Schenk would be glad to enter into any negotiations with any American manufacturers of electric vehicles who would be interested in the matter.

REVISION OF BANKRUPTCY LAW.—A meeting of the special committee of the Merchants' Association on Revision of the Bankruptcy Act was held at the rooms of the association last week, at which the following members of the committee were present: George F. Vietor, of Frederick Vietor & Achelis, chairman; Ora Howard, of Oelbermann, Dommerich & Co.; Ewald Fleitmann, of Fleitmann & Co.; C. N. Bliss, Jr., of Bliss, Fabyan & Co.; Charles E. Meek, of the National Lead Company; Carl Schefer, of Schefer, Schramm & Vogel; C. H. Webb, of J. H. Dunham & Co.; W. S. Mersereau, of Schieffelin & Co.; R. B. Hirsch, of William Openhym & Sons; Benno Neuberger, of E. Rosenwald & Bro.; Geo. E. Armstrong, of the H. B. Claflin Company; E. W. Riker, of Yale & Towne Manufacturing Company. A general discussion as to methods of operation in analyzing the present act and in suggesting needed amendments thereto was had. As a result thereof an executive committee of five was appointed, with full power to conduct the necessary investigation, to communicate with and receive suggestions from other trade organizations and individuals, not only in New York but throughout the country, and to incorporate their conclusions in a report to the main committee. The executive commitee of five is made up as follows: Ora Howard, of Oelbermann, Demmerich & Co., chairman; W. T. Evans, of Mills & Gibb; E. D. Page, of Faulkner, Page & Co.; R. B. Hirsch, of William Openhym & Sons; E. W. Riker, of the Yale & Towne Manufacturing Company.

NEW PLANT FOR NEWPORT NEWS, VA.—The George A. Williams Company, 268 Washington Street, Jersey City, N. J., have been awarded the contract by the Consumers' Light, Heat & Ice Company, of Newport News, Va., for the installation of new ice plant, water distilling plant, artesian wells, and an addition to electric lighting plant. The amount of contract is $145,000. The George A. Williams Company has awarded the boiler contract to Heine Safety Boiler Company, of Philadelphia; the engine contract to the Buckeye Engine Company, the contract for Hawley down-draft furnaces to Vick, Whiting & Co., of Baltimore, Md., and the contract for the electrical apparatus consisting of two 200-kw, two-phase alternators, one 25-kw, direct-current dynamo, switchboards, transformers, meters, etc., to the Westinghouse Electric & Manufacturing Company, of New York, N. Y. The ice plant and distilling plant contracts have not yet been given out. Bids for this part of the installation are now being received.

THE GRANT TOOL WORKS opened up its new works at Franklin, Pa., Oct. 1, under most auspicious circumstances. Governor Stone, of Pennsylvania, attended by his staff, participated in the proceedings. The large 250-hp engine was equipped in such a manner that the pressing of a button started it, and with it the entire machinery of the shop was put into motion. The Governor, at the termination of the preliminary exercises, pushed the button, thus giving the new works its "send off." The shop was crowded with a number of Mr. Grant's friends, who attended to wish him and the new company good luck. A collation for 3000 people was prepared and served, even that lavish provision proving inadequate for the large number who were present. The employes, as a token of their regard for Mr. Grant, furnished his new private office at their own expense.

CONTRACTS AWARDED.—The Mohawk Valley Power Company, Gloversville, N. Y., has awarded the contracts for the equipment of its new power station near Tribes Hill. The Allis-Chalmers Company has been given the contract for three 1500-hp vertical cross-pound engines, together with pumps, etc. The General Electric Company has been awarded the contract for the electrical equipment, including three 1000-kw generators. The Springfield Boiler Company has been awarded the contract for a battery of 10 boilers, aggregating 5500 horse-power. The Broomell, Schmidt & Steacy Company was awarded the contract for the economizers.

PIPING, ETC., FOR SYDNEY, N. S. W., TRAMWAYS.—The Best Manufacturing Company, of Pittsburg, 39-41 Cortlandt Street, has just made shipment of some 260 tons of pipe, valves and fittings to be installed in the central generating station of the Sydney City & Suburban Tramways, Sydney, New South Wales. It will be recalled that the entire contract—valued at some $800,000—for the equipment of the Sydney station was secured by the General Electric Company. The plant has a capacity of developing 6800 horse-power, and will consist of three 1500-kw G. E. generators and the same number of Allis engines of 1500 nominal horse-power each.

NO WESTINGHOUSE FACTORY WEST.—A report has been given considerable circulation in the West to the effect that at the water power of Little Falls, Minn., a factory is to be established by the Westinghouse Electric & Manufacturing Company for the manufacture of heavy pieces of machinery in its Western trade, not less than $500,000 being spent on a big plant for this purpose. We have made inquiry at the New York and Pittsburg headquarters of the company and are authorized by leading officials to state that there is absolutely no warrant for such rumors.

BRITISH WESTINGHOUSE PLANT.—Our Cincinnati correspondent states that Cincinnati concerns got orders for 1500 of the 6000 tons of machinery needed for the British Westinghouse Electric Company's new plant at Manchester, England.

EQUIPMENT FOR LARGE CANADIAN PLANT.—The National Portland Cement Company, Limited, recently organized with American-Canadian capital for the purpose of constructing and operating a Portland cement plant in Toronto, Ontario, is about to place contracts in the United States for the complete equipment of its projected works, which will be operated by electricity. The initial capacity of the plant will be 1000 barrels per day, but the plans have been drawn up so as to make provision for doubling the output. The construction of the original works will mean an expenditure of nearly $250,000. The Americans interested in the enterprise include W. F. Cowham, managing director of the Peninsular Portland Cement Company, of Jackson, Mich., who is president of the National Company. The Canadian parties chiefly concerned in the scheme are A. T. MacLaren, president of the Imperial Cheese Company; P. W. Stanhope, manager of the Toronto offices of the McCormick Harvesting Machine Company, of Chicago, and Gilbert McKechnie, of Durham, Ontario. The company's offices are in the Janes Building, King and Young streets, Toronto. The capital of the concern is $1,500,000.

ALUMINUM *VS.* COPPER.—An article in this issue of Electrical World and Engineer describes a switchboard whose bus-bars are of aluminum. This is said to be the first instance of the kind. The high prices ruling for copper have naturally caused consumers to look about for a substitute. Street railways have been experimenting quite extensively with aluminum as a substitute for copper in feed wires. The Old Colony Street Railway Company, one of the subcompanies of the Massachusetts Electric Companies, has been substituting aluminum for copper. President P. J. Sullivan says: "We made a thorough investigation of the use of aluminum by street railway companies as a substitute for copper in feed wires, and, as a result, we installed about 10 miles of aluminum feed wire on the South Shore. The aluminum has given complete satisfaction, and our next order for feed wire will undoubtedly be for aluminum. The cost of aluminum is 20 to 25 per cent less than copper, and its value as scrap has the same proportionate value as copper. We found that aluminum was being used quite extensively by street railways throughout the country." We have noted from time to time the use of aluminum for power transmission circuits.

ROLLER-BEARING CONTRACTS.—The Hyatt Roller Bearing Company, of Harrison, N. J., has been awarded contract for roller-bearing hangers for the new mill of the Atlas Tack Company, at Fairhaven, Mass., 625 by 220 ft., consisting of some 500 hangers. This contract was awarded to Lockwood, Greene & Co., of 93 Federal Street, Boston. This company is also making for the Washburn-Crosby Company a number of heavy main jack shaft bearings for one of its new mills at Minneapolis. The Champion Coated Paper Company, of Hamilton, Ohio, the largest book mill in the country, will be equipped throughout with Hyatt roller bearings, on heavy main lines, as well as heating engines. The company is also installing for the American Cigar Company, Jersey City, a new jack shaft drive containing a new electric drive, including a number of heavy bearings of the Hyatt type.

CITY OF MEXICO WATER SUPPLY CONTRACTS.—With further reference to the $7,000,000 project for the furnishing of a 40,000,000-gallon daily spring water supply for the City of Mexico, Mr. Warren H. Loss, of 52 Broadway, the contractor for the construction work, who has just returned from Mexico, stated to a representative of Electrical World and Engineer that the actual details of the work and particulars as to the exact requirements in the way of electrical machinery, waterwheels, pumping equipments, etc., would not be determined on until after the various engineering experts returned from Mexico early in December. As already mentioned in these columns the General Electric Company, the Stanley Electric Manufacturing Company, the Pelton Waterwheel Company and the Worthington branch of the International Pump Company will secure the principal contracts.

NATIONAL ACME MANUFACTURING COMPANY.—This concern is a consolidation of the Acme Machine Screw Company, of Hartford, Conn., and the National Mfg. Company, of Cleveland. The new officers are: W. D. B. Alexander, president; D. Elliott, vice-president; O. S. Werntz, treasurer; A. W. Henn, secretary; E. C. Henn, general superintendent, with headquarters in Cleveland. The company has recently been incorporated under the laws of Ohio, with a capital of $750,000. A valuable manufacturing site on the Pennsylvania Railroad at Stanton Street has been purchased, and contract has been let for the erection of a modern factory of brick and steel, 300 ft. long by 50 ft. wide, and four stories high, which will be equipped with electrical power.

THE HUBBELL-GRIER ELECTRIC COMPANY has been formed at Bridgeport, Conn., under the laws of New York State, with a capital stock of $25,000. The officers of the company are: Harvey Hubbell, president; Edward R. Grier, treasurer and manager; Thos. G. Grier, Western manager; Francis E. Laimbeer, secretary. The above-named are also the directors. The company is formed for the purpose of manufacturing the Hubbell electric pull specialties, with a factory at Bridgeport, and New York offices at 93 Nassau Street. Mr. Edward R. Grier, the manager, has been associated with the Bryant Electric Company for the past ten years as their Western manager.

BIG ALLIS ENGINE FOR SYDNEY POWER PLANT.—The Allis-Chalmers Company has just made shipment, from its Milwaukee shops, of another large engine, the third and last for installation in the central power station of the Sydney City & Suburban Tramways, New South Wales, the entire $800,000 contract for the equipment of which, it will be recalled, was secured by the General Electric Company. The engine which has a nominal horse-power of 1500, was loaded on 11 cars. It weighs nearly 200 tons. The bedplate alone weighs nearly 40,000 lbs., and the shaft over 30,000 lbs.

FOREIGN ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, Harrisburg, Pa., through its New York offices, Mail and Express Building, reports receipt of a number of foreign and domestic orders, received within the last three weeks or so. The orders secured through foreign sources comprise a 40-hp standard engine for direct connection to a General Electric generator for shipment to Porto Rico for lighting purposes. A 25-hp standard belted engine is to be shipped for use in a small lighting plant at Matanzas, Cuba.

ELECTRICAL SUPPLIES FOR ABROAD.—The Manhattan Electrical Supply Company, of 32 Cortlandt Street, New York City, reports receipt of several fair-sized orders for general electrical supplies from various parts of the world, but particularly from South America, Great Britain, British India and Australia. An order for 5000 dry batteries has just been received from London parties and shipments of general supplies are about to go forward to Buenos Ayres, Melbourne, and Calcutta.

ELECTRIC STORAGE BATTERY.—The following changes in the officers of the Electric Storage Battery Company have been made by the directors: Herbert Lloyd, formerly first vice-president, was made president, vice George H. Day, resigned; George D. Widener, formerly second vice-president, was made first vice-president; John R. Williams, formrly third vice-president, was made second vice-president. The office of third vice-president has been temporarily abolished.

AMERICAN EXHIBITION IN LONDON.—The well-known export freight contracting and forwarding house of Alfred H. Post & Co., of New York, Chicago and London, acts as American representatives of the exclusively American exhibition, which is to be held in the London Crystal Palace from May 1 to Nov. 1, 1902. Mr. Alfred H. Post, senior partner of the before-mentioned firm, has been appointed special commissioner in the United States for the exhibition.

HOSPITAL LIGHTING PLANT.—Orders have been placed with the Watertown Engine Company for steam engines for the electric light plant at the Hudson River State Hospital. While the order is not large, it is especially gratifying to the builders, as this makes the tenth engine and the sixth installation of Watertown work in State asylums and hospitals.

THE GEO. C. TOWLE MANUFACTURING COMPANY, of Lancaster, Pa., reports that it is very busy at present in its power motor department. It has just finished several orders of motors for bookbinders' machinery. Its type "E" motors have met with a large sale in that trade. It has also added to its line of motors a new 5-hp. Previous to this month it only made up to 3½ horse-power.

GOULD STORAGE BATTERY COMPANY, of Depew, N. Y., reports a number of recent installation orders, including equipments for the Pratt Institute, Brooklyn; the University of Wisconsin, Madison, Wis.; Cooper Union, New York City, and the New National Bureau of Standards, Washington, D. C.

THE H. P. WHITE COMPANY, LIMITED, of Philadelphia, has recently received orders from the Diehl Manufacturing Company for large switchboards to accompany the light and power plants in the Singer Sewing Machine Company's works at South Bend, Ind., and Cairo, Ill.

THE BUILT MANUFACTURING COMPANY, of Akron, Ohio, manufacturer of the Cross oil filters, announces Government orders for two large filters for the battleship "Illinois" and one for the torpedo boat "Bainbridge." Six governments have adopted this filter.

ELECTRICAL APPARATUS WANTED.—The Meyersdale & Salisbury Street Railway Company, of Pittsburg, is in the market for generators, engines, cars, motors, rails, lighting fixtures, wire, etc. Inquiries should be addressed to D. Zinn, lock box 1477, Pittsburg.

General News.

THE TELEPHONE.

PIRU CITY, CALIF.—The Sunset Telephone Company has established a new exchange here.

MARIANNA, FLA.—The Marianna Telephone Company has been incorporated, with $5,000 capital.

TISKILWA, ILL.—A telephone line will be built to Providence this fall.

MONARCH, ILL.—J. A. Smith is erecting an independent telephone line between Bellflower and Saybrook.

EDWARDSVILLE, ILL.—The Kinloch Telephone Company is preparing for active operations in Edwardsville.

ELLIOTSTOWN, ILL.—The Jacobs Telephone Company is extending its line from Eberle to Elliottstown, Winterrowd and Dieterich.

MANHATTAN, ILL.—The Manhattan Telephone Company has been incorporated, with a capital stock of $2,400 by Benjamin J. Baskeville, Dennis Hogan and August Tennyson.

STREATOR, ILL.—The directors of the Independent Telephone Company called a meeting of stockholders for Nov. 19 with a view to increasing the capital stock of the company to $100,000.

ALTON, ILL.—The Central Union Telephone Company has commenced the construction of a new line between Alton and St. Louis. The completion of the line will give four lines between the two cities.

CHICAGO, ILL.—The Chicago Telephone Company has filed an answer to the bill of complaint of the city of Chicago and thirty business men, in which bill the courts are asked to restrain the company from all interference with the telephones of subscribers who offer to pay the rate of $125 a year named in the company's franchise. It makes a general denial of all allegations regarding illegal and excessive rates and sets forth that new inventions and improvements have enabled the company to offer a much better service than that referred to in the ordinance.

BEDFORD, IND.—The City Council of Bedford granted a telephone franchise to James Buddick.

HEBRON, IND.—A new telephone line is being built between Crown Point and Hebron, and will soon be in operation.

TERRE HAUTE, IND.—The farmers of Riley township are forming a mutual telephone company and have asked the County Commissioners for a franchise on the county roads.

SOUTH BEND, IND.—The South Bend Council granted a franchise to the Independent Telephone Company, which is securing much encouragement from business men to locate an exchange there.

BEDFORD, IND.—The City Council has granted a central office franchise to James Ruddick, who has erected a seventy-five mile telephone system, which connects a number of towns of importance.

LAFAYETTE, IND.—George W. Harrison, chief of police of this city, is attracting attention on account of his system of telephonic surveillance in this city and over the entire county. No wrong-doer gets away, it is said.

WASHINGTON, IND.—The City Council has granted the Independent Telephone Company a franchise to establish a system in this city. The new company agrees not to charge for service until it has 300 subscribers, which is said to be more than the present company (the Bell) now has.

FT. WAYNE, IND.—A committee of representative capitalists of this city, engaged in buying and establishing independent telephone exchanges in many Indiana towns, is now touring the State and making examinations. Negotiations are now on for the purchase of the Anderson system as a nucleus for a great system.

SOUTH BEND, IND.—The grant of a telephone franchise to Ft. Wayne capitalists by the City Council is regarded with much interest among citizens of both cities. The new company will make a rate of $24 a year for residences and $36 for business houses, irrespective of distance, which is a 33 per-cent cut in the Bell rates. It will provide the new exchange with the latest improved switchboard, starting with over six hundred connections.

MUNCIE, IND.—Opposition in telephone service is practically assured for this place. The Independent Telephone Company that was refused a franchise by the City Council until it could secure 800 subscribers has readily secured 700, in spite of the active campaign waged by the Central Union. It is said that the City Council, when it refused to consider a franchise until 800 subscribers were secured, thought that would probably end the controversy, but the success of the undertaking is now assured. The new company will be known as the Delaware-Madison Company. It has a plant in operation in Anderson, and hopes to secure franchises in several other neighboring cities.

MT. AYR, IA.—A franchise was granted to the Mt. Ayr Mutual Telephone Company.

SIOUX CITY, IA.—A telephone line is being constructed between Kimball and Platte.

OTTUMWA, IA.—The Ottumwa Telephone Company will build a line to Kirkville to connect with the Union Telephone Company.

NEVADA, IA.—A number of prominent farmers in Milford township have organized a rural telephone exchange which is now being constructed.

LOUISVILLE, KY.—H. A. Bell, sheriff, Louisville, Ky., has presented his report of the sale of twenty-year telephone franchises over the county roads. The purchasers are the Independent Long Distance Telephone Company and the Cumberland Telephone Company.

NEW ORLEANS, LA.—Congressman R. F. Broussard, in speaking of his telephone project, states that New Iberia, his home town, will have 2000 telephones installed, and other towns from 1200 up, and that he has concluded arrangements for 100,000 telephones for New Orleans. No charges are made for installation; only for actual use.

NEW ORLEANS, LA.—The People's Telephone Company will introduce a message rate of two cents. It is claimed that this movement is purely a business one and is not done to bring up the number of subscribers to the number specified in the charter. Several telephones have already been installed on the new basis.

LEWISTON, ME.—The Norridgewock & Fairfield Telephone Company has been organized at Norridgewock, with $100,000 capital stock. E. H. Toby, of Norridgewock, is president.

PORTLAND, ME.—The New England Telephone & Telegraph Company is advertising lower rates in this city, and has installed a few free residence telephones for trial until Dec. 31. This has been brought about, it is claimed, by the competition of the Dirigo Telephone Company. The latter company is extending its system throughout this section of the State.

CUMBERLAND, MD.—The Western Maryland Telephone Company, of Allegheny County, has been incorporated, with a capital stock of $100,000. The principal office will be in Cumberland, Md. De Warren H. Reynolds, Henry J. Glick, of Cumberland, are interested.

BOSTON, MASS.—The Suburban Telephone Company, of Suffolk County, has been incorporated under the laws of Massachusetts, with a capital of $30,000. C. Francis Chisolm is president, A. N. Hooper, treasurer.

IPSWICH, MICH.—A new telephone service is to be installed in this place.

DETROIT, MICH.—The Council Committee on franchises will report favorably on a number of amendments to the franchise of the People's Telephone Company that the latter is seeking.

ANOKA, MINN.—The Minneapolis Telephone Company is building a telephone line from the Twin Cities to Duluth.

WALNUT GROVE, MINN.—The long distance telephone company has decided to put in a local exchange at this place.

LAKE CITY, MINN.—The Dwelle Telephone Company is at work constructing an entire new line between Plainview and Kellogg.

WINONA, MINN.—The Winona Telephone Company has purchased the exchange and toll lines of the Phoenix Company at Rushford.

WEST SUPERIOR, MINN.—A new long-distance telephone line has been opened by the People's Telephone Company of this city to Lake Nebagamon.

MINNEAPOLIS, MINN.—The Rapid Service Telegraph & Telephone Company, of Minneapolis, has filed articles of incorporation. The capital stock is $100,000.

MONTICELLO, MO.—The Citizens' Telephone Company of North Missouri, of Monticello, with a capital of $1,200, has been incorporated, with the following as incorporators: Cyrus C. Rain, Pike Hanna, Charles Seller, and others.

RALEIGH, N. C.—The Interstate Telephone Company will make extensive improvements to its plant in Raleigh. It is now building a line from Raleigh to Angier.

RALEIGH, N. C.—The big water-power plant at Milburnie, near Raleigh, N. C., will soon be ready for operation. Both electric power and light will be furnished to the city of Raleigh. A 900-hp wheel will be used at the plant.

WADESBORO, N. C.—The Bluitt Falls Electric Power Company has been chartered, with offices at Wadesboro, N. C. Mr. F. J. Coxe, of Wadesboro, is interested. The company proposes to develop Bluitt Falls and transmit electric power to Wadesboro and other points. The capital of the new company is $250,000.

ELIZABETH, N. J.—The Interstate Telephone Company has secured franchises at Bradley Beach and Avon.

JERSEY CITY, N. J.—The Brokers' Wire Service Company has been incorporated by W. Benton Crisp and Thomas I. Sinclaire, of 40 Wall Street, and Louis L. Coudert, of Cranford, N. J. The company was organized with a capital stock of $125,000 to furnish brokers with private telephone and telegraph facilities.

BAINBRIDGE, N. Y.—A telephone company has been formed at Union Valley and officers elected.

ALBANY, N. Y.—The Wyoming & Cattaraugus Telephone Company, of Arcade, Wyoming County, has been incorporated; capital, $10,000. Directors: Theodore Hayden, P. E. Merrill and B. B. Lewis, of Sandusky, Cattaraugus County.

GREENSPRING, OHIO.—The Central Union Telephone Company has secured a franchise to operate an exchange here.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has been very much annoyed through the depredations of wire thieves.

FOSTORIA, OHIO.—The report of the Citizens' Telephone & Message Company for the month of September showed a net increase of 16 4-6 per cent.

CLEVELAND, OHIO.—The Consolidated Telephone Company has commenced work on a line connecting the exchanges at Elmira and Waverley, N. Y., with the main long distance system.

ROSEVILLE, OHIO.—The new exchange of the Roseville Telephone Company has been put in operation, with 100 lines. A toll line from Roseville to Zanesville has been opened.

COOLEVILLE, OHIO.—The Home Telephone Company of Athens County has been incorporated with $5,000 capital stock by H. H. Brown, C. E. Barrows, James Drain, Otto Booth and W. C. Matlack.

CLEVELAND, OHIO.—The properties of the Federal Telephone Company, outside of Cleveland and Columbus, made a gain of over 1100 subscribers and $25,000 in revenues during the month of September.

TOLEDO, OHIO.—The American District Telegraph Company, of Ohio, has asked for a franchise in Toledo to put down conduits, erect poles and string wires. The probate court is asked to grant a perpetual franchise.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has increased its capital stock from $50,000 to $75,000.

PAINESVILLE, OHIO.—The Painesville Telephone Company has made application to the Council for permission to lay about 20,000 feet of conduit within the fire limits of the town.

MARION, OHIO.—The Central Union Telephone Company will erect a new exchange building in Marion. This is one of the few large towns in Ohio not touched by the independent service. It is stated that an independent company is being formed.

CADIZ, OHIO.—The Harrison County Telephone Company, which is building an exchange at Cadiz, is building toll lines to Dennison and to Steubenville. At Dennison the line will connect with one which the United States Telephone Company is building from Dayton.

CHAGRIN FALLS, OHIO.—The Cleveland Telephone Company has appealed to the Probate Court of Cuyahoga County to secure the granting of a franchise for a system in Chagrin Falls. The town has had a good independent system for many years and the citizens have several times voted against giving the Bell Company a franchise.

TOLEDO, OHIO.—The Empire Construction Company, of Toledo, has been incorporated with $20,000 capital stock by F. W. Wachter, Robert Tucker, Charles D. Sumner, H. M. Barfield and F. F. Graves. The company will make a business of constructing telephone lines and exchanges. The gentlemen interested have contracts to build exchanges in eleven cities and towns.

PLATTSBURG, OHIO.—The Home Telephone Company, of Plattsburg, is installing the Norstrom automatic switchboard and selective party line lockout system. The lockout system is used in connection with party-line telephones and through its use the operator at the exchange permits only two subscribers on a party line to use the line at one time, thus eliminating the chief objection to this class of service.

AKRON, OHIO.—The managers of the Akron exchange of the Central Union Telephone Company and the Akron People's Telephone Company, claim that so far as they are concerned, the strike of the electrical workers is a matter of history. They claim they have all the men they require, but state that some of the old men may have their former places if they desire. The men are confident of winning their demands.

WARREN, OHIO.—The Lane Construction Company, of Warren, has taken a contract to construct a new telephone system at Jamestown, N. Y., for the Home Telephone Company, in which Warren capital is interested. The exchange will be on the central energy system and full metallic copper circuits will be used. A two-story exchange building 25x80 feet is to be erected by the company in the central portion of the city.

CLEVELAND, OHIO.—The Interstate Telephone Company, has elected officers for the ensuing year as follows: W. L. Cary, Jr., president; W. B. Woodbury, vice-president; W. E. Baker, secretary-treasurer. The above, with J. B. Hoge, Maxime Reber, R. E. Enwright and W. T. Hudson constitute the board of directors. The Interstate Company is a constructing company, which builds many of the exchanges controlled by the Federal Telephone Company.

COLUMBUS, OHIO.—Sixty operators at the exchange of the Columbus Citizens' Telephone Company went on a strike Oct. 19. The young ladies ask that their working hours be reduced from 9½ to 9 hours per day, and that a more accurate method of keeping their time than that in vogue be devised. Forty of the girls have formed a labor union, but the company declined to deal with a committee. The difficulty was adjusted temporarily and the girls returned to work pending a final settlement.

BARNESVILLE, OHIO.—The Belmont County Telephone Company, of Barnesville, has affiliated with the Ohio Valley Telephone Company, of Bellaire and the National Telephone Company, of Wheeling, W. Va., for an interchange of service. The Belmont Company connects all the important towns in Harrison and Belmont counties. It is building five lines from Barnesville to Wheeling and Martin's Ferry, and two new lines from Bridgeport to Martin's Ferry. The work of connecting the systems will start as soon as possible.

TOLEDO, OHIO.—The Auglaize Construction Company has been incorporated by J. N. Goeke, Guy Huffman, Frank A. Huffman, A. K. Detwiler and Z. A. Haskins, of Toledo. It will construct and operate telephone exchanges in Ohio, Indiana and Illinois. Interested in the company are State Senator Brorein, T. H. Tracey, George Metzger and George H. Detwiler, as well as the incorporators mentioned. It is the intention to buy up a number of small independent exchanges and toll line companies, to construct others, and eventually to form one large company which will cover extensive territory in the States mentioned. The capital is $10,000.

CLEVELAND, OHIO.—The following statement of three months' business has been issued by the Akron People's Telephone Company, one of the properties controlled by the Federal Telephone Company:

JULY, 1901.

Gross earnings	$4,243.52
Operating expenses	1,971.69
Net earnings	2,271.83
Interest	1,041.66
Surplus	1,230.17

AUGUST, 1901.

Gross earnings	$4,606.22
Operating expenses	2,182.12
Net earnings	2,424.10
Interest	1,041.66
Surplus	1,382.44

SEPTEMBER, 1901.

Gross earnings	$4,670.90
Operating expenses	2,192.98
Net earnings	2,477.92
Interest	1,041.66
Surplus	1,436.26

PHILADELPHIA, PA.—Council at Pine Grove has extended the right of way to the Schuylkill Telephone Company.

CLAYSVILLE, PA.—The Pure Oil Company is building a telephone line rrom Coraopolis, Pa., to Piney Fork, W. Va.

LYKENS, PA.—An ordinance granting permission to the Juniata & Susquehanna Telephone Company to occupy the streets and alleys of the Borough of Lykens with poles and wires has been passed.

HANOVER, PA.—The Hanover Telephone Company will in the near future be merged into the Cumberland Valley Telephone Company, which will also absorb the Dauphin County, the Adams County, the Cumberland Valley Telephone & Telegraph Company, of Chambersburg, and the Southern Pennsylvania Telephone Company, of Carlisle.

SILVERTON, TEX.—A telephone line has just been completed from here to Tulia, and there connects with a line to Amarillo.

SALT LAKE CITY, UTAH.—P. J. Lackner, of the Telluride & Hercules Power Company has petitioned the County Commissioners of Salt Lake County for a franchise to run a telephone line along the county road west of the Jordan River.

RICHMOND, VA.—The Bell Telephone Company, after a long delay, has received a franchise to install a telephone system in Richmond.

UNION, W. VA.—The American Telephone & Telegraph Company has just completed a long-distance line from Lynchburg, Va., to Charleston, W. Va.

RICHMOND, VA.—It is stated that it will cost from $30,000 to $40,000 to place in the conduits of the Bell Company the city fire alarm and police telegraph systems. It seems that during the fight over the Bell franchise this point was overlooked. The franchise as adopted provides that the Bell Company shall give such space to the city wires.

SPOKANE, WASH.—Articles of incorporation have been filed by M. A. Phelps, of Spokane; Joseph Fisher, of St. Maries, Idaho, and Fred. W. Haverland, of Toledo, Ohio, creating the Interstate Telephone Company, with business headquarters at Spokane. The capital stock of the company is fixed at $20,000. The incorporators are also named as directors of the company in the following official capacity: President, Moses A. Phelps; general manager, Joseph Fisher; secretary, F. W. Haverland.

LA CROSSE, WIS.—A new telephone exchange is being organized in Westby, Wis. The new line will connect with the La Crosse and southeastern lines and will have direct connection, with all cities in western Wisconsin. The capital stock of the company will probably be $50,000.

ELECTRIC LIGHT AND POWER.

REDWOOD CITY, CALIF.—The city is illuminated now by the electric current transmitted from Blue Lakes. The cable lines are owned by the Standard Electric Company of California, while the Consolidated Light & Power Company acts as its distributing agent for the county of San Mateo. The latter company now has the contract for lighting the streets of this city and also the city of San Mateo.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently again established a new record for the world's longest electric power transmission. Current at 40,000 volts was transmitted from the Colgate generating station thirty-five miles from Marysville, Calif., via the lines of the Bay Counties and the Standard Electric Company to Stockton, Calif. Contracts have been made for commercial purposes, and within a month the Sperry Flour Company's mills and the Stockton Gas & Electric Company will be receiving current.

COLUMBUS, GA.—A deal has been closed here by which George J. Baldwin, of Savannah, and his associates secure a controlling interest in the Chattahoochee Falls Company, of this city. It is understood that they will in the near future improve the property, building a very large electric plant, which will develop about 14,000 horse-power. It will require a stone dam 1600 feet long across the river at this point for the plant. Mr. Baldwin is president of the Columbus Railway Company, of the Savannah Street Railway Company, and also of several other lines owned by the syndicate which he represents.

GREENWOOD, IND.—The Board of Town Trustees has granted a franchise to the American Light Company, of Indianapolis, for a lighting plant to be constructed here.

TERRE HAUTE, IND.—The Board of Managers of the Rose Polytechnic Institute is in New York to purchase a large installment of new electrical apparatus and machinery. A considerable outlay in electrical equipment has been decided upon.

ANDERSON, IND.—The Anderson Water, Light & Power Company, Anderson, Ind., has just finished raising the dam 20 feet, making it 44 feet high and giving a head of 48 feet, which will generate 5000 horse-power. The current will be furnished largely to the Anderson cotton mills.

CROWLEY, LA.—The Crowley Light & Water plant has been advertised for sale to satisfy judgments against the city. The property is valued at about $40,000. Municipal ownership, it is alleged, has proven a failure with the present Council.

NEW ORLEANS, LA.—The United Fruit Company has adopted electric power for unloading vessels and loading cars, and will do away with the Italian hand labor now used for this purpose. It is estimated that it will cut down the time of unloading one-third, the loss and damage to fruit one-fourth, and naturally reduce the expense. It will throw several thousand Italian fruit handlers out of work.

ST. LOUIS, MO.—By direction of the Harbor Commissioner, pipes laid by the Laclede Power Company, connecting its plant at Main and Ashley Streets with the river, were taken up. The pipes were laid on a permit for a drain, but were intended to be used for supplying the Laclede Power plant with water from the river. It is stated the matter will be taken into court.

WEBSTER GROVE, MO.—The St. Louis Electrical Construction & Maintenance Company has informed the Board of Aldermen that the electric light plant will be in operation by Nov. 1, and action has been deferred until that time by the aldermen. The city has been without light for two months, owing to the drying up of the River des Peres. It is now proposed to erect a new power-house at Brentwood.

VAN WERT, OHIO.—The plant being installed by the Van Wert Gas-Electric Light & Power Company will be put in operation within a few days.

CINCINNATI, OHIO.—The Cincinnati Edison Company has broken up a plan whereby many persons have been securing current practically free. Connections were made to shunt the current around the meter.

COLUMBUS, OHIO.—The municipal lighting plant is again in operation after a year of idleness. The plant will furnish current for 315 arc lights, while the Columbus Electric Company will furnish about 650 lights.

ROSEBURG, ORE.—The Douglas Electric Company has been incorporated with Roseburg, Ore., as the principal place of business. Directors: L. A. Walker, Mrs. M. Josephson and F. W. Benson. Capital stock, $6,000.

TOLEDO, OHIO.—The Toledo Lighting & Heating Company will erect lighting and heating plants at Coshocton, and Bowling Green, Ohio, Bloomington, Ind., and Findlay and Oak Park, Ill. The last mentioned plant will be a very large one.

CINCINNATI, OHIO.—Articles of incorporation of the Cincinnati & Suburban Light, Gas & Electric Company have been filed at Columbus. The capital stock is $10,000. It is intended to secure franchises in villages and towns surrounding Cincinnati.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company has gone into the courts for protection against what appears to be an organized gang of vandals. Hundreds of electric light globes have been broken, the damage last month alone being $1,500.

SALT LAKE CITY, UTAH.—The Telluride Power Company has started to string wire on poles erected as far south as Farmington.

SALT LAKE CITY, UTAH.—The surveys for the double reservoirs of the Raft River Power Company have been completed, and construction will commence at once. The company will be prepared to furnish light and power early in the Spring.

SALT LAKE CITY, UTAH.—The waters of Shoshone and American Falls, Idaho, will be utilized for power purposes. Two companies are in the field, both trying to avoid publicity until their plans are further advanced. They are the Twin Falls Land & Water Company and the J. H. Brady Company. Engineer Gates of the Brady Company is busy in Salt Lake in connection with the entrance of the lines into Salt Lake City.

SALT LAKE CITY, UTAH.—The American Falls Power, Light & Water Company, which was recently incorporated at Pocatello, Idaho, will install within the next six months two 750-kw generators and two water wheels that will develop, theoretically, 1600 horse-power each. The company has bought about half of the number of poles required for the transmission line, and is now figuring with two different concerns for its electrical equipment. It will have its plant completed and the power ready to deliver at Pocatello, a distance of 25 miles, and to Blackfoot, a distance of 46 miles, by July 1, 1920. A notice of the organization of this company was published in a recent issue of this paper. Mr. J. H. Brady is president, and A. V. Scott secretary.

ROANOKE, VA.—The contract has been awarded by the Roanoke cotton mills for the installation of an electric lighting plant.

NORFOLK, VA.—The Norfolk Heat, Light & Power Company, which is owned by Philadelphia capitalists, has its new plant well under way to completion.

TWO RIVERS, WIS.—The city of Two Rivers is about to experiment in the matter of municipal ownership of waterworks and electric lighting plants. The city will start out with up-to-date plants in every respect.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—Local capitalists are surveying a line from Huntsville to the top of Monte Sano. It is proposed to convert the old dummy road into an electric line. While no contracts have been let, it is understood that work will commence in November.

DENVER, COLO.—The management of the Colorado Southern Railway has decided to use electric traction on its suburban lines running out of Denver. The third rail system will be adopted.

ANDERSON, IND.—All the right of way has been secured for the Muncie, Middletown & Greenfield Traction Company.

NATCHEZ, MISS.—W. A. Percy, of Memphis, Tenn., representing Memphis and other capitalists, has completed preliminaries to a contract for the building of an electric railway system in Natchez.

STEVENSVILLE, MONT.—A franchise has been granted to G. T. Baggs to construct an electric railway here.

HENDERSONVILLE, N. C.—It is reported that an electric railway is to be built to Flat Rock, in the mountain section of western North Carolina.

PENN YAN, N. Y.—Plans are under way for an extension of the Geneva, Seneca Falls & Waterloo Electric Road from Geneva to this village, via Halls Corners.

NORTHPORT, L. I.—This place is to be connected by trolley with the East Northport station of the Long Island Railroad, a distance of two and seven-tenths miles. Upon the request of the people of Northport, the railroad company has agreed to construct the line. All necessary franchises, so far as the town is concerned, have been granted, and the plans for the new line are now before the State Railroad Commissioners for their approval.

ALBANY, N. Y.—The Salamanca & Little Valley Railroad Company has been incorporated, with a capital of $400,000 to construct an electric road fourteen miles long, connecting Salamanca and Little Valley, Cattaraugus County. The directors are A. E. Darrow, F. E. Kelly and T. Champlin, of Little Valley; Hudson Ansley, Fred. R. Adams and Edward Bolard, of Salamanca; Thomas Lathrop, Clifford Hubbell and John S. Rockwell, of Buffalo.

NEWARK, OHIO.—The Newark Council has granted a franchise through town to the Columbus & Granville Electric Railway.

ELYRIA, OHIO.—The Elyria, Grafton & Southern Electric Railway, a branch line of the Cleveland, Elyria & Western system, is now in operation.

GENEVA, OHIO.—The Geneva Council has passed an ordinance granting a franchise through the town to the electric railway building from Painesville to Ashtabula.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Railway Company has filed a mortgage for $1,500,000 in favor of the North American Trust Company, of New York City.

CANTON, OHIO.—The Canton, Lodi & Medina Railway Company has been organized to build a line from Canton to Medina. W. W. Irwin, Wm. Wagner, J. J. Whiteacre and John Harmony are the promoters.

CINCINNATI, OHIO.—The Lebanon & Franklin Traction Company, of Lebanon has been incorporated with $10,000 capital stock by Chas. H. Bosler, S. E. Kemper and A. G. Kennedy, of Dayton and V. J. A. Obenauer and Robert H. Kline.

MORROW, OHIO.—The Cincinnati, Lebanon & Dayton Traction Company has been incorporated, and the company guarantees the road to be in operation between Cincinnati & Lebanon on or before July 1, 1902. Wade Cushing, of Cincinnati, is president.

CLEVELAND, OHIO.—The title of the Little Miami Traction Company has been changed to the Springfield & Xenia Traction Company. The line will be in operation from Springfield to Xenia before the first of the year. Later it will be extended to Cincinnati.

STEUBENVILLE, OHIO.—The Steubenville, Mingoe & Ohio Valley Traction Company, which is extending its line from Steubenville to Brilliant, has made arrangements for through traffic to Wellsburg, W. Va., by means of a ferry across the Ohio River. The road is nearly completed.

CINCINNATI, OHIO.—Peter and Philip Swing, promoters of the Cincinnati & Columbus Traction Company announce that all rights of way and franchises for the line have been secured, and that ground will be broken in the near future. The road will extend from Madisonville to Washington C. H.

COLUMBUS, OHIO.—The Columbus Railway Company has declared a quarterly dividend of 1¼ per cent on its capital stock to its employes, payable Nov. 1. On the same date the stockholders will receive a similar dividend. This will make the ninth dividend the company has declared to its 500 employes.

SPRINGFIELD, OHIO.—Engineers C. A. Alderman and D. H. Ullery, of the Dayton, Springfield & Urbana Traction Company, have completed the plans for the new power-house to be located at Medway. The work will be started at once. There will be three rotary converters between Medway and Columbus.

CLEVELAND, OHIO.—The past year has been the most prosperous in the history of the Cleveland City Railway Company. It is reported that the directors will retire the company's bonds, and thus clear off all its indebtedness, and that to this end about 3 per cent of the net earnings will be used as a sinking fund and the remaining dividend will be 6 per cent for stock.

WEST MILTON, OHIO.—W. E. Gear, of Boston, general manager of the Dayton, Covington & Piqua Traction Company, has submitted the plans for the power-house, car barn, and depot to be built at this place. The power-house will be 50x100 feet. A pumping station will be built on the bank of the river. The capital of the company has been increased from $50,000 to $1,150,000.

TOLEDO, OHIO.—The Toledo Board of Public Works has adopted a resolution to grant no new franchise or extension of any existing franchise to the Toledo Railways & Light Company, until such time as the company shall concede universal transfers, with at least six tickets for twenty-five cents. The company has been refused permission to build a switch to connect with its power-house.

CLEVELAND, OHIO.—The officers of the Sandusky & Interurban and the Sandusky, Norwalk & Southern at Sandusky, the Toledo, Fremont & Norwalk at Fremont will soon be removed to Cleveland, and all four lines constituting the Lake Shore Electric Railway, will be handled from the general offices in the Electric Building. General Manager Danforth and general superintendent Stout will both make their headquarters at and reside in Cleveland.

TOLEDO, OHIO.—The Ohio Supreme Court at Columbus is hearing arguments in the case of the Toledo & Maumee Valley Railway vs. the Toledo Traction Company, the Toledo Consolidated Street Railway and the Metropolitan Street Railway. The plaintiff in error seeks to compel the other companies to receive and permit its cars to run over the tracks under a certain contract agreement. All of the roads mentioned are now owned by the Everett-Moore syndicate and the case is being carried up as a test.

ZANESVILLE, OHIO.—The Columbus, Newark, Zanesville & Wheeling Traction Company, has been organized with the following officers: President, J. M. Ickes; vice-president, John S. Black; treasurer, W. O. Little; secretary, L. F. Taylor. The road will extend from Columbus to Wheeling, touching Newark, Zanesville and Cambridge, and there will be a branch line to Coshocton. It will be constructed in a very substantial manner with a view to hauling freight and passengers at high speed in competition with steam roads.

HARRISBURG, PA.—Charters have been issued by the State Department to the following corporations: Ruth Street Railway Company, Pittsburg; capital, $12,000. Duquesne Heights Street Railway Company, Pittsburg; capital, $18,000. George W. Wilson, of Pittsburg, is president of both companies.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Electric Railway Company has prepared plans and specifications for a new car shop, which is to be erected at New Haven, Pa., at a cost of $50,000. The building will be constructed of brick and steel, and its dimensions will be 80x200 feet. The main power house of the road will be located near the car shop, and bids for the construction of the former will soon be asked for. The electrical equipment of the road has already been contracted for with the Westinghouse Electric & Manufacturing Company, of this city.

THE AUTOMOBILE.

N. J. AUTOMOBILE COMPANY.—Vice-Chancellor Stevens has appointed Samuel P. Lever receiver for the New Jersey Automobile Company, which has an office in Jersey City.

MR. H. WARD LEONARD has recently prepared and issued a very complete general specification for a gasolene motor car drawn in the light of a recent experience and following closely the features of design characteristic of the motor cars which made the best showing in the recent Paris-Bordeaux and Paris-Berlin races.

PRIZE CUPS were presented at the meeting of the Automobile Club of America, at its meeting on Oct. 22, to the three winners in the hill climbing contests at Nelson Hill, New York. They were three handsome silver vases. An interesting evening was spent, the topic being experiences in the New York-Buffalo endurance test.

SPEED RECORD.—All automobile records from one to ten miles were broken at the Grosse Pointe racetrack, Detroit, on Oct. 24, by Alexander Winton, of Cleveland, who covered a mile on his big racing machine in 1:06⅘, lowering Henri Fournier's record by two-fifths of a second, which the latter made on the Empire City track Oct. 10. Winton covered ten miles in 11:09 flat, and three times during the afternoon clipped two-fifths of a second from Fournier's mile record. The mark of 1:06⅖ was caught three different times by expert timers, and it is the fastest mile ever made on any track by any manner of vehicle. The time for ten miles was 11 minutes.

A SPECIAL TRIP.—The automobile department of the American Bicycle Company started a Toledo steam carriage from its Toledo, Ohio, factory on Monday, Oct. 14, on an endurance run to New York, it being the intention of the automobile department to have the wagon demonstrate the practicability of an automobile for touring work. The carriage alone weighs between 1400 and 1500 pounds. The weight of the two occupants will be about 150 and 250 pounds apiece, making a total weight of about 400 pounds. This with their luggage, would bring the combined weight of the carriage and occupants up to about 2000 pounds, which weight it is believed will be the maximum limit for any two-seated touring vehicle. The carriage is to be on view at the New York Automobile Show next week.

AUTOMOBILE EXHIBITORS AT MADISON SQUARE GARDEN.—The following manufacturers are among those who have secured space at the Second Annual Automobile Exhibition, to be held Nov. 2 to 9, in the Madison Square Garden in New York City, under the auspices of the Automobile Club of America: Mobile Company of America, Tarrytown-on-Hudson, N. Y.; Winton Motor Carriage Company, Beldon and Mason Streets, Cleveland, Ohio; Electric Vehicle Company, 100 Broadway, New York; Baker Motor Vehicle Company, Central Avenue and C. & P. R. R., Cleveland, Ohio; Peerless Manufacturing Company, Lisbon Street, Cleveland, Ohio; Locomobile Company of America, 7 East 42d Street, New York; Autocar Company, Ardmore, Pa.; Automobile Company of America, 135 Broadway, New York; Overman Automobile Company, 81 Fulton Street, New York; Haynes-Apperson Company, Kokomo, Ind.; American Bicycle Company, Park Row Building, New York; De Dion-Bouton Motorette Company, Church Lane and 37th Street, Brooklyn, New York; The George N. Pierce Company, 18 Hanover Street, Buffalo, N. Y.; Pan-American Motor Company, Mamaroneck, N. Y.; United States Long Distance Automobile Company, 307 Whiton Street, Jersey City, N. J.; Knox Automobile Company, Waltham Avenue, Springfield, Mass.; Geneva Automobile & Manufacturing Company, Geneva, Ohio; Automotor Company, Box 1073, Springfield, Mass.; Desberon Motor Car Company, 51st Street and 12th Avenue, New York; Holland Automobile Company, 60 Van Winkle Avenue, Jersey City, N. J.; Century Motor Vehicle Company, 517 East Water Street, Syracuse, N. Y.; Ward Leonard Electric Company, Bronxville, N. Y.; Ohio Automobile Company, Warren, Ohio; D. B. Smith & Company, Genesee and Broad Streets, Utica, N. Y.; Duryea Power Company, Reading, Pa.; Steamobile Company of America, Keene, N. H.; Foster Automobile Manufacturing Company, 297 State Street, Rochester, N. Y.; Lane Motor Vehicle Company, Poughkeepsie, N. Y.; Loomis Automobile Company, Westfield, Mass.; Diamond Rubber Company, Akron, Ohio; Joseph Dixon Crucible Company, 68 Reade Street, New York; Charles E. Miller, 97 Reade Street, New York; Janney, Steinmetz & Company, Drexel Building, Philadelphia, Pa.; Dow Portable Electric Asst. Company, 218 Tremont Street, Boston, Mass.; New York Belting & Packing Company, 25 Park Place, New York; Gleason-Peters Air Pump Company, Mercer and Houston Streets, New York; Midgley Mfg. Company, Third and Naughton Streets, Columbus, Ohio; R. E. Dietz Company, 60 Laight Street, New York; American Ball Bearing Company, Central Avenue and C. & P. R. R., Cleveland, Ohio; John Simmons Company, 110 Centre Street, New York; Goodyear Tire & Rubber Company, Akron, Ohio; Standard Welding Company, Central Avenue and Cone Street, Cleveland, Ohio; Buffalo Gasoline Motor Company, Dewitt and Bradley Streets, Buffalo, N. Y.; Shelby Steel Tube Company, 258 Broadway, New York; Vehicle Equipment Company, 38 Nassau Street, New York; Hydra Double Battery Company, 32 Broadway, New York; International Automobile & Vehicle Tire Company 346 Broadway, New York; Rose Manufacturing Company, 910 Arch Street, Philadelphia, Pa.; Munger Vehicle Tire Company, New Brunswick, N. J.; Gray & Davis, Amesbury, Mass.; B. F. Goodrich Company, 66 Reade Street, New York; Veeder Manufacturing Company, Hartford, Conn.; Automobile Supply Company, 310 Mott Avenue, New York; Grant-Ferris Company, Troy, N. Y.; Baldwin Cycle Chain Company, Worcester, Mass.; Consolidated Rubber Tire Company, 1784 Broadway, New York; Porter Battery Company, 1023 Monadnock Block, Chicago, Ill.; Metallic Rubber Tire Company; 210 Centre Street, New York; Badger Brass Manufacturing Company, Kenosha, Wis.; Hartford Rubber Works Company, Hartford, Conn.; Robinson Motor Vehicle Company, 175 Devonshire Street, Boston, Mass.; Searchmont Motor Company, 1230 Orkney Street, Philadelphia, Pa.; Crest Manufacturing Company, 83 Portland Street, Cambridge, Mass.; Upton Machine Company, 17 State Street, New York; Steam Vehicle Company, Reading, Pa.; Stearns Steam Carriage Company, Syracuse, N. Y.; Smith & Mabley, New York.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL & CHEMICAL MANUFACTURING COMPANY, of New York, has been incorporated, with a capital of $1,000.

THE STOREY MOTOR & ELECTRIC COMPANY has been incorporated in New Jersey; capital, $500,000. Incorporators: S. Livingston, Frederick Weiner and Rupert A. Jenks.

THE NEW YORK SWITCHBOARD & MANUFACTURING COMPANY, of New York City, has been incorporated, with a capital of $4,000. Directors: Ernest Ohnell, Peter Gran and A. P. Anderson, of New York.

THE ELECTRIC FURNACE COMPANY, of New York City, has been incorporated, with a capital stock of $200,000, to manufacture potash, carbide and steel. The directors are Theron Davis, Thomas Seelye and Wm. N. Barry, of New York City.

THE MONARCH ELECTRIC COMPANY, of Baltimore, Md., has been incorporated by Messrs. Walter Raymond Carpenter, Raleigh T. Lilley, Frank M. Walton, Clarence D. Boyle and Thomas Ireland Elliott for the purpose of manufacturing and dealing in electrical supplies and appliances. The capital stock is $2,000.

THE EL PASO ELECTRIC COMPANY has been incorporated under the laws of New Jersey. It is a combination of a number of electrical concerns in Texas, and will have a capital of $1,250,000. The incorporators are Henry B. Sawyer, John W. Hallowell, J. Harold Oakes, Benjamin H. Dibblee, Owen W. Young and James B. Dill.

THE TABASCO AGRICULTURAL COMPANY was recently incorporated in San Francisco, Calif. Its objects are to deal in lands, telephone lines, telegraph lines, railroads, automobiles and "everything else in the Philippines and elsewhere." Capital stock, $100,000. Directors: G. B. Ingram, Peter Bacigalupi, R. H. Warfield, J. Dalzell Brown, C. T. Michaels, Dr. C. J. Teass, Howard Perrin, J. F. Burgin, Fred H. Colburn, Joseph Naththaly and C. F. Curry.

LEGAL.

RIGHT TO USE TRADE NAME.—In the suit of the Babcock & Wilcox Company against the Joshua Hendy Machine Works a decree has been entered in the United States Circuit Court for the Northern District of California, enjoining the defendants by perpetual injunction from using the name "Babcock & Wilcox" either alone or combined with other word or words upon or in connection with the sale or offering for sale of any boiler or other steam apparatus not manufactured by the complainant and from stating or representing that any boiler or other steam apparatus sold or dealt in by the respondent and not manufactured by complainant as a Babcock & Wilcox boiler, and from selling or offering for sale, or passing off any such boiler or other steam apparatus, as and for boilers or steam apparatus manufactured and sold by complainant. The court holds that the complainant has acquired all over the world an exceedingly high and valuable reputation under the name of "Babcock & Wilcox,' and is the sole and exclusive owner of such trade name.

ILLIONIS CORPORATION TAXES.—The Supreme Court of Illinois has affirmed the judgment of the Circuit Court of Sangamon County in what is known as the Chicago Teachers' tax case. This in effect awards a writ of mandamus against the State Board of Equalization to compel it to assess the capital stock, including franchises, of twenty Chicago corporations, the cash value of whose capital stock, including franchises, over and above the value of their tangible property, is alleged to aggregate $235,000,000. The following are the corporations directly affected: Chicago City Railway Company, West Chicago Street Railway Company, North Chicago Street Railroad Company, Chicago Union Traction Company, People's Gas Light & Coke Company, Chicago Telephone Company, Chicago Edison Company, Chicago Consolidated Traction Company, Chicago Electric Transit Company, Chicago & Jefferson Urban Transit Company, Evanston Electric Railway Company, Cicero & Proviso Street Railway Company, North Chicago Electric Railway Company, North Side Electric Street Railway Company, Ogden Street Railway Company, Chicago, North Shore Railway Company, South Chicago City Railway Company, Chicago, West Division Railway Company, Chicago Passenger Railway Company, and North Chicago City Railway Company. The case will be appealed.

OBITUARY.

MR. EDWARD C. LEWIS, aged seventy-five years, president of the Farrell Foundry & Machine Company of Waterbury, Conn., and prominently interested in twenty-six other manufacturing concerns in Waterbury and Hartford, died on Oct. 24. Mr. Lewis was the Republican nominee for Congress from the Second Connecticut District in 1886.

MR. JOHN WHIPPLE, JR., son of John Whipple, the well-known real estate agent of Newport, died at Leesburg, Va., last week. The deceased had been located in Virginia for a number of years, being engaged there in the electric light business. The deceased was about forty years old, and leaves a widow. He was the grandson of the late Thomas Swann, who was Governor of Maryland.

MR. Z. S. HOLBROOK, of Brookline, Mass., died suddenly Wednesday night, Oct. 23, after a surgical operation. He recently resigned as president of the Massachusetts Telephone & Telegraph Company, to be president of the American & Moore Electrolytic Companies. Mr. Holbrook attended the Yale Theological School. He left the ministry in 1881 and became engaged in business. For some time past he has been active in the independent telephone movement in New England.

DR. JOHANN GEORG VON SIEMENS, founder and former director of the Deutsche Bank and a leading member of the Reichstag and the Prussian Diet,

[illegible] very seriously ill for several weeks, died in Berlin on Oct. 23. This eminent German financier was a native of Torgau, where he was born in 1839. He was educated at Heidelberg and Berlin, and began the practice of law at an early age. His practice was interrupted by the campaigns of 1864, 1866, and 1870, from which the young lawyer-volunteer emerged as a lieutenant, with the order of the Iron Cross, given only for distinguished bravery in action. When the Deutsche Bank was started, in 1871, Dr. von Siemens, though only thirty-one, was selected to manage it. This he did for thirty years, retiring in 1900, after a career marked by great financial talent and capacity for leadership. He widened the bank's business enormously, and at last raised it to a position where its influence is worldwide. Under him the bank floated, or aided to float, loans from nearly all the countries of the civilized world, and it established connections in all important commercial centers. Notable among its operations in America was the financing of the Northern Pacific Railroad, and its participation in the reorganization. Since his retirement, Dr. von Siemens had been a trusted adviser of the bank. He had within a year been regarded as a possible selection for Finance Minister of the German empire, a post for which his qualities would have eminently fitted him. Dr. Siemens was a cousin of the earlier men of that name, and his father made an advance, it is said, of 6,000 thalers to Dr. Werner von Siemens, when the latter, a young artillery officer in the German army, started his famous electrical works in association with Halske. Dr. Georg was always interested in the celebrated concern conducted by his relatives, and was also interested in the development of the important electrical corporation known as the Allgemeine Elektricitäts Gesellschaft. The joint record of the Siemenses in modern science, modern finance and modern engineering is probably without parallel during the last century.

PERSONAL.

MR. H. C. PATTERSON, superintendent of the municipal water works, electric light and power plant of the city of Austin, Tex., resigned on Nov. 1, in order to take up other work.

MR. W. S. BARSTOW was one of the hard-working jurors on class 10 at the Pan-American Exposition, and our attention has been called to the fact that his name was omitted from the report of awards given in this journal of Oct. 19.

MR. EDWARD CALDWELL has sold his interest in the Trade Paper Advertising Agency, of which he has been president, and has no longer any connection with it. His office is at room 1221, American Tract Society Building, this city.

MR. A. V. ABBOTT, formerly chief engineer of the Chicago Bell Telephone Company, has become associated with the Century Telephone Construction Company, and the Consolidated Telephone Company, of Cleveland, and will have charge of much of their installation work at exchanges being installed in New York State. Mr. Abbott has a widespread reputation in the electrical field.

MR. H. H. ROBINSON, for many years traffic manager of the Central Union Telephone Company, with headquarters at Chicago, has resigned to accept a similar position with the United States Telephone Company, succeeding K. V. Murry, who recently resigned. Mr. Robinson has had long experience in the traffic work of the long-distance telephone business, and is a valuable acquisition to the United States Company's forces.

MR. DE WITT C. TANNER, who for seven years has been connected with the office of Geo. P. Barton, patent attorney, of Chicago, has become a partner in the business, and the firm name will hereafter be Barton & Tanner, with offices in the Monadnock Block, as heretofore. Mr. Tanner has made many friends among the electrical fraternity in Chicago, and was one of the prime movers in the selection and publication of the well known set of standard conventional diagrams of electrical apparatus, published by the Chicago Electrical Association some time ago.

PROF. WILLIAM S. ALDRICH, late of the University of Illinois, has entered upon his duties as Director of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., which position he was tendered and accepted several months ago. Among other recent appointments to the staff of the Clarkson School are Prof. Edwin Haviland, Jr., B. S. (Swathmore), M. A. (Cornell), who will occupy the chair of civil engineering, and Mr. W. S. Graffan, B. S. (Worcester Polytechnic Institute), who has been appointed superintendent of shops.

MR. R. N. KING, formerly with the Stillwell-Bierce & Smith-Vaile Company, has established an office at 35 Wall Street, New York, and is pushing plans for the development of 30,000 horse-power in Nebraska. It is proposed to build a canal 30 miles in length from Linwood on the Loup River to Fremont on the Platte River. This canal will carry the waters of the Loup River through a natural formation into a reservoir on the Elm Creek cañon, at Fremont, Neb., where the bluffs rise 200 feet above the Platte River. It is also proposed to consolidate the street car and electric lighting interests of Omaha and Council Bluffs and vicinity. Reference to this scheme was made in these pages some weeks ago, upon its first rumor.

MR. WILLIAM H. BROWNE, general manager of the Royal Electric Company, of Montreal, Can., has sent in his resignation of the position, to take effect in three months. Mr. Browne went from New York to Montreal in 1893, and took over the management of the Royal Electric at a time when its fortunes were considered to be at a low ebb, and when the need was felt of the presence of a strong man at the head of affairs. The success of the new management was quickly recognized, and the extent of that success may be inferred from the statement, made by insiders to-day, that the stock of the concern is now between four and five times as valuable, all intervening operations considered, as it was when he took hold. Mr. Browne's next movements will be a matter of much interest to a host of friends.

NEW INSTITUTE MEMBERS.—Following are the names of the new members of the American Institute of Electrical Engineers elected this month: William L. Abbott, chief operating engineer, Chicago Edison Company, 139 Adams Street. Harry Bartlett Alverson, superintendent, Cataract Power & Conduit Company, Buffalo, N. Y. Charles Gilman Atkins, engineer on power business, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Willard S. Atkinson, electrical engineer and factory manager, Zimdars & Hunt; R. F. D. No. 5, New Brunswick, N. J. William Childs Bamber, electrical engineer, Rapid Transit Subway Construction Company. Willard S. Bennett, the S. S. White Dental Mfg. Co., New York City. Robert G. Brown, electrician, 158 Montague Street, Brooklyn, N. Y. Arthur Clifford Bunker, engineering department, Stanley Electric Manufacturing Company, 238 Crocker Building, San Francisco, Calif. Willard Gilbert Carlton, assistant to chief operating engineer, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Henry Cannon Carpenter, assistant in engineering department, New York Telephone Company. Oliver Francis Conklin, consulting electrical engineer, the Robbins & Myers Company, Springfield, Ohio. Frank Powell Cox, electrical engineer, General Electric Company, Lynn, Mass. Louis Aloysius Ferguson, general superintendent, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Harry Barnes Gear, general inspector, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Grenville A. Harris, electrical and mechanical engineer, Takata & Company, 10 Wall Street, New York City. John Allen Heany, expert, Peter Heany Development Company, 904 Quarry Street, Philadelphia, Pa. Charles Janisch, chief engineer, the Siemens & Halske Company; Siegmunds No. 12, Berlin, Germany. Peter Junkersfeld, assistant to mechanical engineer, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Paul John Kruesi, assistant to sales manager, General Incandescent Arc Light Co., 572 First Ave., New York. Geo. Holt Lukes, night operating superintendent, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Godfrey Morgan, general manager the Niagara Gorge Railroad Company. Homer Eldredge Niesz, assistant to general superintendent, Chicago Edison Company, 139 Adams Street. Alonso D. Palmer, superintendent, Compania Anonima de Redes Telefonicas de Ponce, box 135, Ponce, Porto Rico. Granville Ernst Palmer, salesman, H. C. Roberts Electrical Supply Company, 802 Equitable Building, Baltimore Md. Samuel Newton Smith, manager of sales, Submerged Electrical Motor Company, 725 Temple Court, Minneapolis, Minn. Ralph Sweetland, electrical inspector, New England Insurance Exchange, 55 Kilby Street, Boston.

EDUCATIONAL.

THE YOUNG MEN'S CHRISTIAN ASSOCIATION, of Cleveland, will conduct, in connection with its educational features, a school of telephony. Messrs. R. C. Gifford and T. J. Tune, both expert in telephone construction work, will conduct the class.

THE CONSOLIDATED SCHOOLS have been opened at 156 Fifth Avenue, New York, in charge of Mr. Ewald. These schools, formerly known as the United Correspondence School, the Institute of Home Study of Engineering and the Correspondence School of Technology, have recently changed hands.

Trade Notes.

THE BURT MANFACTURING COMPANY, of Akron, Ohio, has just entered its tenth order from the Pittsburg Plate Glass Company, for Cross oil filters.

HYLO LAMPS.—Messrs. F. B. Sage & Bro., 123 Liberty Street, New York, announce that they are now the agents in New York City and vicinity for the Hylo lamps.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out a complete descriptive circular, giving cuts and prices of the Newgard waterproof receptacle in the various styles in which it is made.

THE VARLEY DUPLEX MAGNET COMPANY has moved the office of its Western Agent, C. L. Hibbard, to 82 Lake Street, Chicago, Ill., and all inquiries and orders for its well known products will receive prompt and careful attention.

JENKINS BROS., 71 John Street, New York, have received the following awards at the Pan-American Exposition at Buffalo, for their goods: Gold medal for Jenkins Bros. valves; gold medal for Jenkins '96 packing; two silver medals for rubber specialties.

THE WOODS MOTOR VEHICLE COMPANY, of Chicago, suffered a loss by fire in its factory at 549 Wabash Avenue the evening of Oct. 25. Twenty-two automobiles and a number of patterns and parts were lost, making a total loss to the company, which is given as $75,000.

AUTOMOBILE SUPPLIES.—Mr. A. L. Dyke is sending out a batch of pamphlets describing and illustrating the line of automobile supplies and parts handled by him. All those interested in automobiles would do well to communicate with Mr. Dyke, whose headquarters are in the Linmar Building, St. Louis, Mo.

CAR TRUCKS.—In a recent catalogue issued by the J. G. Brill Company, Philadelphia, Pa., is very completely described the construction of the No. 27 truck in its various forms. These trucks are used both on street and steam railways. The catalogue includes several pages of testimonial letters regarding the truck.

CASTINGS.—Telephone, dynamo and motor castings are made a specialty of the business of the John Reek Electrical Works, Camden, Mich. The concern also makes dynamos and motors complete, and a recently issued catalogue gives prices and descriptions of the various machines manufactured by it, besides a full line of electrical supplies.

ELECTRICAL AND STEAM MACHINERY.—Messrs. Rossiter, MacGovern & Company, 141 Broadway, New York City, in their October circular give a list of electrical and steam machinery for railway, lighting and power purposes, on hand ready for prompt shipment. The list includes many makes of machines, street cars, boilers, condensers, engines, etc.

POWER PUNCHING MACHINERY.—The Long & Allstatter Company, Hamilton, Ohio, describe and illustrate in a 160-page catalogue its complete line

of power punching and shearing machinery. The standard machines of this company are made single and double in form, with throats in depth between 4 inches and 72 inches. The machines are very finely illustrated.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, which received the highest award in its line (bronze medal) for its manipulators and Morse adjuster at the Pan-American Exposition, reports that the call for samples of its Morse automatic adjuster, from mills, factories and shops in all parts of the country far exceeds its anticipation. And although this is its first season on the market, the orders are more than satisfactory.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is meeting with unusual success with its new type Scheeffer recording wattmeters. It states that this apparatus has been recently improved, and that it now has a meter which gives an absolutely correct record, is sensitive to the highest degree, and the most economical meter on the market. The company has gotten out a pamphlet fully describing these instruments, together with prices and full information on them, which is mailed on application.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, issues a 6½ by 9½ pamphlet of 60 pages, containing neat half-tone cuts showing the various patterns and types of electric generators and motors that it manufactures, also the construction of armatures, field coils, brush holders, commutators, etc. The direct-connected generators are of the "Standard" engine type and the "Marine" type. As showing the wide range of work for electric motors, a cut is given of one direct connected to a 500-lb. hammer and of another direct geared to an egg-beater.

DYNAMOS AND MOTORS.—The Star Dynamo Works, Jefferson City, Mo., are making a line of small and medium sized electric motors and dynamos, a specialty of the business being the furnishing of complete incandescent lighting plants with directions for erecting, so that any one with slight mechanical ability can install and operate such a plant satisfactorily. The company will be glad to send to any one interested complete lists covering the different outfits furnished by it. The specifications include plants of 15 lights, 25 lights, 50 lights and 100 lights. The company has been making this apparatus for several years past and has established a record for its work.

KEYSTONE ELECTRICAL APPARATUS.—The Keystone Electric Company of Erie, Pa., is manufacturing a line of dynamos and motors ranging from 9 to 180 kilowatts as generators, and 11½ to 240 horse-power as motors. These machines are recommended for general power and lighting service, and, it is stated, are constructed to satisfy the most exacting requirements. They are arranged for either belting, direct connection, or gearing. The Keystone Company's bulletins show machines of various types and of excellent design. The company also makes an enclosed type of machine which is especially adapted to service requiring dustproof and waterproof construction.

ELECTRICALLY-DRIVEN LATHE.—The Prentice Brothers Company, Worcester, Mass., is building a lathe which is driven by a 3-hp constant-speed electric motor attached to the bed, motion being transmitted to the spindle through gearing. The lathe is started, stopped, or the motion reversed, and at an accelerated speed, entirely independent of the motor, by a lever attached to the apron. This lathe is illustrated and described in a leaflet issued by the company. The company's Pan-American souvenir, which is gotten up in neat pamphlet form, gives illustrations of interior views of the company's shops, also an exterior view, in addition to views of the various styles of drilling machines and engine lathes manufactured by it.

NEW ENGLAND MOTOR COMPANY.—The bulletins of the New England Motor Company, of Lowell, Mass., show a line of well designed, direct current, multipolar motors and generators. The motors are made either partially or completely enclosed. The company also manufactures a line of semi-enclosed and dust-proof bipolar motors, covering a wide range of speeds, and a complete line of slow speed motors and generators of modern design suitable for direct connected outfits, printing press and ventilating service. The company calls attention to the fact that its machines are manufactured with a cradle support, which is covered by a fundamental patent issued to Mr. James Burke and purchased by it, patents on improvements being issued directly to the company last March.

STORAGE BATTERY CATALOGUE.—The distinguishing features and construction of the Gould storage battery are well described and illustrated in an attractive booklet of 12 pages recently issued by the Gould Storage Battery Company, 25 West 33d Street, New York City. Those who are not familiar with the process employed in the manufacture of the plates of this battery will find interesting reading in the pages of this little work. The design of the booklet is rather unique. The style is antique. The text is in dark brown ink, the design on the front cover being printed in two colors. The work is the product of the Alwil shop, Ridgewood, N. J., which is owned and managed by Mr. Rae, son of Mr. F. B. Rae, the well known electrical engineer, of New York.

FLEXIBLE SHAFTS.—All those having use for portable drills may be interested in looking over the catalogue of the Stow Manufacturing Company, of Binghamton, N. Y. This concern manufactures flexible shafts for all purposes. The advantage in the use of this shaft is that wherever, on account of the weight or position, it is inconvenient to take the work to the drill, the drill can be taken to the work, thus saving both time and labor. The company also makes a multi-speed electric motor for operating the drills, and for other power work. The company's catalogue is fully illustrated, showing a variety of applications of the flexible shaft, and gives much information on the general subject. It also contains illustrations of the motor, which has been described and illustrated in these pages.

ENLARGING AUTOMOBILE FACTORY.—The factory at present occupied by the Baker Motor Vehicle Company, of Cleveland, was designed for the developing in the experimental stages of the neat little electric runabout which has been described in these columns, and which has attracted widespread attention wherever it has been shown. After producing vehicles at the rate of two per week for more than a year past, the company is amply assured of an increased demand for another year and has completed plans for a large five story brick building. It will be equipped with all facilities for producing all parts of the vehicle, with the exception of the batteries, and its capacity will be sufficient to take care of all demands. During the past few months a very large proportion of the Baker output has been disposed of in New York City.

MESSRS. CHARLES H. BESLY & COMPANY report their foreign trade as very good, many orders being received from South America, England, Germany, Norway and Sweden. Their Mr. Sinclair, who was so well and favorably known among the bicycle trade during the years 1895, 1896 and 1897, at which time he represented them in this line, is now on his second trip around the world selling the well known specialties manufactured by Charles H. Besly & Company, viz.: Gardner grinders, Besly band grinding machines, Gardner die stocks, Badger die stocks, Helmet oil, parallel clamps, Bonanza and Badger oil cups, Helmet bronze spring wire and sheet, and taps of all descriptions. Mr. Sinclair sails Nov. 5, via London, and will visit France, Germany, Russia, India and Japan, returning via San Francisco. As Mr. Sinclair speaks and writes Spanish, Portuguese, Italian, French and German, he is well qualified for such a journey.

LIGHTING THE PAN-AMERICAN.—When the management of the Pan-American Exposition at Buffalo decided to adopt the Frink reflectors for lighting the Railway Station and Transportation Building, they were doubtless thoroughly familiar with the sterling qualities of these famous reflectors, which have radiated light to all parts of the world for nearly half a century, so that the award of a silver medal on their merits would seem only a just recognition of their many valuable points of advantage and superiority in lighting capacity, durability and appearance. These reflectors have been awarded a medal in every exhibition in which they have been entered, and as they are made in every conceivable shape, size and style for every possible purpose, a catalogue of their numerous products is well worth having. A card addressed to Mr. I. P. Frink, 551 Pearl Street, New York, will bring a ready response to any inquiry along the line of light.

THE STOREY MOTOR.—Storey motors and dynamos have been on the market for several years. These machines are made for slow and medium speeds in all sizes, and for direct current. They are especially adapted for ventilating, grinding, buffing, drilling and other like operations. The company makes a specialty of direct connected combinations of all kinds. The Storey motors have been used by the United States Government for three years for driving a special machine where it is necessary to locate the motor inside of a closed iron pedestal. This is an instance of a machine running sealed in the pedestal, besides being sealed itself, and yet gives perfect satisfaction. The peculiar construction of these machines prevents undue heating. Among the advantages of the Storey motor are that it occupies a minimum space for a maximum power, and on account of its compact design and cylindrical form, it is especially adapted for direct connection to all types of machinery or any class of work requiring either continuous or variable speeds. The company's headquarters are now at 226 Carter Street, Philadelphia, Pa.

ELBRIDGE PRODUCTS.—The Elbridge Electrical Manufacturing Company, Elbridge, N. Y., is manufacturing a special line of small dynamos, for which there is an extensive use. Its 450-watt dynamo is designed to supply current sufficient for eight 16 candle-power lamps. It is a substantially built machine of good electrical design, and, used as a motor, gives one-half horse-power. The company also makes a sparking dynamo for gas engines, which displaces primary or storage batteries for igniting the charge in gas or gasolene engines. This machine also is made in the best manner possible, all of the materials used in its construction being the best obtainable. Besides the machines above mentioned, the company makes what it calls the Midget dynamo or motor, which is designed for experimental work. As a dynamo it has an output of about 10 watts, and as a motor it may be run by current from a few cells of battery. In design it is in every way equal to the larger machine above mentioned. The company is also making an arc lamp for illustrating the principles of operation of the lamps used on commercial circuits; also a model transformer for use in schools and laboratories for the purpose of demonstration. The Elbridge Company manufactures other specialties and will be glad to send circulars to any one interested.

MINIATURE LAMPS.—All interested in the art of electric decoration and use of miniature lamps should send for a copy of the new catalogue (No. 1035) of miniature lamps and appliances just issued by the Edison Decorative & Miniature Lamp Department, General Electric Company, Harrison, N. J. This catalogue comprises a complete account of all types of candelabra, special series, and battery lamps, covering the entire field of miniature lamps, including the telephone lamp, automobile lamp, bicycle lamp, etc. Over 400,000 Edison miniature lamps are now annually used and their application is rapidly increasing. One of the latest plans is for central stations to keep a stock of special series lamps (1 and 3 candle-power, plain and colored), with porcelain receptacles for rental to their customers on festive occasions for decorations. The plan popularizes electric lighting and is specially appreciated at Christmas and holiday seasons. In the appendix to this catalogue are chapters on the following subjects: Instructions for installing miniature lamps and receptacles, batteries for miniature lamps, table lighting decoration, house and room decoration, garden and shrubbery decoration, Christmas tree decoration, use of colored lamps, etc. There are profusely illustrated designs and views of electric decorative installations.

PROCTOR VAUDEVILLE is a favorite amusement for New Yorkers and for visitors to the city who wish to spend a casual hour pleasantly. Manager F. F. Proctor is arranging a strong campaign of vaudeville and comedy for the winter season at his theatres in New York, Albany, Montreal and Newark. There will be an enlargement of the vaudeville scope of his amusement scheme as the season advances, and some of the best European acts, as well as all the American headliners, will appear in conjunction with the Proctor Stock Company. At his four New York houses the stock company will continue the revival of well known comedies, with vaudeville interludes between acts. Joseph Arthur's celebrated comedy drama, "Blue Jeans," is scheduled for an early revival, with all the original scenery and mechanical effects, while David Belasco's beautiful production of "Mme. Butterfly," with Mlle. Pilar Morin as Cho Cho San, will continue for several weeks as a ruling attraction on the Proctor circuit. Sandow, the strong man, is one of the first of a long line of great European vaudeville attractions which are booked to appear at these houses, and with some of the best American specialties already engaged, the vaudeville department will be particularly strong. Sunday concerts have been resumed at all of Manager Proctor's New York theatres.

ROENTGEN-RAY WORK.—We are advised by Elmer G. Willyoung, No. 11 Frankfort St., New York City, the well known manufacturer of electrical instruments and x-ray apparatus, that, by a contract recently made with Mr. E. W.

Caldwell, control of the two Caldwell Patents, Nos. 677,498 and 677,499, covering liquid interrupters, has been secured by him. Also that the patent rights covering the Cunningham mercury jet interrupter, described in Electrical World and Engineer of Oct. 1, has been similarly obtained. Two forms of the Caldwell interrupter and one model of the Cunningham interrupter are being made for the market and are described in a new catalogue of Willyoung x-ray apparatus now in the printers' hands. This new catalogue will contain a number of new and valuable devices in the x-ray line, including a new line of portable x-ray machines, the Caldwell radiographic tube stand and table, the water-cooled tube, etc., etc. A new stereoscopic fluoroscope, the invention of Mr. Caldwell, will also be commercially announced for the first time. Among recent orders for Willyoung x-ray machines are two of his 15-inch type H machines, one for St. Luke's Hospital, New York, and the other for the New York Hospital. These machines will be duplicates of the one furnished Roosevelt Hospital about one year ago, and are wound with extra heavy wire so as to produce especially large volume of discharge.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 22, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

684,785. ELECTRIC ARC LAMP; J. Bouillet, Levallois-Perret, France. App. filed Dec. 20, 1899. Horizontal carbons are fed by means of friction wheels bearing against them and rotated by the lamp gearing.

684,791. ELECTRIC RESISTANCE; E. R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. The resistance is composed of looped material suspended in the open air from suitable connecting blocks attached to the bottom of a car.

684,828. SPARK GAP REGULATOR; T. B. Kinraide, Boston, Mass. App. filed March 5, 1901. The main circuit includes a solenoid which controls the length of the spark gap and regulates the discharge.

684,831. PROCESS OF PREPARING SECONDARY BATTERY PLATES; A. Lehmann, Berlin, Germany. App. filed Oct. 10, 1900. The plates are subjected to current while in a bath of fatty acid; the acid is neutralized to cause the organic acid to act in its nascent state; the plates are then removed from the bath and exposed to caustic soda, and after washing they are ready for formation in sulphuric acid.

684,880. INCANDESCENT LAMP BASE; A. Swan, New York, N. Y. App. filed March 6, 1899. A cross-pin passes through the base and projects at each end as a means to hold the base in the socket.

684,881. RAILWAY SIGNAL; H. B. Taylor, Newark, N. J. App. filed Aug. 7, 1900. A three-position semaphore signal controlled by locking devices and circuits actuated by the train.

684,906. ELECTRICAL RECIPROCATING APPARATUS; John Brown, Belfast, Ireland. App. filed July 10, 1900. Details.

684,909. INSULATING BUSHING; J. A. Cole, Boston, Mass. App. filed Aug. 10, 1901. A bushing adapted to be inserted in an opening in sheet metal to carry an insulated wire. The bushing is sprung through the opening and is self-locking when in place.

684,950. ELECTRIC MINE LOCOMOTIVE; C. Robinson, Columbus, O. App. filed Sept. 14, 1895. Details of the frame and mounting of the motors.

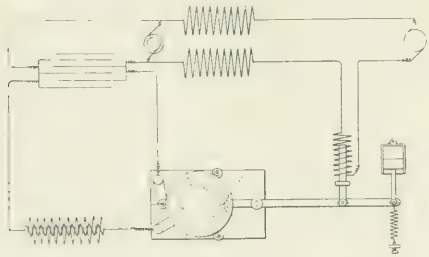
684,952. STREET RAILWAY SIGNALING SYSTEM; J. J. Ruddick and C. E. Rand, Newton, Mass. App. filed Feb. 27, 1899. A plan of circuits and signals for automatically protecting the blocks by the moving cars themselves.

684,963. TELEPHONE INSTRUMENT; Willis W. Washburn, Chicago, Ill. App. filed Nov. 5, 1900. A horseshoe magnet has one of its ends provided with a solid pole piece and the other with an annular pole piece enclosing the former. The annular pole piece is screwed in the telephone head, and the coil is arranged between this and central pole piece.

684,968. SIGNAL; J. A. Wilson, Chicago, Ill. App. filed Sept. 23, 1899. A belt driven by a motor at the signal post is adapted to be automatically clutched and unclutched to and from an arm which moves the signal.

684,969. RAIL BOND; H. W. Wyman, Worcester, Mass. App. filed March 20, 1901. The lug at the end of the bond passes through and slightly beyond the rail; a wedge driven into an orifice in the lug spreads it on the distant side and prevents it from moving.

684,977. ELECTRIC BELT; A. Chrystal, Marshall, Mich. App. filed Aug. 17, 1901. Details.



684,828.– Spark Gap Regulator.

685,008. ELECTRIC SIGNALING SYSTEM; J. J. Ruddick, Newton, Mass. App. filed June 20, 1899. A railway signaling system in which the signals are placed on the cars and automatically operated to inform the motorman so that he may go onto a siding if another car is in the same block with him.

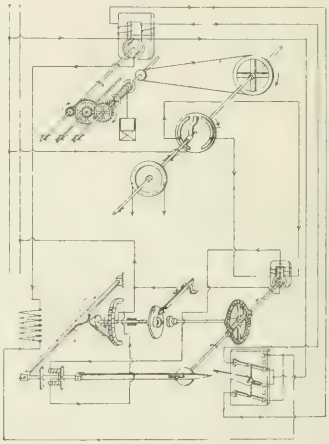
685,012. MEANS FOR INCREASING THE INTENSITY OF ELECTRICAL OSCILLATIONS; N. Tesla, New York, N. Y. App. filed March 21, 1900. Renewed July 3, 1901. (See Current News and Notes.)

685,034. PARTY-LINE TELEPHONE SYSTEM; Wm. W. Dean, Chicago, Ill. App. filed April 28, 1899. (See page 729.)

685,042. ELECTRIC FURNACE; W. T. Gibbs, Buckingham, Canada. App. filed Oct. 14, 1897. (See page 730.)

685,043. ELECTRIC METHOD OF FUSION; W. T. Gibbs, Buckingham, Canada. App. filed March 15, 1901. (See page 730.)

685,046. CABLE HANGER; W. H. Johnston, Chicago, Ill. App. filed April 1, 1901. Improvement in the buckle for holding the ends of the strap together.



685,072. Arrangement for Controlling Electric Elevators.

685,072. ARRANGEMENT FOR CONTROLLING ELECTRIC ELEVATORS; E. A. Wahlstrom, Cannstadt, Germany. App. filed Aug. 25, 1899. Switches on each floor corresponding to the number of floors, means being provided for preventing the actuation of any switch while another is in use.

685,101. ELECTRIC BATTERY; P. Chapuy, Vincennes, France. App. filed Feb. 21, 1901. One electrode in the form of cylinders or rods is embedded in a block of porous, non-conducting material, the other electrode being a plate confined between two of the blocks.

685,118. TROLLEY; A. J. Eberwine, Slatington, Pa. App. filed Aug. 8, 1901. Details.

685,155. SYNCHRONISM INDICATOR; Paul M. Lincoln, Niagara Falls, N. Y. App. filed March 27, 1901. Two coils are mounted at right angles on a revolvable axis and are in a field maintained by current in a coil connected to the station bus-bars. The revolvable coils are connected with the machine to be synchronized by means of two branch circuits, one of which contains a non-inductive and the other an inductive resistance, this disposition producing a difference of phase in the two coils. The patent describes automatic means set in operation by this device, for closing the paralleling switch, which switch is provided with a safety element preventing its closing except during such time as the dynamos are with respect to synchronism within a margin of safety.

685,101. Electric Battery.

685,156. GOVERNOR MECHANISM; P. M. Lincoln, Niagara Falls, N. Y., and L. B. Stillwell, New York, N. Y. App. filed May 11, 1901. (See Current News and Notes.)

685,239. APPARATUS FOR RECORDING AND REPEATING TELEPHONIC SPEECH; Harry A. Rhodes, Denver, Colo. App. filed Jan. 2, 1900. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, NOVEMBER 9, 1901. No. 19.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - President and General Manager.

CHICAGO OFFICE, - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 9, 1901.

CONTENTS.

	PAGE
Editorial	765
Proposed American Electro-Chemical Society	768
Electrical Engineers of the Day—XIX; Caryl D. Haskins	768
The New Bell Telephone Exchange, Cortlandt Street, New York City	769
Important Power Station Work at Kansas City	772
Syntonic Wireless Telegraphy, by A. Frederick Collins	773
The Zossen Polyphase Railway Installation for Experimental Tests, with Speeds up to 125 Miles an Hour—VII., by Walter Reichel (Concluded)	777
The Nobel Prizes	778
The Electrical Protection of Vaults	779
Work of the United States Signal Corps	779
The Activity of American Manufacturers	780
The Storage Battery in Telephone Work	780
Power Development in Northern Indiana	781
New York Electrical Society and Electric Lighting	781
Test of Farnham Third-Rail System at Chicago	782
Electro-Chemical Patents	782
Nernst Lamp Patents	783
New Telephone Patents	784
Current News and Notes	785
LETTER TO THE EDITORS:	
Wireless Telegraphy, by A. G. Dell	786
Digest of Current Electrical Literature	787
Second Annual New York Automobile Show	791
The "Flexduct" Flexible Conduit for Wiring	793
Motors in the Printing Office	793
Universal Sign Receptacles	794
The S. K. C. System at the Pan-American	794
A Pan-American Switchboard	795
DEPARTMENTS:	
Financial Intelligence	796
Commercial Intelligence	797
General News	799
Trade Notes	803
Record of Electrical Patents	803

SWITCHBOARD SIMPLICITY.

The use of high-voltage switches as a necessary accompaniment of the large polyphase generating station of to-day has added a complication to station operation that has placed a problem of no small difficulty before the switchboard designer. We refer to the complication arising in some of the later high-tension switchboards from the inability of the switchboard attendant to tell easily at a glance, without considerable mental effort and without hesitation, just what the connections existing on a board are. This difficulty is one inherent in the use of the enclosed or oil switch. A knife switch with its contacts on the face of the board shows unmistakably its position. The oil switch is operated either by a handle on the front of the board connected to the switch back or below the board, or it is worked by a low-tension switch-operating circuit from a small switch on the face of the board. But the difference in the position of a handle, which indicates whether a switch is open or closed, does not appeal to the eye or mind of a switchboard operator with anything like the clearness that the position of a knife switch on the face of the board does.

While this fact does not make much difference in the case of small or simple switchboards, it demands serious consideration in the case of a large board, where added to this difficulty is that of greater complication. The switchboard attendant cannot have too clearly before his mind the diagram of switchboard connections and the position, whether open or closed, of each switch. The first move in the direction of greater clearness for the switchboard operator was made in the design of the board for the Metropolitan Railway in New York, and a similar design to be used in the plant of the New York Manhattan Elevated Railway, both of which have been described in these columns. The switches controlling the low-tension switch operating circuits are mounted on a bench board, which bears on its surface a wiring diagram. The handles of the operating circuit switches are so included in this diagram as to show at what points the circuit is opened or closed, and the switchboard operator has before him at all times a plan of the switchboard connections existing at any moment.

A still further step toward simplicity and toward aiding the switchboard attendants in keeping clearly before them the relations of the circuits on a board is that outlined in another column as worked out by Mr. R. H. Pierce, of Chicago, for the new polyphase generating station of the Kansas City Electric Light Company. In this case the conditions were considerably different from those in the two plants before mentioned in that the number of generating units is less and the variety of service supplied is greater. In the latter design Mr. Pierce mounts the switches which work the low-tension switch operating circuits directly on the panel which carries the measuring instruments relating to that circuit. Along the face of the row of panels will be run a set of dummy bus-bars, and the operating handles of the switches will be interposed between these dummy bus-bars in such a way as to afford at all times a picture of the connections. While this plan is not as compact as that first outlined where the operating switches are all on a bench board, it has the advantage of having each switch on the panel bearing the measuring instruments in its circuit, and in this respect there is less liability to confusion than where the instruments and switches are on separate boards. This plan, therefore, marks another advance in the direction of clearness and a reduction of chances for dangerous mis-

takes. All efforts in the direction of simplicity and clearness around switchboards of whatever kind cannot be too highly commended, for the necessary complications are great and it takes the best of engineering talent to counteract them.

CURRENT SUPPLY TO LARGE ELECTRIC LOCOMOTIVES.

The discussion of alternating-current motors as against direct-current motors for electric railway service, which has been so prolific lately, has not served to bring out one point which is probably understood by all engineers who have entered the discussion, but which has not been stated in a way to emphasize its importance. The feature of the alternating-current motor to which we refer, is that it enables a high voltage to be used on the trolley line, and that it consequently reduces the difficulty which is sure to be experienced with the current collective devices which large electric locomotives must use. The use of electricity on long-distance lines calls for large locomotives for freight service. For passenger service the trains would, as a result of the change from steam to electricity, be shorter and more frequent than formerly, or, if ordinary trains were used, the mutliple-unit system could be employed for passenger cars and thus the current which would have to be collected for any one car would be relatively small.

The freight business, however, cannot be carried on economically except in large train units. This has been taught by all the railroading experience of the past 50 years. Such large locomotives as are required for freight service presents serious difficulties as to the current-collecting device if the current must be taken from the trolley or third rail at 500 or 600 volts, or even 50 per cent higher. Even at low speeds the collection of sufficient current for an electric locomotive large enough to pull a long freight train, if taken from a third rail by contact shoes, becomes troublesome, on account of the electrical resistance of the sliding contact. What it would be at high speed over long stratches is a matter of surmise, but it should, of course, be much worse than at slow speed, because of heat of friction added to the $I^2 R$ heating. To make practical the operation of such locomotives it seems almost imperative that the voltage must be very materially increased on the trolley or conductor rail in order to reduce the volume of current which must be collected by the contact device, whatever that device is. Any material increase in the voltage employed on a direct-current railway motor seems almost out of the question on account of the commutator troubles that will arise. The use of alternating-current railway motors which would make it possible to carry a voltage of several thousand volts on the trolley line would enable the weight and size of trolley conductors and contact device to be reduced to feasible limits. This appears to be one of the strongest practical points in favor of alternating-current motors for certain classes of railway work involving long distances and high speeds, and where a large amount of power in one locomotive is required.

STANDARDS OF LIGHT.

In spite of the general advance in the precision of physical measurements and the standardization of physical quantities, the first year of the twentieth century is drawing to a close with standards of light and illumination in as unsatisfactory a state as could well be imagined. It is not putting the case too strongly to say that the art of illumination is without an absolute standard, without a definite relative standard, and without accurate knowledge of the relations which exist between the tentative working units which have come into use. That such is the case is a reproach to applied science. There is not even a general concurrence as to the terms in which artificial lighting and lights should be defined. If in terms of the intensity of the radiants, one set of difficulties is encountered; if in terms of luminous flux, another. Back at the very root of the matter lies the fundamental difficulty that the thing in itself is not measurable in the same sense as length and time and mass, but involves physiological variables. It is precisely comparable to the kindred acoustic conditions. Suppose for the moment that sound were a saleable commodity, its value depending on its pitch and loudness, and imagine the confusion that would result from attempts to come to a common basis of reckoning. In face of the physiological facts it must be admitted that there is small hope of establishing a thoroughly scientific system of measurements, interconnecting the subjective and the objective. But a consistent empirical system is far better for scientific purposes than none at all, and for practical operations often quite as convenient.

The only step taken towards the establishment of an absolute luminous standard, the Violle platinum unit, has up to date led to no useful result. Cleverly conceived as it was, its only practical result has been the tentative introduction of the *bougie décimale* as a new and confusing empirical standard. Incidentally it has encouraged the formation of a tentative terminology used just enough to be continually under foot, so to speak. As a matter of fact, there are in common use in this country three standards of luminous intensity. First comes the worthy and unreliable English candle, the only one of the three which has any legal rights. Second is the *bougie décimale* much affected by advanced scientific writers who would like to use it practically if they could find it; and, finally, the Hefner unit, widely used because certified standards are easily attainable, but purely empirical and bad in color. Likewise we have the derived units of illumination the candle-foot, an unholy alliance of a pair of empiricals without scientific standing, and the *bougie-metre* or lux. Also one might add the Hefner-anything-you-please to the list. Really the situation would be amusing if it were a bit less serious, particularly if one remembers that the relation existing between the three units is only roughly known and that they have distinctly different colors.

It is a bad scrape, and the puzzling thing is to find a way out. The fundamental difficulty is that light in its practical relations is a sensation not a physical quantity that can be defined in ergs. It seems to us, therefore, that the very first step is to settle upon a conventional standard selected purely for its physical merits. The Hefner unit is excellent in some respects, but is too small and too red for easy comparison with modern radiants. Until such an empirical standard is devised and accepted attempts at a connected system of units are futile and premature. The primary standard question needs thorough overhauling before anything further is done. In most instances the thing which has to be measured is intensity of illumination, but the definite and steady source has to come first. When that is available the unit-meter will very satisfactorily express the practical illumination at any point. Luminous flux and its time derivatives are not things to be measured directly unless in photographic researches for which the ordinary luminous standard may or may not prove useful. It is conceivable that for actinic purposes the active radiation might be expressed in absolute units with a precision far greater than can be attained in photometry. Indeed, the advances in orthochromatic photograhy might evolve a satisfactory way of determining in absolute measure the relative intensities of radiation of visual usefulness. But the crying need at present is for a general and authoritative agreement as to the principal unit—that of intensity. We applaud the ingenuity displayed by Blondel and other

recent writers in planning a logical nomenclature for the branch of science under discussion, but the Violle standard on which such work has been uniformly based is altogether too far from general acceptance and from common utility to furnish a sound basis for one unit, let alone a half a dozen. The case is one for international convention, which we earnestly hope will not be long wanting.

The Standardization of Electric Apparatus.

An article on this subject, in the November number of the *Engineering Magazine* calls attention to the commercial importance of standardizing electrical machinery, both to the manufacturer and the purchaser. Some of the standard pressures and frequencies of alternating-current circuits recommended in the rules of the American Institute of Electrical Engineers are also quoted. These rules have now been outstanding for more than two years, and it is likely that they will require some slight modification from time to time as the industry advances. It is only reasonable to expect that progress and developments in manufacture should call for corresponding improvements in standardization. In a paper presented before the International Congress of Engineers at Glasgow last September, Mr. Kapp drew attention to the desirability of the systematic standardization of electric apparatus. The Association of German Electrical Engineers has appointed a committee upon this subject, and the recent report of that committee has been provisionally adopted. It resembles to some extent the report of the Standardization Committee of the A. I. E. E., but differs therefrom considerably in some directions.

The German committee divides machines sharply into three classes with respect to rating, namely: (a) Machines for intermittent service; (b) machines for short duration of service; (c) machines for continuous service. In the first class, it is required that the maximum limiting temperature elevation shall not be exceeded in a full-load test of one hour. In the second class, the same limiting temperature elevation shall not be exceeded in a period which is left open to the manufacturer to declare, but which may conveniently be made two hours. In the third class, the machines shall not exceed the temperature limitation under continuous full load, as determined by tests of sufficient duration. The temperature elevations are stated as follows: For coils of cotton-covered wires, 50 degs. C.; for coils of paper-covered wires, 60 degs. C.; for coils of mica-coated wires, 80 degs. C. Stationary coils are allowed to exceed these limits by 10 degs. For railway motors the corresponding three temperature limitations with one hour's shop test are 70 degs, 80 degs. and 100 degs. C., respectively.

We think that in some respects the above classification of temperature elevations is superior to that of the A. I. E. E. Thus, the differentiation between cotton, paper and micanite insulation is very reasonable and attractive. On the other hand, we think that the A. I. E. E. rules are superior in regard to the method of determining the temperature elevation, which is taken on the basis of direct-current measurements of resistance in coils on both fields and armatures, whereas the German rules seem to be based entirely on thermometer readings, except in the case of the field coils of direct-current machines. We think that measurements should always be made both electrically and thermometrically, and that the two should agree fairly closely, and be mutual checks upon each other; but of the two, the electric method is both more reliable and more nearly accurate. Moreover, the A. I. E. E. rules introduce an important correction for the temperature of the surrounding air above which the elevation is observed, and no such correction appears in the German rules. We also think that the German rules are open to criticism in several minor points. Thus, they recommend the rating of motors in *horse power*.

Now, it is true that for commercial reasons a motor often has to be rated in horse-power. But the horse-power is a very crude and unsatisfactory unit of power, viewed from the standpoint of the electrical engineer, and we think that the rules of an engineering body should be framed in more scientific fashion so long as the science does not hinder commercial practice. There can be no harm in rating motors in kilowatts like all other electric apparatus, even if they are sold on a horse-power basis; and, at all events, there is no reason whatever for insisting upon the rating of motors in so crude a manner, for the purpose of electrical testing and comparison. One might as well insist upon having dimensions of machines expressed in inches. There seems to be no reason why a direct-current machine should not be rated either a 100-kw generator or an 80-kw motor. We think that the time-test rating for short-duration service should be definite, and not left open to the manufacturer. The time of full-load for limiting temperature should be one hour for intermittent service, and, say, three hours for short duration service. At all events, if the duration in the latter case is left open to choice, much of the value of the classification disappears. If the manufacturer states the power which a machine can develop without exceeding the temperature limitation (a) for a one-hour run, (b) for a three-hour run, and (c) for continuous service, the temperature elevation in any other interval of time, such as two hours, or six hours, can be fairly well estimated by the engineer.

Taking the German rules as a whole, they are sufficiently nearly in accordance with those of the A. I. E. E. to show that both sets of rules have been carefully framed. Moreover, the differences between their respective provisions are often arbitrary, and such as could readily be annulled by mutual agreement. We hope that before long it will be possible for electrical engineers all over the world to unite and agree upon an international set of electrical testing rules. Even if it were not possible to agree upon everything, and certain differences might necessarily appear, due perhaps to climatic influence on the operation of machinery, yet it would be worth while adopting an international code of rules and standardization ratings which all could agree upon and leave the outstanding matters to be adopted locally in each country. We think that this matter might well receive the attention of the various institutions of electrical engineers, such as those in Great Britain, France, Germany and the United States, without delay, and we believe that if the A. I. E. E. were to broach the subject of international electrical standardization, the kindred bodies of engineers across the Atlantic would gladly acquiesce. It would probably be necessary to appoint an international conference upon the subject in connection with some European congress or world's fair, since it would be very difficult to adjust differences of opinion by correspondence. There seems to be no reason why electrical machines should not have the same rating, and the same method of determining that rating all over the world. It is, for example, unreasonable that a 50-kw machine in one country should be regarded as a 60-kw machine in another country, and there is no reason to suppose that a uniform method of rating and testing would create any hardships upon manufacturers in any one particular country. In fact, the cordiality with which American manufacturers have received the A. I. E. E. standardization rules clearly indicates the value to the industry of such a code, and we cannot see that this value would be any less if a code had an international instead of national acceptance.

Proposed American Electro-Chemical Society.

A meeting was held on Nov. 1 at the rooms of the Engineers' Club, in Philadelphia, to discuss the question of the advisability of organizing a national electro-chemical society on the same general plans as the American Chemical Society and the American Institute of Electrical Engineers. Some twenty or thirty persons from different parts of this country who were thought to be interested in the subject of electro-chemistry had been asked to be present or to express their views by letter. Among the communications received the majority, specially from the electro-chemical industries, were in favor of the formation of such a society; the minority thought the time had not yet come for such a society, that the American Chemical Society and the American Institute of Electrical Engineers filled the needs, that there were already a number of other societies at which papers on this subject could be read, etc.

Those present included representatives from New York City, from the Cornell, Lehigh and Johns Hopkins universities, from the American Chemical Society, the American Institute of Electrical Engineers, the Franklin Institute, etc. Professor J. W. Richard, vice-president of the American Chemical Society, acted as chairman and Carl Hering, past president of the American Institute of Electrical Engineers, as secretary. All those present were heartily in favor, the only doubt expressed was whether a sufficient number of members could be obtained to make such a society a success. A committee was appointed, with Dr. Chas. A. Doremus, of the College of the City of New York, as chairman, to canvass for members, and if 75 or over pledged themselves to joint, the society will be formed. In that case, certain committees which were appointed will arrange for holding a formal meeting, at which the society will be founded, and papers read and discussed. Anyone desiring to become a member is asked to communicate with Dr. Doremus, at the above address.

It was furthermore decided to be the expression of those present that the name of the organization should be the American Electro-chemical Society; that the dues should not exceed $5 per year, and that at first only a few meetings of a few days each should be held per year, and that they be held in different cities, as the society is to be a national one.

The fact that papers on the subject of electro-chemistry are now scattered over a half dozen or more existing national societies was thought to be in itself a very good reason for bringing them all together into one, where they could then be properly discussed, which is not now the case. Attention was also called to the fact that the annual electro-chemical products of this country already amounted to nearly $100,000,000, which is far greater than in all the other countries combined. Germany, which comes next with $14,000,000, has a flourishing electro-chemical society with about 40 members in the United States.

Electrical Engineers of the Day—XIX.

Caryl D. Haskins.

Caryl Davis Haskins was born in Massachusetts in 1867 and obtained his early education in the public schools of Philadelphia and Dedham. In 1879 he went to England and attended the Allison Towers and Roslyndale schools, devoted to the preparation of boys for military and engineering work. Later he studied under the London University tuition system about a year, but finally gave up the idea of a university course and returned to the United States, where he took up the study of biology. This was in 1887, and in the same year he again returned to England and entered the employ of Haskins, Davis & Company, of London, from which engagement the commencement of his technical work dates. After about six months, during which time he specialized on gas engine work, Mr. Haskins entered the shops of S. Z. de Ferranti. Commencing at the lowest round of the ladder, he was advanced to the meter department, of which he became foreman; during this period he was also connected with some of the early work at the old Grosvenor and Deptford stations.

Returning again to the United States, Mr. Haskins, in 1889, entered the employ of the Thomson Electric Welding Company, at Lynn, Mass., in the capacity of designing draftsman, but was almost immediately transferred to the Thomson-Houston Electric Company as assistant foreman of the meter department at Lynn. Shortly afterward he was transferred from the shop and given charge of the company's outside meter interests. The consolidation resulting the formation of the General Electric Company gave Mr. Haskins another promotion and placed him at the head of the meter interests of the consolidated company. In 1893 he was given, in addition, charge of the company's instrument department. In 1900 his responsibilities were again enlarged by including the switchboard department, which appointment necessitated his removing his office from Boston to Schenectady.

While Mr. Haskins is professionally best known as a meter expert, he has been an inventor in several branches. Among almost a score of patents granted to him are included the subjects of steel refining, meters, transformers, switches, circuit-breakers, time relays, etc. Perhaps his most important invention, as well as the most ingenious, is an auto-dirigible torpedo. For obvious reasons, the principles of this torpedo have never been described in print. It has, however, been inspected and favorably reported upon by a special naval board, of which Captain (now Admiral) Sampson was president. Mr. Haskins has refused advances from foreign powers relative to this invention. During odd hours, Mr. Haskins has found time to devote to literary work. In 1892 he became the author of a book on transformers, which answered an excellent purpose in its day when printed information on this subject was very meagre and eagerly sought. Of an entirely different nature is a book entitled "For the Queen in South Africa," a work of fiction consisting of six war stories. Mr.

Haskins has also been a contributor to the *Transactions* of the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, the American Street Railway Association, the Northewestern Electrical Association and other electrical organizations. He has also contributed many articles to the periodical press, and has lectured on electrical technical subjects, torpedo warfare, coast defense, etc.

Most of Mr. Haskins' ancestors from the time of the Revolution down, have borne arms in defence of the flag, and with such forebears it was but natural that when a rupture with Spain seemed probable Mr. Haskins should promptly volunteer his services to the Government. Having submitted a plan for raising a volunteer corps for submarine mining, coast and harbor defence, he was summoned before the Chief of Engineers, and his plans were approved. Upon his return to Boston he raised a battalion of electricians, numbering 160 men, immediate command of which body was given to him. This battalion was the first volunteer organization called out for military duty in connection with the Spanish War, and was quietly at work some 10 days before war was declared. Among other things, it mined Boston Harbor, installed searchlights in the harbor system of fortifications, erected and cared for a system of range and position finders, put up telephone and telegraph lines and planted submarine mines. In an official report made by an army officer and forming part of a Congressional document (H. R. 364) it is stated that "When the order to plant the mines was received, the corps was called out and rendered most faithful and loyal service. The result was a torpedo defence in Boston Harbor with great actual as well as moral strength."

Mr. Haskins is a member of the American Institute of Electrical Engineers and of a number of other technical bodies.

The New Bell Telephone Exchange, Cortlandt Street, New York City.

FIG. 1.—BREASTPLATE TRANSMITTERS.

On Saturday night, Nov. 2, the New York Telephone Company calmly and deliberately dumped $400,000 worth of telephone apparatus into the scrap heap and started at Cortlandt Street a new exchange in place of the old one, a change representing all told there over half a million dollars, in order to increase the efficiency of its service. The salvage from the old board and the old subscribers' equipments is far too small to be mentioned, but the New York Telephone Company has always been profuse in its expenditures on new and improved equipment, and the opening of the new exchange at "Cortlandt" represents its latest step in a transformation which in the aggregate runs into millions of dollars. The change on Saturday night was made very quietly, in the presence of experts and newspaper men; and very few of the ten thousand subscribers served by "Cortlandt" in using the service this week are aware of any change except in the quickening and improvement generally of the service, under the new "common battery" regime, with lamp signals on the switchboard in place of the "drops."

It appears from the records that the first common battery exchange in New York City was opened at Harlem in November, 1898. Since then exchanges on the new system have been built at West 89th Street (Riverside), East 79th Street, 58th Street (Columbus), 38th Street, 29th Street (Madison Square), 18th Street, Spring Street, Franklin Street, John Street and Broad Street. This work has involved the building anew in every detail of each exchange plant, new buildings in many cases, and alterations to others, much work to the underground cable system, and the re-equipment of every subscriber's station. While this work has been in progress the various reductions in rates have given a marked increase to the number of subscribers, so that in three years the New York Telephone Company has reconstructed its entire plant and added at the same time 40,000 stations to its Manhattan system, bringing the number up from 26,000 in November, 1898, to over 66,000 in November, 1901. It is now by far the largest city telephone system in the world. The Borough of Manhattan alone has more telephones in service than London and Paris together.

The original "Cortlandt" exchange, which went out of business last Saturday, was put in operation Oct. 28, 1888, and served a few days over thirteen years. It is still in sound working order, and is replaced simply because a better system has been invented. At the time the old switchboard was built it was the largest metallic circuit multiple switchboard in the world. It was equipped for 6,000 lines, and for some years served a district comprising the whole of Manhattan Island south of Canal Street. Now there are three other exchanges in that district, and nearly ten times as many telephones in use to-day as there were ten years ago.

Telephone headquarters in New York occupy one of the largest blocks of real estate in the city, with an arcade from Cortlandt Street to Dey Street. The new exchange occupies the entire ninth floor of the Cortlandt Street building and three floors of the new wing of the building. The ninth floor was recently added to the building—originally only eight stories high—for the accommodation of the handsome new switchboard. The operating room is U-shaped, 67½ feet wide at the widest point, 128 feet long in the west wing, and 105 feet long in the east wing. A new wing, recently added to the Cortlandt Street building, contains the cable terminals, distributing frames for connecting subscribers' lines to the switchboard, power plant, storage battery and other auxiliary apparatus. The switchboard is 256 feet long, and consists of 48 sections, end to end. Thirty of these are known as subscribers' sections, and at these are handled all the calls made by "Cortlandt Street" subscribers. The other 18 sections in the eastern run of the board are known as "incoming trunk" sections, and handle calls made by subscribers at other exchanges for subscribers connected to Cortlandt Street. The telephone service of a large city is necessarily worked on a double-track system. Each exchange in the system has many outgoing trunk lines to carry messages to subscribers connected to other exchanges, and many incoming trunk lines to receive messages from other exchanges. These trunk lines, which are wholly distinct from the subscribers' lines proper, aggregate many thousands of miles of wire. The Cortlandt Street exchange is equipped with 1,000 incoming trunk lines and 840 outgoing trunk lines. The switchboard has a capacity for 9,000 subscribers' lines, and each of the 36 sections of the switchboard contains 9,000 multiple jacks or switches.

As already noted above, the new Cortlandt Street exchange (Fig. 2) is operated on what is known as the common battery system, and, being the largest, is the last of the New York Telephone Company's exchanges to be converted from the old magneto system. Details of the method are familiar to our readers. The new subscribers' set consists simply of transmitter, receiver and call bell, with a switch operated by the hand telephone or receiver. When the receiver is taken off the hook the exchange is automatically signaled by the lighting of a small

FIG. 2. INCOMING TRUNK AND SUBSCRIBERS' SECTION, CORTLANDT CENTRAL BATTERY BOARD, NEW YORK CITY.

incandescent lamp placed immediately below the "answering jack," or switch, by which the operator connects to the subscriber's line to ascertain his wants. When the operator puts her plug into the answering jack, the signal lamp is automatically extinguished. With the

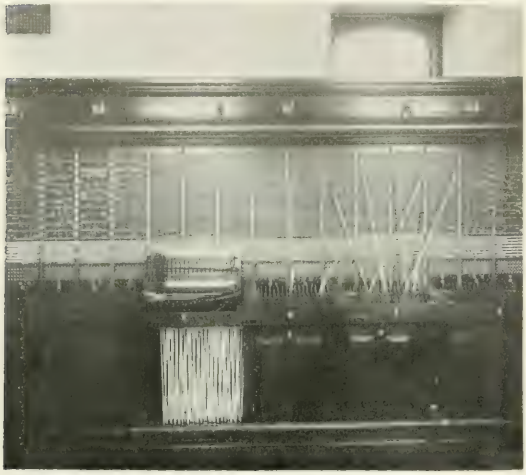


FIG. 3.—FACE OF MULTIPLE SWITCHBOARD, SUBSCRIBERS' SECTION.

second plug of the pair she connects to the line of the subscriber wanted, or to a trunk line if that subscriber is in one of the other exchanges. The connection is then governed by two lamps adjacent to the cords by which the two lines are joined. As long as these lamps are extinguished the two subscribers have their receivers off the hooks and are using the line. When both subscribers hang up their receivers, the two lamps light up, and that is a signal to the operator to take down the connection. This automatically extinguishes the two disconnection lamps. The subscriber, therefore, signals the exchange simply by taking the receiver off the hook and by replacing it. He has

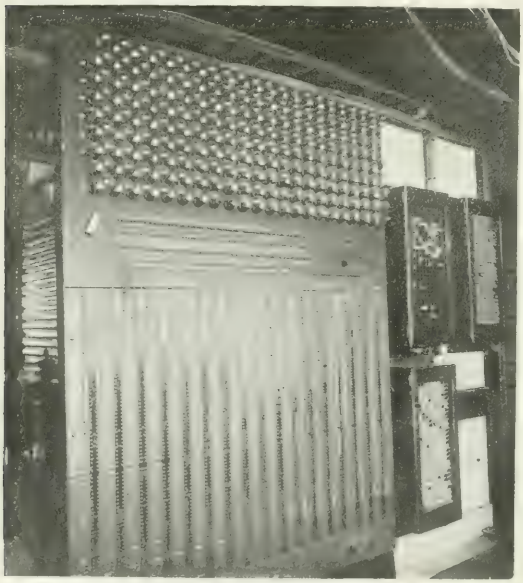


FIG. 4.—FUSE PANELS; ALARM INDICATORS AT RIGHT.

no generator to turn for calling and "ringing off," and the operator has no indicators to restore, and does not have to supervise each connection to make sure that subscribers have not finished their conversation and forgotten to ring off.

Aside from the board, there are many features of interest in the exchange. In the new wing of the Cortlandt Street building are placed the storage battery, the distributing frames, the relay racks, the power plant, the wire chief's desk and other auxiliary apparatus, Figs. 4 to 8. All this machinery occupies three floors, each 44 feet by 22, but it is grouped at very close quarters, not an inch of floor being wasted. Seven

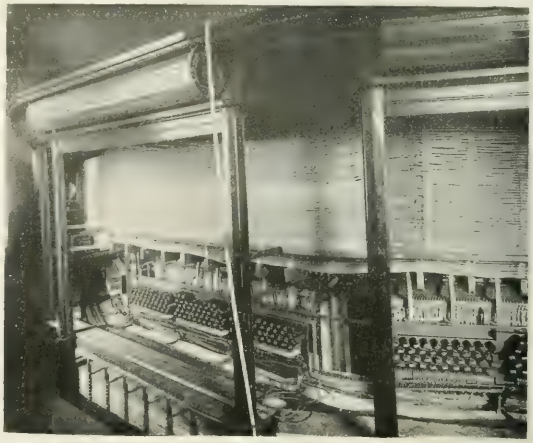


FIG. 5.—BACK OF SWITCHBOARD.

Western Electric motor generators, aggregating nearly 50 horse-power in capacity, are used for furnishing current for charging the "Chloride" storage battery and ringing and testing current. Owing to the constant changes among the users of the service a flexible link between the subscriber's lines and the switchboard wires is absolutely necessary. This is provided by the usual distributing frame or rack. The underground wires are all brought in lead cable to fixed terminals on one side of this frame, and the switchboard wires to fixed terminals on the other. This distributing board has a capacity of 20,000 lines. An intermediate distributing frame on the same general principles permits of grouping the subscribers' lines in the switchboard so as approximately to equalize the work at the different positions. The

FIG. 6.—END OF INTERMEDIATE DISTRIBUTING FRAME.

use of the service varies widely among different subscribers, and it is often necessary to rearrange the groups of answering jacks to prevent certain positions from being overloaded.

"Cutting in" a new exchange is an interesting but not sensational

performance, although in physiology it would be equivalent to connecting up a man's whole nervous system with a new brain. There were between 8000 and 9000 lines, and 9300 subscribers' stations involved in this transfer. Up to the time the service was taken up by the new switchboard, the lines had branches connected to both switchboards. The circuit of each line to the new switchboard was kept open, however, by the insertion of an insulating block in certain spring contacts on the distributing frame. The transfer was effected by taking out these insulating blocks, thus allowing the circuits to the

FIG. 7.—CABLE TURNING SECTION.

new switchboard to become complete, and then cutting off the branch from each line running to the old switchboard. The actual work of effecting the transfer occupied about six hours. A few lines of subscribers who use the service largely at night, such as newspapers, were cut into the new switchboard in advance of the general transfer.

The new switchboard contains over 470,000 spring-jacks or switches, and nearly 14,000 incandescent lamp signals. Each spring-jack and each lamp and its controlling relay is connected to the circuits by several wires and all connections are soldered for greater security. The number of soldered connections in the exchange rune well up into the millions. Each operator is provided with her individual telephone set consisting of breast plate transmitter and head receiver. The total

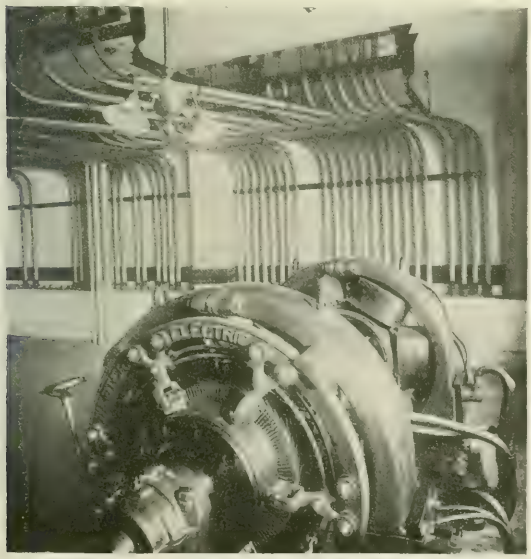


FIG. 8.—PART OF POWER PLANT AND CABLE TERMINALS

number of operators' positions at the switchboard is 126. The compactness of the new board is indeed striking, the multiple jacks in the board being reduced, it would seem, to the practical limit of minuteness. One interesting feature in the board is the frequency of white lines of varying lengths under the multiple jacks. These signify that the jacks so underlined connect with wires that all terminate at the same point, and the operator, finding the first line "busy," tries the second, and so on. At the subscribers' premises these lines terminate in the private branch exchanges, which are now becoming so numerous in large and active business establishments.

The usual care for the staff is shown in the new exchange.. The

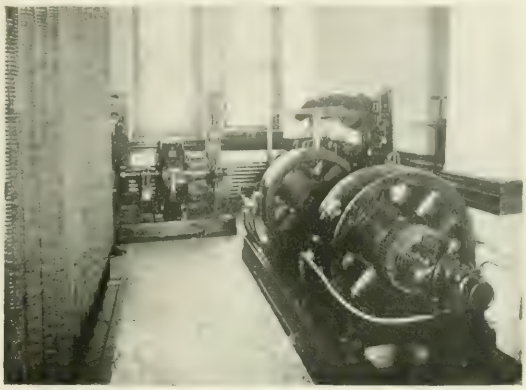


FIG. 9.—PART OF GENERATING PLANT.

operators' quarters occupy the entire ninth floor of the Dey Street building and comprise a spacious locker room equipped with sanitary wire-netting lockers, a large dining room, where tea, coffee, etc., are provided by the company, a sitting room provided with newspapers and magazines, a sick-bay, lavatory, etc., the whole in charge of an experienced matron.

On Saturday night last the New York Telephone Company provided a collation and was represented by many members of its staff, including Messrs. Bethell, Carty, Thurber, Webb and Cox, and Brooklyn was represented by Messrs. Sargent and Reilly, of the New York & New Jersey Telephone Company. The switchboard, etc., was furnished by the Western Electric Company, who were represented by Messrs. Thayer, of New York, and Patterson, of Chicago. All visitors invited were escorted by experts of the company, who explained with great care all the technical points of interest. One notable feature is the exquisite care and thoroughness with which the wiring has been done. The treatment of the cables in the cabinet where the lines from the subscribers' sections and those of the "incoming trunks" come together, over the doorway leading to the distributing frames and power plant in the new wing (Fig. 7) is a thing to be seen to be appreciated. We have never seen a more symmetric and successful piece of work of this kind.

Telephone Competition in New York.

Justice Clarke, in the New York Supreme Court last week, reserved decision upon an application made for the Atlantic Telephone Company for a writ of peremptory mandamus to compel Henry S Kearny, as Commissioner of Public Buildings, Lighting and Supplies, to permit the company to use the subways of the Empire City Electrical Subway Company (Limited) wherever they exist or wherever they may be built in the future for the purpose of stringing wires. The company also wants permission to erect poles and string wires wherever the subway does not exist. The Atlantic Telephone Company is said to be owned by Senator William A. Clark and Col. Robert M. Thompson, of the Orford Copper Company. The officers of the company assert that they already have 65,000 subscribers enrolled who will take their service for at least five years. The company propose to spend $1,500,000 if they get the permits they are after. They will have eight exchanges in the boroughs of Manhattan and the Bronx, and will make an annual rate of $40 a year to subscribers. Public service rates will be fixed at five cents per call and proportionately low rates will be made on long-distance lines. Objection is raised that the present subways could not take care of any such number of lines and that the company is a "mushroom."

Important Power Station Work at Kansas City.

SINCE the acquirement of the Kansas City Electric Light Company, by stockholders interested also in the Metropolitan Street Railway, of Kansas City, a remarkable development of electric lighting business in that city has taken place. It is seldom that an electric lighting company can record such a growth of business as has been experienced there, and the expedients that have been resorted to in order to take care of this rapid increase of business form an interesting chapter in engineering work. The consulting engineers for the Kansas City Electric Light Company and the Metropolitan Street Railway Company are Pierce, Richardson & Neiler, of Chicago. Mr. Richardson has resided in Kansas City for some time past, and is the general manager of the Kansas City Electric Light Company. The electrical work in the new power stations which are being planned is being looked after especially by Mr. Pierce, while in the steam engineering department Mr. Neiler has had the most active part in the design. Charles Grover is the electrician of the Metropolitan Street Railway.

The Kansas City Electric Light Company is now building a large alternating-current plant from which distribution will be made through sub-stations. This is on the Kaw River almost opposite the present direct-current plant of the Metropolitan Street Railway Company. The Metropolitan Street Railway Company is also to erect a large polyphase generating plant, the machinery for which has been contracted for. The site, however, has not been selected. It is expected that these two polyphase generating plants will exchange current as the necessity arises, and they are, therefore, both being designd for 25-cycle, 6600-volt, three-phase machines.

The adoption of the low frequency for electric lighting service is in this case no serious drawback because the greater part of the output is through a direct-current Edison three-wire network, which must be fed by rotary converters or motor generators, whatever the frequency. The machinery contracted for by the Metropolitan Street Railway includes three 3500-kw, 25-cycle, three-phase, 6600-volt generators, of General Electric manufacture. The station will be designed for three more of these units. Each of these generators will be direct connected to cross-compound condensing vertical Allis-Chalmers engines. These engines are somewhat similar to those in the Metropolitan Street Railway's Ninety-sixth Street power house, in New York, but the area of the low-pressure cylinders is considerably larger. These engines will have 46-inch high-pressure and 94-inch low-pressure cylinders, with 60-inch stroke, and will run 75 r. p. m. At 175 lbs. steam pressure they will develop at an economical cut-off, 5200 horse-power, or 4600 horse-power at 150 lbs. steam pressure. The plant will probably be started at the latter pressure.

The Metropolitan Street Railway Company will also use in its new plant 18 Babcock & Wilcox water tube boilers of 500 horse-power each, with Green Engineering Company's traveling link grates. The Kansas City Electric Light Company will put in at first three 1500-kw, three-phase, 25-cycle, 6600-volt General Electric generators direct connected to Allis-Chalmers vertical cross-compound condensing engines running 75 r. p. m. These engines have 32-inch high-pressure and 72-inch low-pressure cylinders with 48-inch stroke and are rated at 2250 horse-power, with 175 lbs. of steam. The station is designed to contain five units of this size, or two more than are first being installed. This station will have the distinction of having the largest surface condensers ever put in for central station service. Each of these two condensers will have 8000 square feet of heating surface. The condenser tubes are to be 1½ inch in diameter.

The use of surface condensers in this plant rather than jet condensers was considered advisable because of the very poor quality of the Kaw River water, which has a great amount of solid matter, not only in solution but in suspension. The proximity of the Kansas City Stock Yards naturally does not improve the quality of the water at this point as a great deal of the refuse matter from the Stock Yards is discharged into the river near by. The Metropolitan Street Railway power house, which is in operation on the other side of the river, one day was obliged to shut down its condensers through a stoppage in the water supply pipe. Upon investigation it was found that a good-sized hog had found its way into the suction. By use of separators the oil will be taken out of the exhaust water going from the condensers so that it can be used again for feed water, and it is expected that very little city water will be purchased for boiler feeding purpose. The importance of surface condensers for a location such as this, where the water used in condensing is not fit for boiler feed, can be easily appreciated.

Although electric auxiliaries will not be used to any extent since the consulting engineers do not believe that, when the interest on the total investment is considered, electrically-driven auxiliaries are any saving over steam-driven auxiliaries, the two centrifugal pumps which are to raise the river water supplying the water condensers will be driven by synchronous motors. These are well adapted to the purpose, since the speed and load will be constant, and they will not need to be started or stopped frequently. The boiler plant for this electric light power house will contain eight 500-hp Babcock & Wilcox water tube boilers with Green Engineering Company's traveling link grates.

SWITCHBOARD ARRANGEMENT.

The switchboard for this station has been a matter of very careful study on the part of Mr. Pierce, who has had to consider not only the latest advance in the art, but also the special conditions at Kansas City. The result has been a type of switchboard, which differs from anything previously designed, and which marks the latest advance in switchboard construction. In designing this switchboard the General Electric Company's electrically-operated oil switch, such as is being put in the Manhattan elevated power house at New York, is to be used. Instead, however, of having a dummy bench board in front of the switchboard with a diagram of the circuits and the switch operating handles incorporated in the diagram as in the Manhattan power house, and having the instruments on a separate set of panels, Mr. Pierce has designed what he calls a "picture panel"; that is, the dummy bus-bars showing the connections and the handles of the switches are placed directly on the panel which bears the measuring instruments. There are, of course, no high-voltage wires around the operating switchboard, as the switches thrown by the attendant operate only the 125-volt direct-current circuit which in turn operates the main oil switches in the 6600-volt circuit. By having the switch handles which indicate by their position whether the circuit is open or closed, directly on the panel bearing the instruments relating to that circuit, there is less chance for error than if the switches are placed on an operating board, and the measuring instruments are placed on a panel, at some distance away.

The design of the dummy circuit indicating benchboard which will be used in the Manhattan elevated power house, New York, marked a distinct advance in the way of clearness of circuit and a decrease in the liability of errors in throwing switches. The switchboard of the Kansas City Electric Light Company may be considered to mark still another important step toward the clearness of circuit connections and the decrease of mistakes in throwing switches. Any one who has had any experience with the switchboards of large stations cannot fail to appreciate the importance of having all connections indicated clearly on the face of the board. Even if the switchboard attendant is familiar with the circuits the danger of throwing the wrong switch is decreased very much by the use of the picture panel. The switchboard will have on the front of the panels a dummy bus-bar running its entire length, and also whatever auxiliary busses are needed. The movement of the switch handles will show directly in diagram on the face of the board whether a machine or feeder is connected to a buss-bar or whether the circuit is open.

The necessity for clearness in the switchboard operation is even greater in a station like that of the Kansas City Electric Light Company, where there are a number of different kinds of service to be supplied, than in a plain railway station. For example, the board at Kansas City is designed to supply sub-stations, feeding a three-wire system, sub-stations driving arc machines and frequency changers, and also to give or take current from the Metropolitan Street Railway power house which is to be constructed. All these require special consideration in the design of the switchboard, and necessarily complicate matters enough, so that, as said before, it is very important that an attendant see plainly on the face of the board, what connections are made.

The oil switches will be placed along one side of the power house, near the generators, and the amount of high-tension station wiring required has been reduced to a minimum. The idea in the design has been to work along the lines of modern methods in steam piping and cut down the length and complication of wiring as much as possible. The use of the auxiliary low-voltage circuits for operating the oil switches make such a directness of circuits possible, since only the low-voltage operating and instrument circuits need to be led to the switchboard.

Mention has been made of the great increase in business which the electric light company has had to meet since the present manage-

ment took charge. The latter part of December, 1899, the maximum load on the Edison three-wire network was 3500 amperes. During the same period in 1900 the load had increased to 6500 amperes, notwithstanding the fact that the theaters had been thrown onto the alternating-current mains. In September, 1901, the maximum load was 8200 amperes on the three-wire network, and there is little doubt but that the load will be 10,000 amperes by the latter part of December. In other words, the load will have been multiplied by three in two years on the Edison system alone, to say nothing of the alternating current and arc distributions. To take care of an increase of this kind has taxed the ingenuity of the engineering staff, and the history of the expedients which have been resorted to in order to carry the load is most interesting. At the start it may be stated that the company had practically no reserve capacity to take care of any increase. How to provide for the load which came on so rapidly in the fall of 1900 was one of the most serious problems. The Helios-Upton storage battery installation, which has been previously described in these columns, was hurriedly installed to help on the peak in the fall of 1900. This, however, was not sufficient for carrying the total load, and a street railway rotary converter was run off the bus-bars at the Armour packing plant, and the output of this was used after proper transformation for the Edison network. In addition to this, the output of the old Edison generators in the downtown station was increased by the liberal use of an air blast.

For the coming winter one of the company's old stations, known as the Santa Fe station, which has been dismantled for some time, will have two 700-hp Corliss engines and two 500-kw three-phase, 25-cycle, 6600-volt alternators belted thereto. Two of the 500-hp boilers already contracted for will be put in this plant temporarily. These two alternators will supply step-down transformers and rotary converters in the two sub-stations, which supply the Edison network, thus helping out the old Edison steam plant. These alternators will ultimately, after the new station is started, be converted into motor-generators or frequency changers. The 25-cycle armature, which will run as a generator the coming winter, will be run as a motor, and in place of the pulley a 60-cycle armature and fields will be placed. These machines will supply the 60-cycle alternating service in outlying districts. In the Edison district there will be two sub-stations. No. 1 will be at the present steam plant, and will have one pair of 200-kw rotary converters and storage batteries to a capacity of 200 kilowatts on each side of the three-wire system. At sub-station No. 2 four 200-kw rotary converters will be put in and possibly some of the direct-current arc machines will be put here and driven electrically by synchronous motors.

Syntonic Wireless Telegraphy.

By A. Frederick Collins.

THE history of wireless telegraphy since Hertz is fundamentally the evolution of electric wave syntonization. From the evidence at hand it seems clear that the first experimentalist to actually demonstrate the value of telegraphing without wires also recognized that commercially directing a message was quite as important as the bridging of distance.

By directing a message it is not intended to convey the thought that such messages transformed into electric waves, should be literally directed, though this was, curiously enough, the genesis of syntonic wireless telegraphy. That to the beautiful deductions of James Clerk-Maxwell relating to his electro-magnetic theory of light and to the experimental proof so ably given by Heinrich Hertz were the causes, indirectly, of the first error in directing the new space telegrams sounds improbable, yet such, unfortunately, was the case. Maxwell, by a delicate synthesis of Lagrange's co-ordinate system, provided the mathematical evidence showing that the propagation of luminous undulations and the phenomena of electric and magnetic manifestations in vacua may be reduced to stresses and motions of a material medium, ether, and that their only difference is in the length of the waves. On the suggestion of Helmholtz, Hertz took up Maxwell's theory, and, after the manner of the illustrious Faraday, succeeded in producing the desired electric waves, these being, approximately, a meter in length.

By means of his oscillator and resonator, Fig. 1, *a* and *b*, he was enabled, not only to produce them but to analyze their properties and determined that the waves were susceptible to all the tests of wave motion, were capable of being reflected and refracted, and as a final test of wave propagation, that they exhibited the phenomenon of interference. Having all the characteristic of the undulatory motion of light, Hertz concluded with Maxwell, that electric and magnetic waves are manifestations identical with light waves and resultant from the same causes.

Almost a decade before Hertz's classical researches, Professor D. E. Hughes in his experiments with the microphone, discovered the effects of a disruptive discharge on an imperfect electrical contact, but it was not until M. Edouard Branly rediscovered the lost art in 1890 that the coherer invented by him replaced the resonator of Hertz. It was exceedingly sensitive to the waves emitted by a dis-

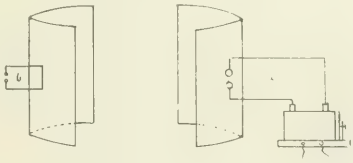


FIG. 1.—HERTZ'S OSCILLATOR AND RESONATOR.

ruptive discharge, and one of its earliest practical applications was to meteorological observations by Popoff and others. Sig. Guglilemo Marconi was working silently with it a few years later as a detector for his wireless telegraph. In this new sphere he makes the first reference appertaining to directing a message or signal projected by the electric waves of a high-tension apparatus, and here is where the relation of light and electricity assisted an error to creep in and rob the new system of a carefully directed message.

In the first provisional specification of Marconi in England, dated 1896, relating to the transmission of wireless electric signals, he states that "when transmitting through air and it is desired the signal should be sent in one direction, I place the oscillation-producer at the transmitting station in the focus or focal line of a reflector directed toward the receiving station, and I place the circuit-closer (coherer) at the receiving station in a similar reflector directed toward the transmitting station." (Fig. 2.)

MARCONI REFLECTOR SYSTEM.

Marconi's statements were evidently based on an assumption which at that time prevailed, namely, that the emitted waves utilized in wireless transmission of energy as manifested by the coherer action are identical with those waves exhibited by a Riess micrometer spark-gap and therefore are the same as light. In the Hertzian experiment radiators of zinc 40 cm. square were employed on either side of the spark-gap and placed in a horizontal position, whilst in the Marconi scheme the plates are placed vertically. By adjusting the resonator and the oscillator with its radiating plates in the focal line of two large mirrors of planished metal, Hertz found that the spark was

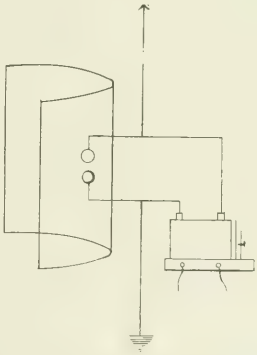


FIG. 2.—MARCONI REFLECTOR SCHEME.

accentuated. The same result was likewise obtained when no radiators were employed. In the Marconi apparatus whilst the spark-gap is placed in the focal line of the reflectors, the vertical wire leads from one oscillator to a masthead and there radiates into free space and from the opposite to the ground and there discharges into the earth. From these glaring deficiencies of the reflector as a means of directing wireless messages it will be seen that there is no similarity

in the combinations of Hertz and Marconi, and that the Hertzian waves and electric radiation used in the wireless telegraph are quite as different as a ray of light when compared to a primary electric current. That the waves available for wireless telegraphy are not radiated directly from the spark is apparent, and it is likewise plain that the effects of the waves are strongest at the terminal plates. The idea of the double reflectors was a curious error and we no longer hear of their use.

LODGE TUNED WIRELESS SYSTEM.

Early in the history of the new space telegraphy Dr. Oliver J. Lodge, of England, made some experimental tests, but purely in the interest of science. The action of the newly discovered waves he applied to telegraphy on a small scale, but the tests were not followed to a conclusion. It was not until Marconi had demonstrated the

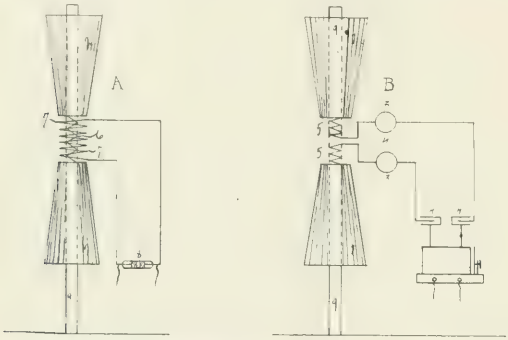


FIG. 3. LODGE TUNED WIRELESS SYSTEM. A, RECEIVER; B, TRANSMITTER

practicability of telegraphing without wires that Lodge again took up the subject, and recognizing the prime importance of an absolutely syntonic system for commercial purposes, he developed a tuned apparatus which he patented in Great Britain May 10, 1897, and in the United States Aug. 16, 1898. He states that "the object of my invention is to enable an operator, by what is now known as 'Hertzian-wave telegraphy,' to transmit messages across space to any one or more of a number of different individuals in various localities, each of whom is provided with a suitably arranged receiver, and to effect the ancillary improvements, the nature of which are hereinafter more particularly described and claimed."

The ancillary improvements are a method of "utilizing certain processes and apparatus for the purpose of producing and detecting a sufficiently prolonged series of rapid electric oscillations of a particular frequency or of some multiple or sub-multiple of that frequency." In determining the value of Lodge's method of tuning the analogue of primary resonance in sound waves may be useful in elucidating his theory of electrical resonance and his application of it to the new wireless waves. If two tuning forks identical in pitch, size and form are arranged at a distance apart so as to effect condensation and rarefaction of the waves in absolute conjunction, the sound will be twice as loud as a single tuning fork is capable of producing. In electrical resonance if two condensers or capacity areas have the same period of oscillation or frequency, and if the first one is discharged, similar oscillations will be set up and augmented by the second condenser. Should the charged capacity areas be connected by a conductor of small resistance, there is a sudden surging from the charged to the negative surface in order again to restore the electrostatic equilibrium. Owing to the large self-induction of the coiled wire connecting the condensers, the potential is not instantly nutralized but the surging continues and the recharging and discharging alternately takes place between the two surfaces, each subsequent oscillation diminishing until after several repetitions when the discharge will have found its potential level.

Lodge's capacity areas are virtually condensers, and if the capacity of a condenser in farads is C, the ohmic resistance of the conductor R and the self-induction in heneries L, oscillations will occur $\sqrt{\frac{1}{CL} - \frac{R^2}{4L^2}}$. The frequency of the oscillations is given by the equation $\frac{1}{2\pi}\sqrt{\frac{1}{CL} - \frac{R^2}{4L^2}}$. Thus the oscillations of a quart Leyden jar continue approximately only $\frac{1}{500,000}$ part of a second. But by using a large condensing surface, Lodge obtained oscillations slowed down to 400 to 500 per second. This was determined by viewing the spark through a telescope focussed on a revolving mirror. In his invention Lodge uses as a radiator and resonator a pair of capacity areas or condensers of definite and uniform capacity. These he connects with what he terms a syntonizing self-inductance coil; that is, a single coil of wire or metallic ribbon as above described and shown in Fig. 3 at 5, 5, thus obtaining the necessary inductance with a given amount of current, and the oscillations being prolonged in the capacity areas by the electric surgings, a definite frequency is obtained, theoretically rendering tuning possible.

Lodge was the first to seriously take up the subject of syntonization, employing scientific methods. In Fig. 3, the capacity areas 1, 1, and 2, 2, are triangular sheets of metal which are connected by means of switches to the transmitting and receiving apparatus as desired. Those at Station B are shown in connection with the oscillators 3, 3, forming the spark-gap of a Ruhmkorff coil. Between each capacity area and its oscillator is inserted the self-inductance coil of wire 5, 5, for prolonging the oscillations as before described, and thereby establishing a definite frequency rendering syntony possible, so Lodge states, since exactitude of response depends largely on the emission of a number of successive waves the feeble impulse received being gradually strengthened until it produces a perceptible effect on the principle of sympathetic resonance. The capacity areas are exactly alike at the two communicating stations so as to have an identical frequency. This frequency can be altered by enlarging or reducing the capacity of the Leyden jars in the emitter circuit 4, 4, Fig. 3, and also by varying the inductance coils or both. At the receiving station, A, the capacity areas are connected by a primary inductance coil, 6, and the coherer, 8, in series with the secondary coil, 7, 7. The local battery circuits are not shown, but are connected in the ordinary way. It will be observed that the supports 9, 9, *A* and *B*, insulate the capacity areas from the earth and that the system is not grounded at any point. This is undoubtedly the reason for the limited distance over which signals can be obtained, and the construction of the apparatus leads us to suspect that the theory which formed a working basis for this system is that of the Hertzian waves.

At the Royal Society Conversazione held May 11, 1898, in London, a complete set of Lodge's instruments were shown in action operating in a satisfactory way, just as two Leyden jars may be tuned to respond to a similar frequency, but where the earth is to be taken into consideration the hypothesis will not hold good. From recent patent reports it would appear that Dr. Lodge is still experimenting, and with his wide knowledge of electric waves it will not be surprising to hear of his new system being launched forth at any time.

GUARINI REPEATING SYSTEM WITH SLOTTED SHEATHS.

That the electric waves are intercepted, absorbed and conducted by the metals is an irrefutable fact, and to this action we owe some

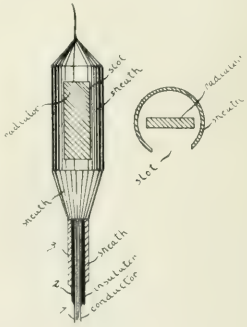


FIG. 4.—GUARINI REPEATING WIRELESS SYSTEM. SLOTTED SHEATH.

clever features in the new space telegraphy. Marconi first applied the metallic casings enclosing the coherer and receiving apparatus this protecting it from the untoward effects that the transmitter in close proximity would produce. The metal box or casing is grounded, thus conducting all extraneous waves to the earth.

M. Emile Guarini, of Brussels, has also made advantageous use of this principle in his system of relaying wireless messages. The aerial wires at Malines were insulated with an outer metallic sheath which diverges at the top into a cylinder of large diameter in which

slots are cut oppositely disposed. With an induction coil giving a 26 cm spark, Guarini was unable to transmit messages between Antwerp and Brussels direct, but with a relay at Malines he could easily send and receive the signals. To send and receive at Malines simultaneously by the wireless method is not a problem unattended by difficulties, for the waves incoming and those outgoing will conflict and the message thus be lost unless special means are adopted to remedy this defect. This Guarini did by first insulating the vertical wires and then encasing them in metallic sheaths (Fig. 4), which were grounded, and the extraneous waves made to pass into the earth whilst the desired waves were received through the slots and likewise transmitted through the opposite slot. There is, no doubt, a tremendous loss of initial e. m. f., yet this loss of energy is not equal to that caused by increasing the distance to twice the length, as Guarini has shown. The combination he employed and the operation is as follows:

The relaying device consists of a coherer and its incident paraphernalia coupled with an induction coil and oscillators. From one of the conductor plugs of the coherer a strip of copper, 1, is enclosed by an insulating medium, 2, and this in turn by the sheath, 3, which leads to the mast. The copper sheath with the slot and interior strip is shown in Fig. 4. From the opposite conductor plug a wire leads to the copper plate buried in the earth. This is the extraneous or electric wave system, the connection of the local circuits being similar to those of other forms utilizing the coherer and spark-gap. The action of the wave system when the spark passes across the gap at Brussels is to project the energized waves toward Malines, the slot in the sheathing facing in that direction. At Malines the slot facing Brussels receives them and they are conducted to the apparatus proper where they are re-energized and via the vertical wire and its attending slot, transmission is again effected toward Antwerp.

Guarini advances the peculiar theory that the radiators and resonators must be within sight of each other or there can be no successful transmission. This seems to follow the Hertzian wave thought, and the belief that these electric waves are propagated in straight lines. The Guarini system of excluding all the undesirable waves bears no relation to true syntonization, but nevertheless accomplishes it in a crude and limited way.

TOMASSI-JEGON DIFFERENTIAL WIRE SYSTEM.

Another measure applied to determine individual wireless messages where three stations are employed is that of the Tomassi-Jegon system. With the exception of the slotted-sheath scheme of Guarini this is the simplest in theory and the least effective in practice, although it has accomplished all that has been claimed for it. In the strict sense of the word it is not a tuned or syntonized system, but like the one before described, it separates the messages in a limited way. In its simplest and most easily understood form a Jegon equipment representing a three-station system may be reduced to a single transmitter and two receivers at a distance apart, as diagramatically represented at Fig. 5, *A, B, C*. At the transmitting station, *A*, two vertical wires are suspended from a mast. These radiating wires are of different lengths, one being one-fourth longer than the other. At the receiving station, *B*, 5 km. distant, the vertical receiving antenna is equal in length to the shorter one at *A*, whilst at station *C* the receiving wire is the equal of the longest radiating wire at *A*. It will be seen that four wires are employed, two at the transmitting station and one each at the receiving stations. Now, by adjusting the individual coherers at *B* and *C*, and the galvanometers employed as the translators are not actuated except when the shortest wire at *A* is sending to *B*, or the longest one at *A* to *C*, except, as Jegon points out, where a definite value of the distance produces absolute neutralization of both receivers.

SLABY-D'ARCO MULTIPLE WIRELESS SYSTEM.

We now leave the practicable for the more or less practical results that have been obtained in tuned or multiple wireless telegraphy. As is very often the case in discovery and invention, those who have been largely responsible for the new art of syntonization have worked out independently, and it may be said often simultaneously, factors that are closely analogous. The first patent granted, excepting the one Lodge described, relating to a tuned system is that devised by Mr. W. G. Brown, of England, and is dated July 13, 1899. In the provisional specification of his English patent he claims the novelty of two vertical wires or conductors of unequal length joined to each side of the spark-gap. Now, in this dual wire system which both Brown and Jegon have employed to some little advantage, although each in a different way, lies the keynote of the work of Slaby and Marconi.

Since Dr. A. Slaby, of Charlottenburg, Germany, was the first to make public the methods employed by him and his collaborator, Count D'Arco, in their tuned or multiple wireless telegraphy, as exhibited before the German Emperor, when two messages were received simultaneously from different stations, their system will be described first. The result of the Slaby-D'Arco experiments has led them to a number of original conclusions, one of them bearing on syntonization being to refute the law giving the distance over which the waves would be transmitted as proportional to the square of the length of the sending and receiving wires; though Dr. Slaby does assume that the lengh of the wire terminating in the air is of great importance since it should be one-quarter of the received wave length or an uneven multiple of the wave length. To demonstrate this Slaby gives an interesting mechanical analogue with a vibrating steel wire. In Fig. 6, *A*, it will be seen that in a flexible steel bar where the wave is produced by mechanical vibration or by electric oscillation the greatest amplitude is at *a*. In Fig. 6, *B* illustrates the vibration of a steel wire bent to form a right angle having legs of equal length, and if the angles be firmly clamped to a fixed object and if one leg be vibrated, stationary waves will be set up in the steel wire, *b*, as shown, and the vibrations transmitted to the leg *c*, which will respond in syntony to *a; d, d*, the fixed points are the nodes and the wave crest and the wave valleys are represented by the dotted lines.

Slaby assumes that if the legs *a* and *c* are the vertical wires of the wireless telegraph sending and receiving stations, respectively, the connecting wire *b* is replaced by the ether. It is therefore evident that the coherer should be attached to the highest point of the receiving wire, where the amplitude of vibration is the greatest, and the oscillations the strongest when corresponding to the wave frequency. In the original or non-syntonized wireless telegraph one conductor plug of the coherer is connected directly to the terminal of the aerial wire nearest the earth and the second with the earth direct (Fig. 7). In the Slaby-D'Arco system this arrangement has been superceded by grounding the receiving wire or antenna direct, which forms a node for the waves. At the nodal point or earth end of the wire a second or auxiliary wire equal in length to the receiving wire is attached, and a wave crest will be formed having the same amplitude as that of the end of the vertical wire in the air (Fig.

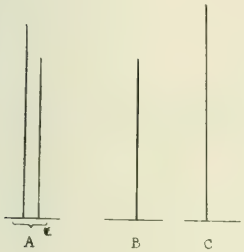


FIG. 5.—TOMASSI JEGON DIFFERENTIAL WIRE SYSTEM.

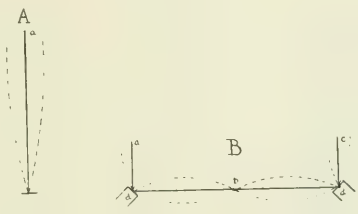


FIG. 6.—MECHANICAL ANALOGUE OF ELECTRIC WAVES.

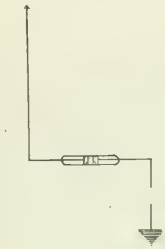


FIG. 7.—ORIGINAL WIRELESS TELEGRAPH.

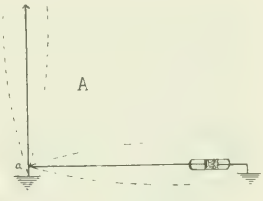


FIG. 8.—AMPLITUDE OF ELECTRIC WAVES.

8). To economize space, Slaby forms a coil of the duplicate wire, as shown at *B*, Fig. 9. It is this portion of his system that he terms his multiplicator, and by this means he points out that lightning rods may be made to serve the purposes of the antenna instead of a specially arranged one.

According to the principle here involved the waves received by the vertical antenna that are not of the predetermined length will pass into the ground, since the nodal point of the predetermined length of wave is at a point just above the earth, *a, a* (Figs. 8 and 9). Slaby's theory that the earth acts merely as a capacity and not as a conductor between the two stations is based on the resultant action of his apparatus constructed according to this view. To receive signals from any desired station separate coils of wires representing different wave lengths may be switched in, forming a connection with a single aerial wire.

Slaby's new transmitter is not subject to the defects of his previous one. It is shown in Fig. 9, and his former one in Fig. 10. It will be seen by referring to *B* (Fig. 9) that it is similar to the receiver in so far as the vertical wire is concerned which is grounded. This antenna emits waves of great amplitude, but must be tuned to the wave length produced by the wave producing apparatus and its system, which includes the inductance 4 and the capacity 5. The induction coil, 1, serves to regulate the fundamental harmonics of the sender, which produces waves of any desired length; 2 is the exciting spark-gap, 3, 3 the horizontal conductor with the tuned self-inductance coil and the capacity. In order to further regulate the vibrations of the exciter the coil 1 is brought into action. Slaby lays great stress on the necessity of tuning the exciter, 3, 7, with the sending or emitting system, 6, 8. He points out that by increasing the capacity of the exciter it is not possible to obtain any stronger effects in radiation. The capacity, 5, can be replaced by a conductor and coil of wire, but the method shown is more compact. The system shown permits of tuning to be effected between the transmitter and receiver, which is accurate to within 3 per cent, and this is very exact. Again, the air wire, 6, is connected directly with the earth, and as the tension is low there can be no fatal results from physical contact with it, while its emitting efficiency is great. To obtain a radiation equal to other systems, Slaby claims that only half the amount of primary current is needed, and this is of considerable importance in places where the storage or a primary battery must be employed.

In Fig. 10 is shown the original form of the Slaby-D'Arco transmitter, wherein a loop or circuit is formed by the dual vertical wires connected at the top by the coil and at the base by the earth. Lodge has demonstrated that in such a closed system the oscillations are very persistant, but the vertical wire acts feebly in emitting the waves. The new Slaby transmitter eliminates the latter feature without greatly damping down the oscillations.

MARCONI SYNTONIC WIRELESS SYSTEM.

In his system of syntonic wireless telegraphy Marconi has also obviated the untoward effects of the closed circuit system, but in quite a different manner from that of Slaby. In theory and in practice the two systems are widely divergent. Marconi has worked upon similar lines to those laid down by Lodge in the previously described apparatus, except that he has found the earth wire absolutely indispensable. He has striven to produce an emitter that will amplify the oscillations, and though each oscillation may be in itself feeble, and the syntonized receiver may not respond to the first few oscillations it will be receptive to a succession of the impulses, so that after several of the oscillations have acted on the coherer its resistance breaks down and the receiver is made operative.

To produce these persistent oscillations Marconi employs, instead of the usual form of high vertical antenna, an inner copper cylinder, *A* (Fig. 11) connected with the earth and one terminal of the spark-gap 2. The outer cylinder, 3, is connected to the opposite terminal of the spark-gap, and though the cylinders represent so great a capacity, the oscillations are made very persistent, for the inner and outer concentric cylinders with its dielectric of air acts as a Leyden jar, and the difference of potential is equalized by the impulse swinging to and fro many times. The Marconi receiver is shown at *B* (Fig. 11). To tune or syntonize the receiver to the transmitter it is necessary that the coefficients of capacity and inductance in the circuits be identical. Marconi says if we start with a very small capacity which we gradually increase, a value of the capacity will be reached which will cause signals to be recorded on the receiver. Supposing the receiving station to be within the sphere of action of the transmitter, then the signals will be the strongest when the capacity of the condenser is of a certain value. If we still increase the capacity, the signals will gradually die away, while if we go on increasing the capacity and at the same time add inductance to the aerial wire to keep it in tune with the condenser circuit, we are still radiating waves, but these do not affect the receiver. If, however, at the receiving station we add inductance and capacity to the wire, 1, and also to the terminals, we find ourselves able to receive messages from the transmitter, although we are utilizing waves of a different frequency.

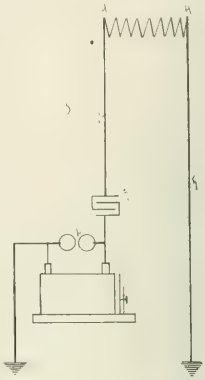


FIG. 10. — SLABY D'ARCO MULTIPLE WIRELESS SYSTEM TRANSMITTER.

This practically represents the state of the art at the present time. There are other investigators who have done excellent work, but the principles here described are involved to a greater or lesser extent. The apparent success of the selective systems should not be taken as a standard for absolute syntonization, for contrary to the opinion of a contemporary worker in this special field, the writer does not believe that the laws governing wireless transmission of energy as characterized by the disruptive discharge are fully known. The results thus far at least hardly justify our claiming a full and complete knowledge of them. That the production of given wave lengths may be accurately determined and the effects of inductance and capacity on the oscillatory waves are commonly known, is also true; but the mode of propagation of these waves after their emission from the radiators through space and the role the earth plays, what absolute knowledge have we to boast of here? It is yet an open question whether the electric waves are projected in straight lines, or whether they follow the curvature of the earth. When wireless telegraphy first made its debut as a commercial commodity it was assumed that the waves obeyed the same laws that govern those of

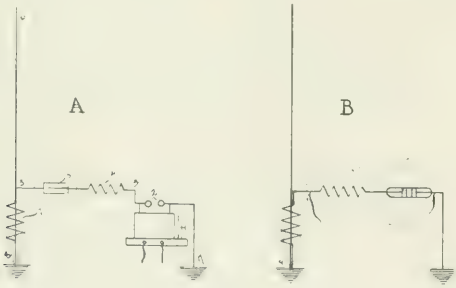


FIG. 9.—SLABY D'ARCO MULTIPLE WIRELESS SYSTEM.

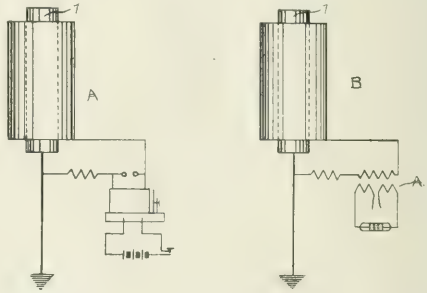


FIG. 11.—A, MARCONI SYNTONIC WIRELESS TRANSMITTER; B, MARCONI SYNTONIC WIRELESS RECEIVER.

light. In this case intervening hills and the curvature of the earth would intercept them, but this does not hold good, since messages have been transmitted 150 miles with vertical wires 190 ft. high.

In the Lodge system mention is made concerning the earth as a capacity. In the Slaby-D'Arco it is used as a means for receiving extraneous waves. In Marconi's recent paper he does not state specifically the reason for grounding the inner cylinder.

In a recent article over the name of M. Guarini a case is cited wherein the Marconi syntonic system failed in its action during some tests near Nice, when a dispatch transmitted from Biot to Calvie was intercepted at Ville Franche in its entirey and with perfect distinctness. The Belgium inventor states that he also tried the Marconi method of syntonization, but with complete disaccord, and that though the distance was more than 2½ km., exchange of signals could be maintained almost as well as with complete tuning. Sig. Marconi on the other hand, states that he installed the apparatus described by Dr. Slaby at Minton, Isle of Wight, and at Poole, using wires 35 meters high, but with the receiving wire earthed at the nodal point of the loop in accordance with the Slaby specifications, he could receive nothing, although he tried various frequencies.

This is the other, the seamy side of wireless tuning. It would appear that the laws already worked out were either incorrect or misunderstood. That any of these systems are commercially accurate is doubtful, yet the failure of one inventor to produce another's system and obtain satisfactory results is insufficient evidence that such system is without merit, for each worker may keep secret some minute but mighty factor that is safer in his own keeping than it would be if publicly labeled with the patent protection of a government.

It is not at all strange that with the meagre information regarding the details of the apparatus that men of different temperaments and especially of different countries should fail utterly to reproduce an identical system, which, when all is said, the original inventor does not himself grasp perfectly. But it is good to know that all these geniuses have done as much, and some of them more, than is usually the lot of this class of workers to do. And there is yet enough to do for syntonic wireless telegraphy is a new art looming up a gigantic factor on the horizon of the twentieth century. The work that has been done need deter no one who cares to essay the porduction of a syntonic system, but let him be forewarned that the difficulties which beset the path of those who would devise a commercial system are manifold.

But the gun has been fired, the smoke is clearing away, and a clearer and better view of what has been and is yet to be accomplished is gradually coming into the range of our mental perception.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.—VII.

By Walter Reichel,
(*Chief Engineer Siemens & Halske Company.*)

(*Concluded.*)

TESTS AND FINAL RESULTS.

THE resistances were tested first without cooling, and afterwards with cooling by an air current having a velocity of three to four meters per second. The tests were made with different intensities of currents and continued in each case until the normal temperature was arrived at, or in the case of high currents until the laminations of which the resistances were composed showed a dark red heat. The results of the tests are shown in Fig. 41, the temperatures referring to the centegrade scale. Without cooling and without giving forth any visible rays the resistances carried 300 amperes, which is more than that to which they will be submitted when working (210 amperes). At starting, however, 400 amperes will be taken by the resistances for 2½ minutes, and the test showed that without cooling the resistance would withstand this current for 4 minutes before becoming red hot. Owing, however, to the air passages in the resistances and the air that will be admitted to them, they will in practical operation be submitted to a strong cooling effect, so that the tests demonstrated their adequacy.

As to the rheostats, tests were made by cutting out energy at the rate of about 20 horse-power per step in order to observe if any injurious sparking occurred at the contacts. After a series of 150 of these operations with current at 500 amperes, 50 cycles and 40 volts, the rounded edges of the contacts were slightly burned, but this did not

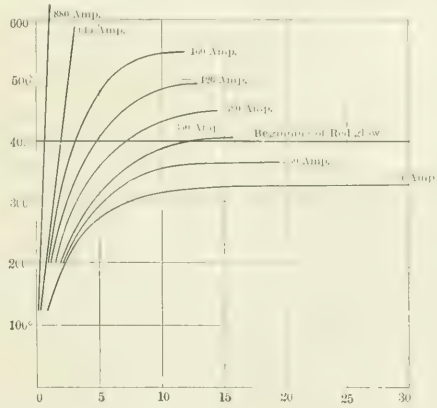


FIG. 41.—RHEOSTAT TEMPERATURE CURVES.

interfere with the working of the contact arm, and the contact surfaces remained in perfect condition.

The low-tension switches were tested by connection with transformers, the voltage being gradually increased up to 6000. Both the

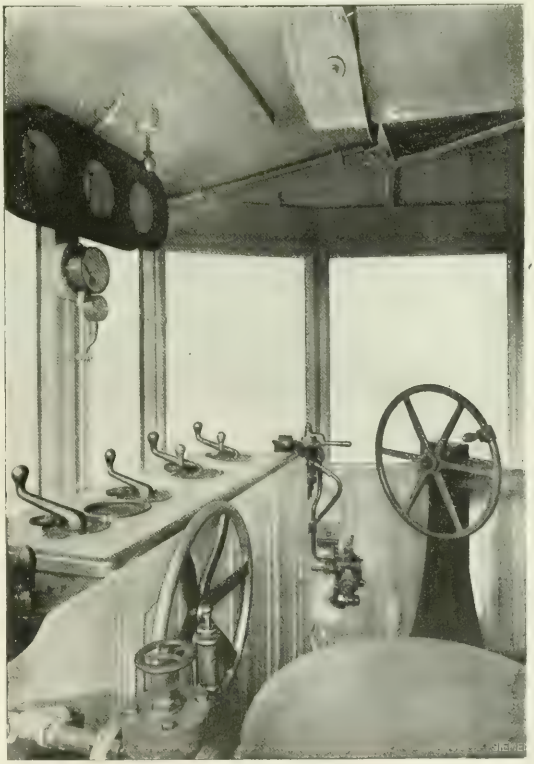


FIG. 42.—CONTROLLING APPARATUS.

high and low-tension switches were also tested with the motor at normal voltage until the fusing current value was reached. At that point the switches worked properly and the fuses blew accurately. The

switches are to be operated, as they will be normally, by compressed air. Thus not only their electrical operation was tested, but also their mechanical manipulation as well as the packing and piston of the air cylinders. In addition, the latter were tested up to a pressure of 20 atmospheres.

Both the large and small transformers were tested for insulation by being submitted to 20,000 volts for one hour.

HIGH-TENSION SAFETY DEVICES AND INSULATORS.

The rubber and other insulation was first tested by alternating current up to 30,000 volts at 60 cycles in the form of small specimen bars. Then grooved sample bars 2½ inches in diameter and 16 inches in length were tested while subjected to a spray of water, and withstood 12,000 volts to earth, and consequently 24,000 volts with respect to a pair. The tests show that with a grooved surface an insulating length to earth of 16 inches was sufficient for 1500 volts.

The trolley wire insulators were tested under a drizzling rain, and the cup insulators proved to be sufficiently safe for 20,000 volts, and the trolley supporting insulators, three of which were connected to each other in series, were subjected to 5000 volts.

In testing the high-tension switches a device was constructed involving the principles of the Siemens horn lightning arrester. It was found, however, that in a draught of air a short-circuit may arise from the arc blowing out. Another arrangement was, therefore, employed and satisfactory results were arrived at.

A bow sliding contact device installed on a truck which was hauled over the Gross-Lischterfelde road by the three-phase locomotive used on the trials over that road, which latter was supplied with its energy by the current collector under test. The contact was sparkless, and the adjusting mechanism worked well.

Special care was taken in testing the compressed air plant. The cylinders operating the switches and rheostats, as well as the rubber connecting hose, were tested as to their packing with air under pressure of 20 atmospheres, and the valves with water under 12 atmospheres. The car air valves were tested at 8 atmospheres. The tests showed that the efficiency of the air compressed apparatus was excellent.

After installing the whole electric equipment on the car, the circuits and apparatus were put under a tension of 15,000 volts.

When the installation was entirely completed on Sept. 16 the entire weight of the car completely equipped was found to be 89,000 kilograms (196,000 lbs.). This corresponds almost exactly to the calculated weight. Tests have shown that all of the hand manipulations can be very evenly performed as was designed. The arrangement enables the engineer to instantly make all manipulations without moving from a given place. The starting is very simple. The two handles to the right in Fig. 42 are not touched while the car is in motion. In starting the second lever to the left, or motor lever, is thrown in and the hand wheel turned step by step. In cutting out, the motor lever is reversed and the throwing out of resistance occurs simultaneously. The furthest lever to the left is only used for starting the air pump. The motorman cannôt come into contact with any insulated wires, much less with any bare terminals.

Fig. 43 shows the car about to start on its first trip.

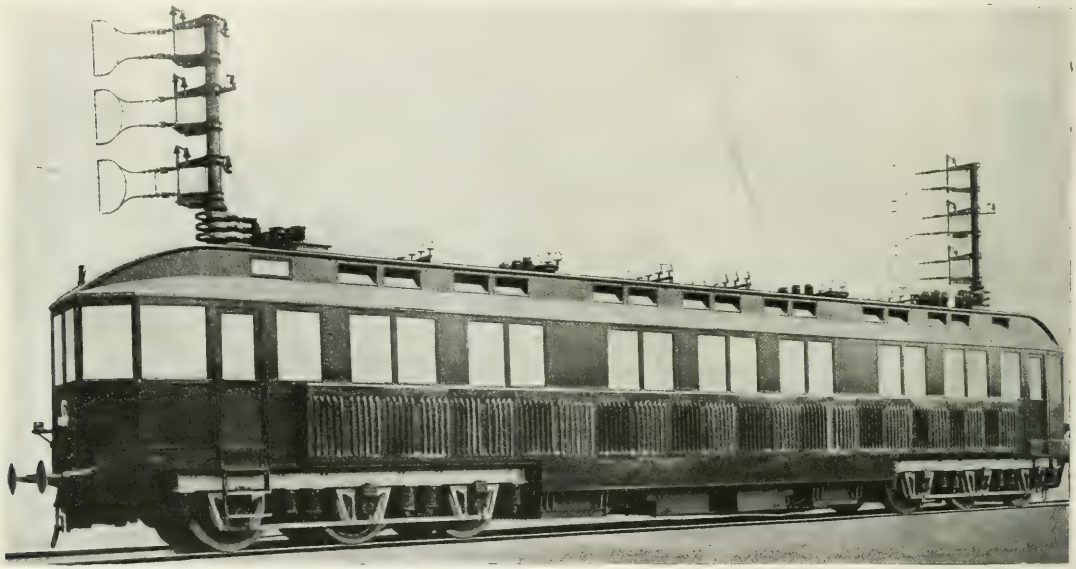


Fig. 43.—Car Ready for Its First Trip.

The Nobel Prizes

Prof. Chas. E. Munroe, Professor of Chemistry and Dean of the School of Graduate Studies of Columbian University, of Washington, D. C., has been designated as the representatives in the United States of the Royal Swedish Academy of Sciences, which will confer the Nobel prize for the most important invention in chemistry.

Alfred Nobel, who died at San Remo Dec, 10, 1896, provided in his will that the interest on a capitl which he bequeathed should be annually divided into five equal parts, to be awarded as prizes to those persons who should have contributed most materially to benefit mankind during the year immediately preceding, as follows: One part to be given to the person having respectively made the most important discovery or invention in the science of physics, in the science of chemistry, in the science of physiology or in medicine, for the most distinguished work of an idealistic tendency in literature, and to the person who shall have most or best promoted the fraternity of nations and the abolishment or diminution or standing armies and the formation and increase of peace congresses.

The contest of the will by the heirs-at-law is now over and the conditions under which the awarding of the prizes are to be made have been formulated and the first awards are to be made in 1902. At the time of Nobel's death his estate was estimated to have a value of from 30,000,000 to 35,000,000 kroner, which, if invested at three per cent, would yield an annual income of from $240,000 to $270,000. Each fifth would thus amount to $48,000 to $55,000. Since then 1,500,000 kroner have, by agreement with the heirs-at-law, been set aside for the foundation of Nobel institutes in Sweden, but at the same time the interest for the intervening years since Nobel's death has been accruing, so that the exact value of each annual prize is not now known.

Under the conditions it is essential that every candidate for a prize under the terms of the will be proposed as such in writing by some duly qualified person. A direct application for a prize will not be taken into consideration.

The right to hand in the name of a candidate for a prize belongs to (1) Home and foreign members of the Royal Academy of Science in Stockholm. (2) Members of the Nobel Committee of the Physical and Chemical Sections. (3) Scientists who have received a Nobel prize from the Academy of Science. (4) Professors, whether in ordinary or associate, of the Physical and Chemical Sciences at the universities of Upsala, Lund, Christiania, Copenhagen and Helsingfors, at the Caroline Medico-Chirurgical Institute and the Royal Technical College in Stockholm and also teachers of the same subjects who are on the permanent staff of the Stockholm University College. (5) Holders of similar chairs at other universities or university colleges, to the number of at least six, to be selected by the Academy of Science in the way most appropriate for the just representation of the various countries and their respective seats of learning. (6) Other scientists whom the Academy of Science may see fit to select.

Acting under Section 5 of the conditions given above, the Royal Swedish Academy of Science has conferred an honor on the Columbian University, of Washington, D. C., by designating Prof. C. E. Munroe as one of the six representatives in chemistry in foreign countries.

The Royal Swedish Academy of Sciences confers the prizes in chemistry and physics only. The prizes for peace are conferred by the Norwegian Parliament and the prizes in literature and medicine by their respective academies. The foreign representatives in these departments and in that of physics are not yet announced.

The Electrical Protection of Vaults.

The remarkable robbery which recently took place in the Chicago post office, where the burglars got away with many thousands of dollars' worth of stamps after a comparatively easy job in drilling through the vault walls from an adjoining underground passage way, and in which the burglars were aided by miniature incandescent lamps operated by portable batteries, has called forth some comment on the new use of electricity in burglary. Such comment is, of course, idle and valueless. The point that should occur to the thoughtful electrical engineer in this connection is the possibility of preventing such losses by the use of modern burglar alarm systems. It is a fact not sufficiently appreciated even by electrical men who should be posted on such matters, that it is possible by electrical means to throw around a vault or safe a protection from burglary more absolute than can be obtained in any other way. Although the perfection of vault steel has reached a point where the burglar must be skilled indeed if he penetrates it, still there is always the possibility that it can be done. But a vault, however flimsy, if protected by an electrical lining, connected to sufficiently delicate circuits, the disturbance of which in any manner is absolutely certain to give an alarm, makes it impossible for a burglar to enter a vault without the fact being known either at a central office or by the general public in the vicinity. Of course, a certain amount of mechanical protection is necessary even with an electrical alarm system in order to hinder a raid. It is, however, safe to say that few burglars care to attack a safe with the positive assurance that an alarm will be sent in the instant they penetrate the electrical lining.

This much should be said in justice to the inherent possibilities of the arc of electrical vault-protection, as indicated by what has been actually accomplished. It is a matter to be regretted that the commercial development of burglar alarm systems of the highest class has not always been in hands possessed of the best technical or business foresight. For example, one beautifully worked out protective system has apparently been the tool of stock jobbers and speculators rather than the means of the large legitimate commercial development to which its inherent merit entitled it. This, too, coupled with attempts to alarm the banking fraternity by exaggerating the possibilities of the electric arc as a burglar's tool, and a lack of thoroughness and technical business ability in carrying out and maintaining the work installed and in keeping abreast of the times in improvements, has also marked the burglar alarm industry. Some of the systems, as said before, are of great inherent excellence, but faulty workmanship and maintenance have caused them to come into disrepute. Other older systems have not been improved as time went on, as they might have been, with the result that their imperfections have been exposed greatly to their detriment. It is not, however, likely that so legitimate a branch of electrical industry will always suffer from commercial mismanagement, as it has in the past. The very matter of economy in first cost alone is conducive to the installation of modern vault protecting apparatus because the electrical protection is cheaper to install and maintain than many of the elaborate mechanical expedients that have been proposed and used.

There is probably a greater need for the fool killer among inventors of devices for protecting against burglaries, than in any other branch of the electrical business, but that does not in any way discredit the use of the legitimate and thoroughly thought-out systems.

Work of the U. S. Signal Corps.

General Greely, chief signal officer, has just issued his annual report at Washington. In the course of it he says: The operations of the signal corps have been coexistent with the operations of the army of the United States, not theoretically, but on broad lines and activities which have comprised practically the entire area, not only of the United States proper, but also of Alaska, Cuba, Porto Rico, the Philippines and a portion of China.

The muster-out of the last volunteer soldier would seem to mean a reduction of work, but in an electrical age the demand of our active and progressive generals has developed in the American army the application of electricity to war on a scale unprecedented in military history. Incessant demands were made by military commanders for inter-communication with their detached organizations by telegraph and by telephone, in addition to the former methods of visual signaling.

General Greely says the corps should be increased to meet present demands. There have been constructed 336 miles of telgraph line in Alaska, and arrangements have been made with the Canadian Government to use its line to Alaska. The signal corps operates 3418 miles of telegraph in Cuba, an increase of 162 miles during the year.

The operations of the corps in the Philippines have been very extensive, there being 4801 miles of telegraph line, an increase of 2054 during the year. The military cable lines in the Philippines connect Manila with Mindoro, Marinduque, Masbate, Samar, Leyte, Cebu, Negros, Mindanao, Jolo and Siasi.

With regard to the work in the Philippines, General Greely reports that it has been done under very great obstacles, and says if the officers and men of the Signal Corps had struggled only against the natural disadvantages they were under, their work in the Philippines would have commanded commendation; but to this must be added the extreme difficulties arising from the practically constant efforts of the insurgents to destroy indispensable means of intercommunication. In the region southeast of Laguna de Bay, Santa Cruz to Antimonan, and thence to the head of the Gulf of Ragay, the insurgent troops had caused no end of trouble and annoyance, not only by the cutting of the wire, but by the removal or destruction of considerable stretches of line. The commanding officer of Santa Cruz informed me that experience had caused him to furnish every repair party with at least a mile of wire, as nearly that amount was taken away at each break. Destruction of sections of two, three or even five miles of line were not unusual, but the climax was reached in the total destruction of 38 miles of line, every insulator being broken, every bracket destroyed or removed, every pole cut down, and the entire wire carried away.

General Greely recommended an international cable conference to prepare regulations for cables. Concerning experimental work he says: In wireless telegraphy the Signal Corps has perfected its own system, which was the first one ever successfully operated in the United States, on September 30, 1899, bewteen Fire Island and Fire Island Lightship, a distance of 10 miles. There are now in successful operation two stations in San Francisco harbor, one at Fort Mason, and another at Alcatraz Island. Arrangements have been made for the establishment of stations in the Philippines at suitable points. The chief signal officer adheres to the opinion that this system has its limitation, which are not entirely dependent on distance.

In regard to a Pacific cable the report says: It is only a matter of time when Luzon shall be connected with Japan and Tonquin and the Chinese Empire. The Philippine Islands are now only accessible telegraphically over a short cable of about 600 miles of the Eastern Extension Company between Manila and Hong Kong. The experiences of the War Department in connection with the relief

of the legation at Pekin show clearly the tremendous disadvantage under which the United States would labor without its own cable facilities in case of an extended war in the East. An American trans-Pacific cable is a military and commercial necessity, if American interests are to be safeguarded in Asiatic regions. Such a cable, while of great value militarily, will especially foster industrial interests, and facilitate commercial operations. As it is officially known that an American cable can only enter Japan from the east, and not from Russia, China or the Philippines, the only possible route is that already recommended to Congress by the President, via Hawaii and Guam.

The Activity of American Manufacturers.

It would appear that American manufacturers are quite as busy in 1901 as they were in 1900, from an examination of the figures of the Treasury Bureau of Statistics. The total imports of manufacturers' materials in the nine months ending with September, 1901, were greater in value than those of the corresponding months of last year, although an analysis of the imports, article by article, shows that in many cases the prices per unit of quantity have decreased. This decrease in price is so strongly marked that in many cases while the figures of value show a decrease in the nine months of 1901 as compared with those of 1900, the figures of quantity for the same period show an increase. For instance, imports of india rubber, when measured by value, show a slight reduction in 1901 as compared with 1900, while the quantity imported in 1901 shows an increase of more than 5,000,000 pounds as compared with the same months of 1900. Pig tin, used in manufacturing tin-plate, shows in value a slight reduction in the imports of 1901 as compared with last year, but in quantity there is an increase of over 2,000,000 pounds. Imports of unmanufactured fibers show a decrease of more than $2,000,000 in value as compared with those of 1900, yet the quantity shows a material increase. Taking the grand total of value of imports of raw materials for use in manufacturing, the imports in the nine months of 1901, compared with those of 1900, were: For 1901, $221,469,984; for 1900, $217,619,372; while in the month of September alone the figures of the month in 1901 are $22,725,325, against $18,505,980 in September, 1900, a marked increase. They formed in September, 1901, 34 per cent of the total imports, against 31 per cent of the total imports in September, 1900.

The Storage Battery in Telephone Work.

Mr. J. G. Wray, of the Chicago Telephone Company, gave a very profitable talk before the Chicago Electrical Association on the above subject the evening of Nov. 1. In Mr. Wray's remarks he considered batteries more from the standpoint of a telephone man than a storage battery expert. As an introduction he mentioned four points which rendered the storage battery especially suitable for telephone work as compared with primary batteries. The first of these was low internal resistance. This low internal resistance is a strong point in its favor, especially where a number of transmitters are supplied from the same battery. The greater the internal resistance of a battery in such cases the more liability there is to cross talk. A battery of zero internal resistance would, of course, be the best. A storage battery comes nearest to this ideal theoretical condition. The storage battery is cleaner and more desirable to have around a telephone exchange than a primary battery even like the Edison-Lalande. Its uniformity of voltage with various loads is another point in the storage battery's favor as compared with the primary battery, as the variation of voltage of the primary battery interferes much with the requirements of a telephone exchange. The fourth advantage of the storage battery is that it does not need to be renewed by the addition of chemicals as does a primary battery, but is renewed in place without any mechanical disturbance.

Eight or nine years ago the storage battery was practically unknown in telephone work. Signaling was done by magneto generators, and what batteries were needed were all of the primary type, individual batteries being placed at the subscribers' instruments and a set of primary batteries being used at the central office for the operators' transmitters. A little later the practice of signaling on trunk circuits with primary batteries was begun, using potassium bichromate, gravity, or Edison-Lalande cells. Storage batteries followed primary batteries for use in this work. The custom at first was to charge a set, put it in place and when it was discharged to replace it with a freshly charged set. The introduction of lamp signaling a little later called for the use of more batteries. At first it was customary to have a couple of storage calls at each subscriber's instruments. These were charged at the central office, taken out to the subscribers' instruments and replaced with newly charged cells as often as necessary. It was soon found practical, however, to charge the batteries over the subscribers' line from the central office. The batteries in this work gave very good results. Following the use of the lamp signaling or express system came the common battery or central energy system, in which all the electrical energy needed for the exchange was supplied from a 24-volt battery at the central station. The battery capacity at the telephone exchange of to-day is 10 to 20 times what it would have been in an exchange of the same size five years ago. The evolution of the telephonic art brought out from time to time the use of batteries of a great many different voltages, so that an exchange would have a battery for signaling, a battery for talking, a battery for lamp circuits, and so on. The central energy system has done away with the complication of many different voltages of battery, and everything is supplied from a standard 24-volt battery circuit.

A standard practice of the telephone interest with which Mr. Wray is connected is to have a battery of sufficient capacity to carry the entire load of the telephone exchange for two days if the source of power is interrupted. In actual practice batteries will be found in use in some places which will carry the exchange for seven days. The batteries in the present central energy systems are charged through a motor-generator supplied from the Edison three-wire system in cities where that service can be obtained. The standard practice is to install a gas engine and generator for use in case the Edison service should fail. The exchange, therefore, has not only the reserve capacity of the battery for emergencies, but the gas engine. The first batteries used by the Chicago Telephone Company were the old American type, which consisted of a plate or a sheet folded back and forth upon itself. The Pumpelly pasted type of cell was next used, but this was later replaced by the Pumpelly "formed" or Planté type, which latter was found to be well suited to telephone use. Many of these batteries are in use by the Chicago Telephone Company to this date. The insulation between the plates in the earlier batteries took on various forms of asbestos and rubber mats, but later standard practice in which the batteries were made heavier and less liable to buckle has involved the use of glass tubes to separate the plates and plenty of free space between the plates. The use of oil to prevent spray has almost been abadoned. The deterioration of batteries in telephone work Mr. Wray considered to be more than in any other class of service, and he was at a loss to account for this, as conditions were in some respects favorable to them.

When the chloride type of batteries first came in there was much trouble from the dropping off of the lugs. A growth would also form on the positive plate, and the buttons of active material in these plates would fall out. This dropping of the lugs was due to corrosion at the top of the solution. There was so much trouble of various kinds with the positive plates of early chloride cells that it was claimed by some that rival battery makers had in some way doctored the cells. That theory was exploded, however, by an experiment in which some plates fresh from the factory were boiled for some time in distilled water and the water so obtained evaporated. The result was a considerable amount of chloride of zinc, which demonstrated that the chloride had not all been extracted in the manufacture of the positive plates. This trouble has been quite overcome by the use of the present Manchester type of plate as positive in the chloride battery.

In conclusion Mr. Wray propounded some interesting questions as to why depreciation is so rapid in telephone service, and raised the question as to whether the battery would give its best service when worked fully through its cycle of charge and discharge or only part through this cycle. In telephone work, of course, the whole cycle of charge and discharge rarely occurs. Professor Woodworth, in discussion, in answer to the question as to why batteries depreciate so rapidly in telephone work, asked another question which was: "Why do storage batteries depreciate so much more rapidly in other work than in telephone work?" He had had considerable experience with storage batteries, having been connected with the early experiments of Mr. Chas. F. Brush, and he is now occasionally engaged in storage battery testing of various kinds. He considered an automobile battery of a life of six or eight months to be something extra good. Mr. F. S. Hickok raised the question as to why end-cell switches would not be desirable for keeping an even battery voltage in a telephone exchange. His question was answered by Mr. Schuchardt by citing the experience of companies using end cells in central station work. It

was found there was considerably more depreciation of the end cells than of the others because of the difficulty of keeping the end cells regularly charged and discharged. Mr. Wray confirmed this statement as regards the use of end-cell switches in telephone work and stated he had had the same experience. The life of batteries in telephone work was given by Mr. Wray as four or five years.

Power Developments in Northern Indiana.

Capitalists of Northern Indiana, Chicago and the East are at the head of an electrical enterprise which, if successfully carried out, will prove one of the greatest steps ever taken in the industrial advancement of the St. Joseph Valley. Under the name of the St. Joseph & Elkhart Power Company, they are arranging the preliminaries for a 9000-hp electrical plant, to be built six miles above South Bend, the power to be derived from the St. Joseph River. Watervliet, Benton Harbor, St. Joseph, Niles, Buchanan, Dowagiac, LaPorte, South Bend, Elkhart and all other towns in Southwestern Michigan and Northwestern Indiana, within a radius of 25 miles, will be furnished with light and power at a rate so low that other means for operating factories and supplying light or power will be distanced. The company owns the Elkhart lighting plant and has a franchise from South Bend to furnish light and power. It is also behind the organization known as the Berrian Springs Power Company, whose legal fight with Chapin over the water-power rights in the St. Joseph River at Berrian Springs has just been terminated in a victory for the company.

Forty men, a number of teams and a 125-hp boiler and engine plant are on the ground, and the preliminary work is progressing rapidly under the most favorable conditions. No work on the dam proper will be started until spring, at which time the river will be turned from its course and on the dry bed of the stream work will be rushed to complete the structure within two months. It is not likely, however, that the plant will be ready to operate in much less than a year. The power-house will be erected on the south side of the river, at a point about three miles south of the line between Indiana and Michigan, and will be built of specially prepared concrete, which will be made on the ground and compressed into oblong bricks. The foundation will be of solid concrete, to be laid on a base of 5000 piles driven down to hard pan. The concrete itself will begin 17 feet below the present water level.

The power will be furnished by 30 large turbine wheels, connected in tandem in six units of five turbines each, the units being of approximately 1500 horse-power each. Six large three-phase alternating current generators will be connected direct to these units. The water will enter the station by a head race 2000 feet long, 800 feet wide and 15 feet deep, the channel for which is being prepared now, so that the river can follow this course when work on the dam proper is begun. A coffer dam will be built in the river below the head opening of the race, and meanwhile work will be kept up on the power station, so that it will be finished and ready for operation by the time the big dam is finished. The latter will be a trifle more than 400 feet in length and will project about 21 feet above the water level. It will be built of cement and will cross the river almost at right angles, just above what is known as Hen Island. As the back water will extend up the river nine miles and will overflow the banks, a respectable lake will result. The company has purchased outright or has leases of nearly all the property which will be affected.

In leaving the station the water will pass through a tail race 600 feet long, 100 feet wide and 15 feet deep. In excavating for this a fine quality of gravel, admirably suited for concrete work was found and will be used in the concrete for the foundation of the power station.

The construction work is being done by the Sanderson & Porter Company, of New York City, and is in personal charge of W. H. Lang, a hydraulic engineer of the same city. In order to furnish the 1,500,000 feet of sheet piling which will be used, a small sawmill plant has been installed, and the logs used are cut from the company's own land, in the vicinity of the proposed dam. To facilitate the handling of the timber a 570-foot boom was thrown across the river to catch the logs as they are floated down. A large pile driver operated by a portable engine is doing effective work in driving the stake piling to keep the high banks from caving in as the excavations are made, and will be utilized later as part of the base for the foundation of the power-house. The loose nature of the ground, the existence of quicksand and the appearance of water near the surface are making the work of excavation exceedingly difficult. The utmost precaution is being exercised and piles are being driven as closely together as possible and joined by tongues fitting into 1½-inch grooves cut in the piles, so that to all intents and purposes a solid wall is formed. The company's temporary equipment also includes carpenter and blacksmith shops, all fitted with steam-power machinery, a storeroom equipped with necessary supplies and fixtures, cement sheds, a cement storehouse with a capacity of 20,000 barrels, the amount which it is estimated will be used, and an abode for the workmen employed. A sidetrack from the Lake Shore & Michigan Southern Railway is on the grounds.

The electrical power plant will consist, as now planned, of six three-phase alternating current generators of 800 kilowatts each, and the current will be transformed at the central station to a high line potential, at which it will be distributed to the various towns and cities using the power. Sub-stations outside of these towns will step the current down to a voltage suitable for lighting distribution, and rotary converters will provide for the power current. The plant will have cost, when completed, $500,000. The St. Joseph & Elkhart Power Company was organized by James DuShane, of South Bend. The largest stockholders are the members of the firms of Beigler & Saunders, of Mishawaukee, Ind.; Thompson, Tenney & Crawford, of New York, Boston and Chicago, and Sanderson & Porter, the New York engineering firm that is doing the work.

New York Electrical Society and Electric Lighting.

The opening meeting of the 1901-02 season of the New York Electrical Society was held at the College of the City of New York, Oct. 30. There was a crowded house. Twenty-eight new members were elected. A report was read by the treasurer showing the finances of the society to be in excellent condition. Mr. F. W. Willcox, of the Edison Lamp Works, Harrison, N. J., lectured on the "Manufacture and Use of the Modern Incandescent Lamp." Mr. Willcox reviewed the whole subject of lamp manufacture, indicating and illustrating the progressive changes which have been made in perfecting the lamp and in lowering its cost to the public. The various stages in the production of the lamp were elaborately illustrated with slides, and many and various economic features of efficiency, life, etc., were discussed. It was intended that Mr. Luther Stieringer, consulting engineer of the Pan-American Exposition, should supplement this lecture by a brief address on the incandescent lamp at the Pan-American Exposition, but at the request of several of the members, Mr. Stieringer has consented to give the society a whole evening later in the season to the description and discussion of the wonderful illumination obtained at the Exposition.

Apparatus for the illustration of Mr. Willcox's admirable lecture was kindly loaned to the society by the Tiffany Glass & Decorating Company, Waite & Bartlett Manufacturing Company, the Kny-Scheerer Company, the Wappler Electric Controller Company, the General Electric Company, the New York Edison Company, the Manufacturing Electric Novelty Company, E. B. Meyrowitz, the National Electric Improvement Company, the Mason Sign Company, the Columbia Electric Supply Company, the Mason Sign Company, the Columbia Electric Supply Company, and the Electric Motor & Equipment Company, Newark, N. J. The beauty of the Tiffany lamps was a revelation even to many to whom all ordinary forms of electrical illumination are familiar.

The following members were elected: Goodrich Curtiss, 220 East 119th Street, New York; E. W. Caldwell, 315 Fifth Avenue, New York; Arthur J. Weed, 129 East Thirty-first Street, New York; C. A. Greenidge, 163 Twelfth Street, Hoboken, N. J.; W. H. Hill, 558 Metropolitan Avenue, Brooklyn, N. Y.; D. Davies, Cliffside Park, N. J.; S. G. Rhodes, 589 Walton Avenue, New York; George A. Baker, 53 Duane Street, New York; William Kohler, 25 Barrow Street, New York; W. S. Brown, 39 Cortlandt Street, New York; Charles L. Eidlitz, 1133 Broadway, New York; Albert Taylor, Electric Storage Battery Company, 100 Broadway, New York; Alfred E. Poirier, 29 West Twenty-first Street, New York; Dr. William Benham Snow, 74 West Forty-seventh Street, New York; C. H. Holden, Emerson Electric Manufacturing Company, 136 Liberty Street, New York; Charles M. Priggen, 806 Halsey Street, Brooklyn, N. Y.; Charles L. Wilcken, 269 State Street, Brooklyn, N. Y.; Dr. C. H. Tyndall, 137 South Sixth Avenue, Mount Vernon, N. Y.; Edward R. Heilig, American Electrical Works, 26 Cortlandt Street, New York; Ralph A. Schoenberg, 344 Columbus Avenue, New

York; A. J. Sefton, 55 Duane Street, New York; Caleb H. Jackson, Plaza Hotel, New York; C. S. Jackson, 55 Duane Street, New York; H. W. York, 55 Duane Street, New York; George Fulton, 471 McDonough Street, Brooklyn, N. Y.; Henry Stephenson, 55 Duane Street, New York; E. J. Kenny, 129 South Second Street, Brooklyn, N. Y.; C. J. Marsh, 56 Liberty Street, New York.

The secretary announced that the following programme of lectures for the season is proposed: Robert T. Lozier on "Modern Methods of Driving Machines and Tools Electrically"; Dr. F. A. C. Perrine on "Long-Distance Transmission"; A. J. Wurts on "The Nernst Lamp"; Professor Dayton C. Miller on "Polarized Light"; Visit to the new switchboard at Cortlandt Street telephone exchange; Dr. Kennelly on "Phenomena of Storage Batteries" and R. A. Fliess on "The Edison Storage Battery"; Luther Stieringer on "The Incandescent Lamp at the Pan-American Exposition"; visit to the new Edison Waterside station, with paper to be subsequently announced; T. C. Martin on "A Statistical Survey of American Electrical Industries"; Caryl Haskins on "Electric Meters."

Test of Farnham Third-Rail System at Chicago.

A test of a new third-rail system, invented by E. W. Farnham, one of the officers of the Chicago, Burlington & Quincy Railroad, at Chicago, was witnessed by a number of gentlemen interested in such matters at Clyde, Ill., near Chicago, on Saturday, Nov. 2. The test was reported successful. The third rail of this system is enclosed under a wooden trough covering and contact is made from beneath by a shoe carried by the truck frame. The third rail is divided into a number of sections and before entering each section the contact shoe passes under a short section of the third rail, which is free to swing with a slight endwise motion. This slight endwise motion closes a switch which supplies the section of third rail ahead of the car. When the shoe has passed from under this swinging section of rail the swinging section falls back to its original position by gravity, but the switch is held closed by a magnet in the feeder circuit as long as any current is flowing through the car when it is on that section. The switch automatically opens as soon as the current ceases to flow.

TEST OF NEW THIRD-RAIL SYSTEM.

Electro-Chemical Patents.

Several interesting patents relating to electro-chemical subjects bear date of Oct. 29. Dr. Max Haas, of Aue, Saxony, proposes to utilize the hydrogen which is liberated when alkali metal chlorides are electrolyzed to effect the necessary circulation of the electrolyte. In the electrolytic production of hypochlorite two molecules of hydrogen are set free for each molecule of the salt decomposed, and this hydrogen, admixed with a column of the electrolyte, reduces its specific gravity to such extent that an automatic circulation may be effected by the simple device illustrated in Fig. 1. A tank, *a*, subdivided by carbon plates, *e*, which constitute bipolar electrodes, is mounted within a reservoir *V*, the electrolytes in the inner and outer vessels communicating above the level of the former and also through numerous apertures, *l*, in its bottom. The carbon electrodes are mounted in insulating supports, *p*, to guard against accidental short-circuiting, and the outer tank is fitted with a cooling coil *b* by means of which the temperature may be exactly regulated. Circulation of the electrolyte occurs in the direction indicated by the arrows, the evolved gases so reducing the specific gravity of the liquid between

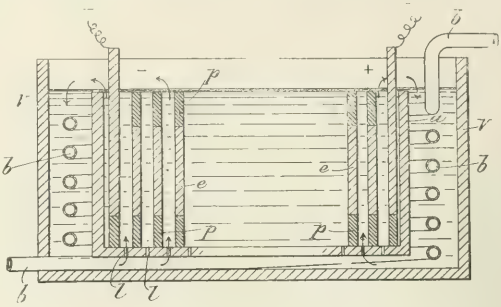


FIG. 1.—HAAS ELECTROLYTIC CELL.

the plates that it is continuously forced over the edges of the inner vessel by the solution entering through the apertures, *l*. Not only is this circulation accomplished without moving parts or expenditure of power, but it is automatically controlled, because the amount of hydrogen liberated and hence the speed of flow is proportional to the current.

Dr. Oscar Frolich, of Steglitz, Germany, seeks to solve the vexed problem of the disposal of the reaction gases from calcium carbide

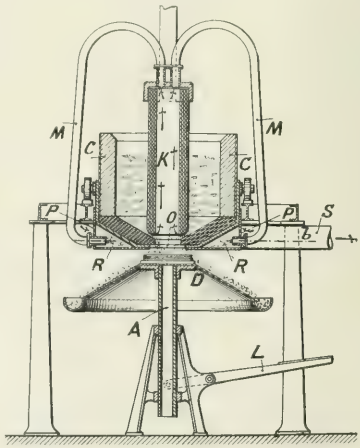


FIG. 2.—FROLICH CALCIC CARBIDE FURNACE.

manufacture by means of the furnace shown in vertical section in Fig. 2. An iron crucible *C*, having its sides interiorly lined with firebrick and its conical bottom with carbon, forms one electrode, the

other being the carbon tube K hung vertically above the central tap hole O, the disposition of parts being such that the charge gravitates through the arc onto the adjustable table D. Surrounding the lower portion of the crucible is a flue R, and in this is introduced and burned the carbon monoxide derived from the reaction and withdrawn for the purpose through the tubular electrode and the conduits M; air is permitted to enter the flue through openings P, the products of combustion escaping at S. The process may be either continuous or intermittent as desired, the central support A and lever L affording means for adjusting the table D to a position suitable for either mode of operation.

The proposal to utilize the reaction gases for heating purposes was almost the first suggested improvement in the manufacture of calcium carbide, but has never been adopted in commercial work on a large scale. The gases are laden with dust, and their utilization involves complications in the furnace which interfere with the replacement of the electrodes and the supply of the charge, and entail a disproportionate increase in the cost of construction. In all of these respects the present furnace offers advantages over prior forms. The gases are not withdrawn through the body of the charge and are, therefore, relatively free from dust, and the construction whereby the powdered mixture of oxide and carbon itself constitutes the gas seal permits an open furnace to be used, with ready accssibility for renewal of parts and for charging. If the construction of the large tubular carbons is not impracticable the furnace should prove both efficient and economical. The patent is assigned to the Siemens & Halske Company, of Berlin.

Two patents issued to Claude A. O. Rosell, of New York, and assigned to the American Lithographic Company, contain restricted claims to methods whereby zinc is electroplated upon an aluminum base in the form of an adherent yet porous deposit, suited for planographic printing. The patents derive their main interest, however, from the fact that they disclose a principle which seems to mark a distinct advance in printing of this character.

Heretofore these surfaces have been prepared by mechanically securing a thin sheet of zinc or aluminum around a cylinder and roughening it by a sand blast—a procedure entailing mechanical difficulties of a serious order. It has also been proposed somewhat recently to electro-deposit zinc upon a cylinder of copper, and after the printing of each edition to remove the coating by nitric acid and prepare the cylinder by a fresh deposit for further work. The disadvantage of this is that the acid used to remove the zinc acts slowly and unevenly upon the copper, producing irregularities in its surface, and in the end so reducing its size as to destroy the register and render it useless. Mr. Rosell proposes to electro-deposit this thin coating of zinc upon an aluminum base, preferably a cylinder accurately trued, and after development of a planographic printing surface according to known methods and use, to remove the deposit by dilute nitric acid, which is well known to be without sensible action on aluminum. A fresh deposit of zinc may then be plated out for each edition, the accuracy of register being preserved indefinitely by reason of the entire permanence of the aluminum base. Mr. Rosell finds the best conditions for producing a deposit of the required character to be the use of solutions of zinc and aluminum sulphates, or of zinc, aluminum and ammonium sulphates, rendered basic but not alakine by the addition of such reagents as ammonia, potassium carbonate or the hydrates of zinc or aluminum. The current density employed is low, varying from one-quarter to one-half ampere per square foot of cathode surface, a zinc anode being used to maintain the bath in its basic candition.

Nernst Lamp Patents.

The Nernst lamp is represented by 17 patents in the list of patents granted Oct. 29, of which 10 are fundamental patents issued to Dr. Nernst, the earliest application for these being dated April 28, 1898, and the latest Nov. 8, 1900. Of the remaining seven patents four were granted to Henry Noel Potter, two to A. J. Wurts and one to Marshall W. Hanks. As the recent paper read by Mr. A. J. Wurts before the Buffalo meeting of the American Institute of Electrical Engineers and reprinted in these pages, gave an account of the Nernst lamp as perfected up to date, much of the matter in the Nernst patents relating to constructional and circuit details may be omitted from an account of the patents.

The applications for five of the Nernst patents bear date of April 28, 1898, the titles of the patents being as follows: Method of electric lighting, electric glow lamp, electric lighting apparatus and electric glow lamps, two having the latter title.

In describing the general features of the glow lamp Dr. Nernst states that the refractory so-called rare earths when traversed by an electric current not only emit more light under the influence of a given amount of electric energy than the ordinary incandescent lamp, but also resist decomposition and disintegration even in the open air, and consequently the lamp does not require a vacuum chamber. Moreover, the general characteristic of the light-giving portion of the lamp are so widely different from those of the ordinary incandescent lamp that to term it a filament would be not only inappropriate, but to a certain extent misleading; for, aside from the light being emitted without material disintegration even when exposed to the air, the material becomes translucent and emits light both from its interior and surface. As a consequence the inventor gives the name of "glower" to the light-giving portion and "glow lamp" to the lamp itself.

The materials used, even when in their best operating conducting condition, have a specific resistance so great with reference to that of carbon that a glower to be used with a given voltage may be much shorter and thicker than the carbon filament of an ordinary incandescent lamp. For instance, a practicable glower of, say, 1/50 of an inch in diameter and ½ an inch in length, may be so made that when heated to a low incandescence it will become a sufficiently good conductor to be traversed under 100 volts difference of potential by a current of .4 of an ampere, which will be sufficient to maintain it at a state of high incandescence. As the material has sufficient strength to enable it to be used in much longer lengths than this, it is possible to construct lamps adapted to be operated at very much higher voltages than are practicable with lamps using carbon filaments.

It is stated that very excellent results have been obtained from a mixture of approximately 70 per cent of zirconia and 30 per cent of yttria (oxide of yttrium); another mixture which has been used with good advantage consists of approximately 10 per cent of zirconia, 70 per cent of thoria and 20 per cent of yttria; another mixture given is 70 per cent of thoria and 30 per cent of yttria, and still another consists of .5 per cent of ceria, 80 per cent of thoria and 19.5 per cent of yttria. It is stated that these percentages may be widely varied, and generally speaking, the oxides of the rare earths are well adapted for mixture in widely varying proportions.

In preparing the glowers the two or more oxides used are thoroughly pulverized and mixed with a binder of clear starch paste, from which the glowers are "squirted" by the same process used in making carbon filaments. After drying the glower is heated to a very high temperature, for example, in an oxyhydrogen flame, preferably after a preliminary heating in a porcelain kiln. The specifications describe means for making a junction between the ends of the glower and the conducting wires, a form of starting heater and the use of a ballast wire, the object of the latter, it will be remembered, being to introduce a resistance which increases with flow of current and consequently increase of temperature, in order to compensate for the reduction of the resistance of the glower with increase of temperature and current. As the Wurts article describes in detail the latest forms of these two latter devices, and we have recently printed accounts from patents of methods of making terminal connections which apparently supersede those first suggested, it is unnecessary here to consider these parts of the specification.

Reference is made to a patent by Jablochkoff, which suggested the use of so-called electrolytic conductor in electric illumination. The patent suggests the possibility of heating the edge of a kaolin strip or plate placed between two electrodes separated by an intervening air space and employing the electric spark of a induction coil. Dr. Nernst says that such a method has not been found capable of commercial use and differs from his method and lamp because of the facts, among others, that kaolin is easily melted, that his illuminant is primarily brought to a conducting temperature throughout its mass and not merely along a line or portion thereof, and that his lamp permits the use of currents of much lower pressure. In certain publications relating to the Jablochkjoff candle it is also suggested that the heating of the upper part of a porcelain plate might be brought about by applying thereto a surface coating of gum and carbon, or by using some other temporary expedient for leading the spark across the edge of the plate. Dr. Nernst says that these suggested constructions are not commercially practicable, and are also lacking in a heating conductor which is a permanent part of the structure and capable of repeated use. The Jablochkoff devices, he says, are not

heating devices, but merely devices in the nature of switches for starting the arc.

The patent from which the above has been abstracted contains six claims on the method of operating an electric lamp having a glower composed of dry electrodes, and in the method of developing light by the incandescence of a refractory body.

The second patent in serial number, which contains the same specifications as the one just considered, has 44 claims relating to all the various elements of the Nernst lamp, and particularly to details of the heater, including means for automatically cutting the same out of circuit. The two following patents relate also to the electric heater, covering specific forms and heater circuits. The claims of the fifth and last of the earliest patents in date of application relate to the means for joining glowers to metallic terminals.

The sixth and seventh patents in serial order are on applications filed Aug. 24, and cover different mixtures of materials from which the glower is formed, as follows: Eighty parts of oxide of zirconium and 20 parts of a mixture of the rare earths of gadolinite; 80 parts of the oxide of zirconium and 20 parts of a mixture of the rare earths of the yttria group in such proportion as occur in gadolinite; 80 parts of the oxide of zirconium and 20 parts of a mixture of gadolinite and the rare earths commonly associated therewith in nature after removing the portion of those belonging to the ceria group; 85 per cent of zirconium and 15 per cent of one of the other rare earths; 85 per cent of zirconium and 15 per cent of yttria; a mixture of the rare earths containing approximately 85 per cent of zirconium.

A patent for which an application was filed Sept. 29, 1899, describes a divided ballast consisting of a portion enclosed in an air-tight chamber, which is standardized as perfectly as possible, and an auxiliary adjustable exposed ballast adapted to compensate for any inequality due to the peculiar conditions of each glower.

The two final Nernst patents were granted, one on an application filed Aug. 24, 1899, and the other on an application filed Nov. 8, 1900, and both relate to the composition of the material of the glower as follows: In the first-mentioned patent the mixture claimed is 80 parts of oxide of zirconium, 10 parts of oxide of erbuim and 10 parts of the oxide of yttria. In the second patent the mixtures claimed are 80 parts of oxide of zirconium and 20 parts of a mixture of those metals of the yttria group which occur in an yttria containing mineral; a predetermined per cent of the oxide of zirconium and a mixture of the rare earths of the yttria group in such proportions as they are found associated in nature; a preponderance of zirconia, together with such of the rare earths of the yttria group as are contained in yttria containing materials, in the approximate proportions that such earths are found therein.

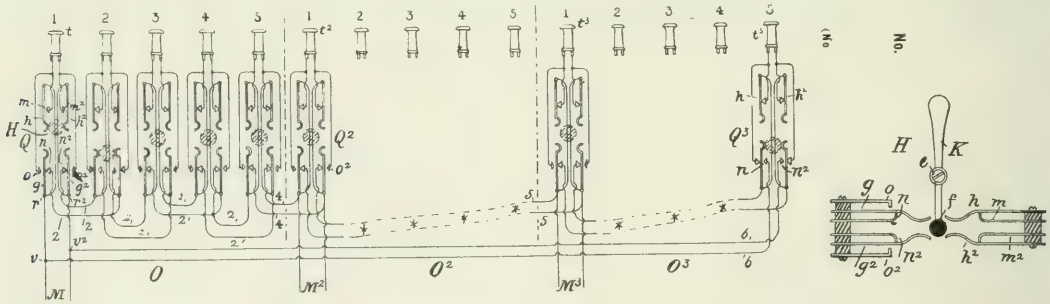
Of the four Potter patents, one for which application was filed Aug. 9, 1899, relates to the operation of a heater by means of magnetic or thermostatic devices included in a shunt circuit to the glower. As the glower becomes conductive the increased current through the ballast wire in series with it operates a thermostatic device, which makes a contact whereby the heating device is withdrawn from proximity to the glower by a solenoid. Another patent, for which application was filed Sept. 11, 1899, relates to a heating device for electric lamps, consisting of a plurality of heaters disposed in parallel lines adjacent and at right angles to the glower or glowers and connected in parallel. A third patent, of which the application is dated July 14, 1900, is on a means for automatically cutting out the ballast conductor when the voltage increases materially beyond the normal, this being accompanied by a solenoid which causes a contact to be made that short-circuits out the ballast device. The fourth Potter patent is on an electromagnetic heater cut-out, which has two coils primarily connected in series with the glower, one of which is short-circuited after the heater circuit is broken. By this arrangement the heater circuit is interrupted before the glower takes sufficient current to render the heater and glower current dangerous to other lamps in series, and the short-circuiting of a part of the magnet winding leaves only sufficient winding in circuit to maintain the heater circuit in open condition.

Of the two Wurts patents, the application of one was filed Feb. 21, 1900, and that of the other April 17, 1901. The earlier patent describes an arrangement of a Nernst lamp in portable form for use upon desks and tables. The mechanism is enclosed in a tube bearing some resemblance externally to a wax candle; the glower is supported on a stem which projects from this imitation candle, and located above it are the heater tubes, which are so arranged as to constitute a downward reflector for the light. The second Wurts patent is on an electromagnetic heater cut-out. When current begins to flow in the glower a magnet is energized, which attracts a ball, thereby interrupting a circuit which had been closed by the ball being seated over a gap in the circuit.

The Hanks patent is on a method of treating Nernst lamp glowers whereby they may be adapted to circuits of a given voltage. This is done by maintaining the glowers at an elevated temperature by passing a current through them, and at the same time subjecting them to a cloud of powdered material, the composition of which is the same or similar to that of the glower bodies.

New Telephone Patents.

Among the issue of the Patent Office for Oct. 29 is a grant to Frank A. Cumings, of Greersville, Ohio, on a "secrecy telephone system," which is a device adaptable only to series party lines. By means of a switch joined by a connecting-rod to the regulation switch-hook the bell and generator are cut out of circuit, and by means of a separate switch, operated by hand, the line can be grounded on either side of the station in use, thus cutting off the stations beyond. In these days of highly complicated circuits the device of Mr. Cumings appeals to one by reason of its refreshing simplicity; the series grounded circuit party line is, however, chiefly confined to rural districts and rural use of the grounding switch might be expected to cause a lack of harmony among the users of the line.



Figs. 1 and 2.—Telephone Toll-Board Operation.

Another patent that arrives rather late on the scene, in view of the present state of the art, is granted to Ernest Krahenbuhl, of San Rafael, Calif., on a treadle device for operating power generators by foot, for use at the switchboards of telephone exchanges. This is particularly adapted for use at small exchanges in localities where power is not obtainable or is too expensive.

A patent granted to A. S. Hibbard, the general manager of the Chicago Telephone Company, is on a "universal" call-circuit and apparatus for handling toll-service. As is generally known, modern practice in handling toll-service—an important part of the work of all

large telephone systems—consists in the maintenance of a special toll-board, at which the toll lines centre, connected by trunks and call-wires with the various exchanges of the system. The call for a toll connection is passed to a recording operator, who makes out a ticket for the call, which ticket is passed either by a messenger or by mechanical means to a connecting operator, who proceeds to establish the connection, first getting the distant subscriber and then going back to the originating subscriber on an incoming trunk. This requires the work of two and sometimes of three operators at the toll board on each connection, and the passing of message tickets to and fro, with the consequent risk, slight as it may be, in a well-managed office, of confusion and error.

The object of Mr. Hibbard's invention is to enable a single operator to take entire charge of each message passing through the toll-room and to carry out the various sub-operations concerned in the establishment of the connection, thereby expediting the service, dispensing with the circulation of the ticket and minimizing the chance of error. This object is attained by connecting the call-wires (over which orders for toll service are received from the various exchanges in the system) among groups of operators in such a manner that the operators may switch into the call-wire, cutting off the wire beyond, bridge on to the call-wire to determine if it is in use, or cut out of the call wire altogether. This is accomplished by passing the call wire through a three-position switch connected to the toll operator's telephone set. With the switch in one position the operator is connected to the call-wire and the call-wire is cut off beyond her, so that she has the exclusive use of it for the time being; with the switch in the second position the operator is disconnected entirely from the call-wire and the call-wire is in a state of continuity; with the switch in the third position the operator is bridged on to the call-wire and can listen to orders.

This arrangement results in the operators being practically in line on the call-wire. The first operator, on receiving a call, makes out the toll ticket and then throws her switch so as to disconnect from the call-wire, which is then automatically passed on, as it were, to the next operator, who normally has her switch at the connect position. Thus each operator receives calls in turn, goes out of circuit with the call-wire to establish the desired toll connection, and leaves the next operator in line on the call-wire. In coming back on the call-wire the operators turn the switches to the bridging position to make sure that no order is being transmitted at the moment, before turning the switches to the "connect" position to place themselves back in line on the call-wire. It may occur that all of the operators of a group have received orders and are all disconnected from the call-wire and engaged in completing connections. To give each call-wire access under such conditions to other operators, the contacts of the last switch of a group are connected to some one of the other call-wires at the board, so that all the operators normally serving one call-wire being out of circuit, that call-wire is temporarily extended to another group, and so on.

The accompanying diagrams (Fig. 1) show the arrangement of call-wires, switches and operators' telephones, and Fig. 2 shows the details of the switch or circuit changes. In Fig. 1, M, M^2 and M^3 are call-wires. O, O^2 and O^3 are groups of operators, and Q. Q^2 and Q^3 are loops in which the operators' telephones, t, t^2, t^3, are connected. H is the circuit changer, shown fully in the first group, but indicated by stars in the other groups. From Fig. 2 the operation of the system can be clearly seen. The call-wire is connected to springs g, g_2, h and h^2; the operator's telephone is connected to O and O_2, m and m_2, and the switch is connected to the succeeding switch from springs n and n_2; thus, if the switch handle is moved to the right g and g_2 break contact with n and n_2 and make with O and O_2, thus puting the telephone in circuit and cutting off the call-wire from the next switch; if the switch is moved to the left h and h_2 break contact with m and m_2 and the telephone is cut off from the call-wire altogether, the call-wire being left in continuity by the contacts between g and n, g_2 and n_2. In the middle position of the handle the telephone is bridged on at h m, h_2 m_2 and the call-wire is continuous.

In Fig. 1 it will be seen that operator No. 1 has cut out of the call-wire to make a connection, No. 2 has connected with the call-wire and so cut it off from the succeeding operators, and Nos. 3, 4 and 5 are bridged on, waiting to come into line.

Mr. Hibbard's system promises an advance in methods of toll-board operation.

CURRENT NEWS AND NOTES.

THE NEW ORLEANS LEVEE LIGHTS.—It is stated that the arc lights along the famous levee at New Orleans have broken up completely the last remnants of the old gangs of thieves that were a terror there. Now some 60 policemen guard it easily, and a newspaper can be read at night all the way.

VELOCITY OF LIGHT RAYS.—The Franklin Institute has renewed its offer of the Boyden prize for an answer to the question whether all rays of light and other physical rays are, or are not, transmitted with the same velocity. This prize has been before the public since 1859, and the original amount of $1,000 has by accumulations of interest increased to over $3,000.

STANDARDIZATION OF EXTRA HEAVY FLANGES.—During the summer a committee representing a number of valve and pipe-fitting manufacturers prepared specifications for the details of extra heavy flanges of pipes, fittings and valves, and these specifications have been formally adopted by the leading manufacturers of the United States. The specifications cover the diameter and thickness of flange for different sizes of pipe, the diameter of bolt circle and the number and size of bolts. The rules will go into effect Jan. 1, 1902.

CENTRAL STATION INSURANCE.—At the recent meeting in Rock Island of the Illinois State Electric Association a letter from Mr. Frey, chairman of the committee on insurance, was read, giving the result of the investigations of the committee as to the conditions of central station insurance. Seventy-six replies to a circular were received from Illinois stations, 56 companies reporting $1,247,350 insurance, of which $206,500 was carried by mutuals; 20 companies reported no insurance. Among the companies carrying insurance, 46 had brick stations and 10 frame, the average rate paid by the former being $1.50, and by the latter $1.10. The average insurance among these plants is not over 40 per cent. The investigations showed that considering the expense of inspection and the rate charged by the mutual companies, the expense of insurance in these companies would equal that in the old line companies. The report advised the organization of a central station mutual company, saying that with such a company from 25 to 50 per cent could be saved. No success attended the efforts to obtain a reduction of insurance rates from old line companies. In the discussion which followed the concensus of opinion was that it was not practicable to form a mutual company, and that central station plants paying a high insurance rate should make such changes and adopt such dispositions as would reduce the fire risk, in which case a lower rate could be accorded them.

MARINE WIRELESS TELEGRAPHY.—According to our London contemporary, the *Electrician*, the Lloyds' (marine underwriters' association) have entered into an important agreement with the Marconi International Marine Communication Company. According to this agreement, Lloyds will employ no other system of wireless telegraphy than that of the Marconi Company for a period of 14 years; they will receive commercial messages at their signal stations from any vessel equipped with the Marconi apparatus, and will also send messages to any such vessel; but they will receive or transmit no wireless telegraph communication whatever where a vessel is equipped with apparatus not supplied by the Marconi Company. It is provided by the agreement that wherever a centre for commercial wireless telegraphy with ships would be advisable, the existing Lloyd's stations at these points shall be worked on the Marconi system; or, if no station exists within about 20 miles, a new Lloyd's station will be erected at a convenient point, and, of course, be placed in ordinary telegraphic communication with the post-office lines. Arrangements have been made by which Atlantic liners fitted with Marconi apparatus will be supplied with all the latest important news as soon as they come within about 100 miles of America or the British Islands; and, in course of time, the same will be done for liners on other ocean routes. As regards the revenue which the Marconi Company expects to derive from these operations, we understand that a tariff system is being adopted in place of the rental system formerly in vogue. Signal stations are allowed free use of the apparatus for the ordinary receipt of Lloyd's signals, and vessels signaling to one another are permitted a certain number of free service messages, but

for all commercial messages a charge of 6d. per word, in addition to land charges, etc., is made for each wireless transmission.

THE ENGLISH PUBLISHERS of Fitzgerald's "Lead Storage Battery" regret that, owing to fire which occurred in their bindery, almost the entire sheet stock of this work was destroyed, and that, at least for some little time to come, they will be unable to supply copies.

PHILIPPINE CABLE RATES.—The Commercial Cable Company announces reduced rates to the Philippine Islands. We are advised that the following rates go into effect on and after the 15th inst: Luzon Island, $1.66 per word from New York; all other islands, $1.76 per word from New York.

CLOSE OF THE PAN-AMERICAN.—The Pan-American Exposition, at Buffalo, closed on Saturday night, Nov. 2. The total attendance was 8,350,000, but the receipts are about $3,500,000 short of the expenditures. It is universally agreed that it will be remembered in history by the dastardly assassination of President McKinley and by the wonderful electrical display at night, attaining with the aid of current from Niagara a beauty and magnificent never before reached.

TELEPHONE WAR IN PHILADELPHIA.—It would appear that the telephone war in Philadelphia is now on in earnest. The Bell Company has announced a new schedule of rates for next year, brought about by prospective competition and the comparatively lower rates of the new Keystone Telephone Company. Illustrative of the Bell reductions for a limited service and party-line rates are the following: The old rate for business houses special circuit was $90 for 900 calls and six cents for each additional call; new rate, $69 for 800 calls and five cents for additional calls. For a two-party circuit: Old rate, $60 for 600 calls; new rate, $48 for 600 calls.

NERNST LAMPS IN THE CONNECTICUT STATE CAPITOL.—A contract has been awarded for wiring the capitol at Hartford, Conn., on the basis of 3931 incandescent lamps. Incandescent, arc and Nernst lamps are to be used in proportions to be subsequently decided upon. A particular feature will be the interior and exterior illumination of the dome. For the interior 836 incandescent lamps, or their equivalent, will be used. At the top of the interior of the dome a large Nernst lamp will be installed, and probably many more of these lamps will be used in the dome. Three hundred and seventy-two incandescent lamps, or their equivalent, will be placed on the exterior of the dome. Directly under the railing at the top there will be a circle of 36 Nernst lamps.

ST. LAWRENCE RIVER LIGHTING.—A special dispatch from Ottawa, Ont., of Oct. 30, says: "An important patent connected with the St. Lawrence navigation has been railroaded through the patent branch, application being made at noon yesterday, and the patent issued to-day and submitted to Minister of Public Works Tarte, by whom it will be laid before the Cabinet. The patent is designed specially to do away with the lighthouses, buoys and the entire paraphernalia for night navigation between Montreal and Quebec and substitute a submerged electric system which, however, will apply to all inland navigable waters. The main idea is to sink an electric cable in the center of the navigable channels, with power transmitted from a power-house at Montreal, and lines of colored lights at or above the water level, each side of the channel, the lights on one side being of a different color from those on the other side, and supported by cork floats. The patentee is H. J. Cloran, Mayor of Hawkesbury." Very similar work, however, has been done for years in Gedney Channel, New York Harbor.

SPEED AT ZOSSEN.—A newspaper dispatch from Berlin of Oct. 13, says: "The Kaiser is much disappointed to-day over the failure of the German engineers to get more than 73 miles an hour out of electrical cars on an experimental track from here to Zossen. Double that speed was expected." As the Zossen trials have just commenced, and the speed tests were only to be undertaken after every detail of the car equipment and collecting system had been tested out and remedied where found defective, it is somewhat premature to anticipate final results at the present time. Since the above was written a later cablegram reports that the Zossen trials have been entirely successful. It is stated that the speed of the trains has been gradually increased until now 85 miles are comfortably covered in the hour. The cars run smoothly and the engineers express confidence that they will attain a speed of 125 miles an hour. The wires have been tested to a capacity of 14,000 volts, but hitherto only 8000 volts have been necessary. It is expected that a voltage of 10,000 will suffice to give a speed per hour of 125 miles.

CONSTANT E. M. F. FROM A VARIABLE E. M. F.—A patent granted Oct. 29 to Norman W. Storer relates to means for maintaining a constant voltage at a translating device, such as a storage battery, on a circuit having a variable voltage. Assuming a storage battery to be the translating device to be supplied with a constant voltage, in series with it is the winding of one of three armatures mounted upon a single shaft. The first-mentioned armature is provided with a series field winding, and an auxiliary winding, referred to below. A second armature is connected across the main circuit and provided with a shunt field which is saturated under conditions of normal operation. The third armature is also provided with a shunt field so proportioned that the iron of the latter shall always be worked at a point well below saturation. The latter armature is connected at one side to a conductor of the main circuit, and at the other side to one terminal of an auxiliary winding on the field of the first-mentioned armature, the other terminal of which is connected to the other conductor of the main circuit. The armature with the saturated field will always respond quickly to all changes in the voltage of the main circuit. These changes in speed being imparted to the armature having a non-saturated field, the e. m. f. supplied by this armature to its circuit will vary rapidly with such changes, and thus will vary the excitation of the field magnet of the armature connected in series with the storage battery, and therefore also vary the e. m. f. impressed by the latter armature upon the storage battery circuit. By a proper proportioning of the windings this variation of the e. m. f. may be made such as almost to equal the difference between the e. m. f. of the main circuit and the constant e. m. f. in the storage battery circuit. This difference will be either a boosting or a counter e. m. f., depending upon whether the main circuit voltage is less or greater than the constant voltage desired.

A NEW THERMO-ELECTRIC COUPLE.—In 1827 Becquerel the elder investigated the thermo-electric relation between copper and its sulphide and later Becquerel's son constructed thermo-electric couples of copper sulphide in contact with copper or German-silver. By reheating bars of melted copper sulphide for several hours, he found that the thermo-electric power became more regular, and he constructed a thermo-electric battery in his laboratory with bars of fused copper sulphide thus obtained, covered at their ends with coils of copper or German-silver, which gave an e. m. f. relatively much higher than that given by any other thermo-electric couple known. Unfortunately, the natural resistance of this type of battery is so great that it was inappropriate for any practical use. Two patents granted Oct. 29 to Eugene Hermite and Chas. Friend Cooper, of Paris, France, relate to overcoming this difficulty, and also that of making contact between the copper sulphide and the metal employed therewith which shall be indestructible by heat. The copper sulphide is first melted, then cast in the form desired; the pieces thus obtained are next placed in a crucible heated to redness, in which they are submitted to the action of sulphur vapor for about half an hour. After being taken out and cooled, they are again put back into a closed furnace and heated to bright redness for several hours with exclusion of air, some ingots of copper being placed in the furnace to absorb the sulphur vapor evolved. After this operation the resistance is found to be greatly decreased, and every piece gives a perfectly regular e. m. f. of from .2 to .3 of a volt. It is also advantageous to add from 1 to 5 per cent of sulphate of iron to the copper sulphide. It has been found that the most advantageous metal to use in contact with copper sulphide in the construction of thermo-electric couples, is brass. Minute instructions are given in the patent concerning the operation of securing the brass to bars or tubes of copper sulphide, and also for mounting the couples in a protecting casing.

LETTER TO THE EDITORS.

Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—From time to time there have appeared in print accounts of wireless telegraphy experiments, in which two signals have been sent simultaneously without interference. Now, it is well known that from an aerial wire, no difference what its length, the waves are sent

out in every direction, and any well-constructed receiver within reach will pick up the waves.

What effect could a receiver in tune with a certain sender, simply because it was in tune, possibly have on some other receiver at a distance not in tune? And if two receivers are in tune, would not a receiver not in tune with a particular sender be in tune with some other, possibly still unconstructed, sender? And if the latter does receive the waves sent out, is it possible that the one in tune, simply because it was in tune, will receive no other waves than those from that particular sender? Another thing that appears to me to be somewhat doubtful is the statement that a certain fixed condenser capacity and no other, properly attached, will put a sender and receiver in tune. I find that by using a condenser with one of its sheets of tin-foil attached to one side of the induction coil's secondary, and the other sheet earthed, that with the rotating disks described in a former article, the condenser exerts no varying effects when its capacity is varied. A small capacity being sufficient to contain one side of the impulse, positive or negative, from a transmitting coil, if enlarged, it will still hold the one side of the impulse, and the increase of capacity is without effect, excepting possibly involving more dissipation of the charge before discharge is made.

It is not like charging a Leyden jar with an influence machine, where there is a stream of impulses, positive or negative, to be accumulated before discharge; but rather a single accumulated one-side impulse, positive or negative, and then a discharge toward the side without condenser.

Alfred G. Dell.

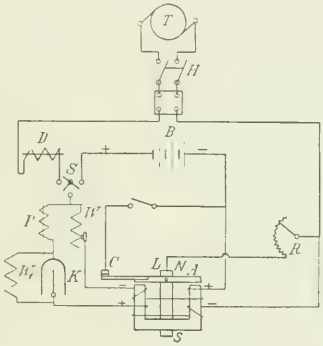
Baltimore, Md.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers

Leblanc Converter.—Feldmann.—A well illustrated description of a new converter devised by Leblanc. It consists of a stationary transformer of special construction, a stationary collector the segments of which are connected to the secondary coils of the transformer, and a small synchronous motor for revolving the brushes around the collector. These three essential parts are placed in one casing. This converter transforms 3500-volt, two-phase currents into 120-volt direct current. When combined with a synchronous motor, which takes care of the wattless currents supplied from the line to the converter, the converter transforms 3500-volt single-phase currents into 120-volt direct current without sparks at the commutator. If the converter is to be used for transforming direct current into single-phase or two-phase currents, it must be used in both cases in combination with the last mentioned synchronous motors which then acts as a storage of energy. The special feature of the converter is the stationary transformer part, which is quite complicated. Besides the primary and the secondary windings there are two "compensating windings." The primary windings are connected to the line, while the secondaries are connected to the segments of the stationary commutator, in a manner similar to the construction of direct-current machines. The synchronous motor, which has to take care of the wattless currents, as mentioned above, must have the same capacity as the converter when used for single-phase. The article is well illustrated by figures and diagrams, and Leblanc's theory is given. Such a 16-pole, 60-kw converter of this type has been built by the Helios Company, and the results of tests were in full agreement with the theory.—*Elek. Zeit.*, Sept. 26.

Charging Storage Batteries from Alternating-Current Mains.—F. J. Koch.—An illustrated article on "A new system of getting direct current from alternating-current mains." If an alternating current with sinusoidal e. m. f. is converted by means of a synchronously revolving commutator, the e. m. f. of the current has a wave form which consists of a series of half sine waves of the same polarity. the e. m. f. pulsates continually between zero and a maximum. Such a current is not adapted for charging a storage battery. Only those parts of the wave of e. m. f. are adapted for this purpose, in which the e. m. f. is greater than the counter e. m. f. of the battery. The other parts of the current must be cut off by the commutator. The current which is supplied from the commutator to the battery, has, therefore, the following waveform. It increases from zero to a maximum and decreases to zero, remains zero for an interval, increases then again to a maximum, and so on. He describes a commutator devised by him for this purpose. It is somewhat similar to a polarized relay. A special feature is the use of a condenser to counteract the effects of the self-induction of the coils of the commutator. To adjust the capacity and the self-induction relatively to each other, he varies the self-induction by means of an auxiliary choking coil, the iron core of which is movable. He claims that his commutator interrupts and closes the circuit exactly at those moments when the e. m. f. of the current supplied from the commutator is exactly equal to the converter e. m. f. of the battery. There are, therefore, no sparks at the point where the contact is made and broken. The arrangement is shown in the adjoining diagram. *T* is an alternator, *B* is the battery to be charged, *C* is the point where the contact is made and broken, *P* is the choking coil, with adjustable self-induction, and *D* is the main choking coil. *K* is a condenser, shunted by the choking coil W_1. The magnet arms have two windings, one supplied with current from the battery, the other from the alternating-



CHARGING STORAGE BATTERIES.

current mains. By properly adjusting these windings contact may be made only by the surplus of the alternating e. m. f. of the mains over the counter e. m. f. of the battery.—*Elek. Zeit.*, Oct. 10.

Aluminum Rectifier.—Mitkieviez.—An illustrated article in which he expresses the opinion that the electrode of an aluminum rectifier practically represents a large number of Wehnelt interrupters mounted in parallel. The glow on such an electrode resolves itself under the microscope into an infinite number of minute luminous stars, making as many punctures of the thin film of aluminum oxide, which covers the electrode. If the analogy holds good, it is not surprising that one phase of an alternating current is suppressed, since Wehnelt's interrupter does the same. In an aluminum rectifier it is not necessary to use a large aluminum surface. He uses an aluminum wire, cleaned by scraping with a knife and a lead cylinder, as electrodes in a solution of bicarbonate of soda.—*Phys. Zeit.*, Sept. 28; abstracted in Lond. *Elec.*, Oct. 11.

Variable Speed Direct-Current Motor.—An illustrated description of a device of Ziehl, by which the speed of a direct-current motor can be varied in wide limits, while the efficiency is only slightly changed. This is accomplished by producing a special counter e. m. f. in the armature and thereby diminishing the voltage of the current received, hence, according to the value of the special counter e. m. f. in the armature, the speed of the motor is varied without influencing the efficiency considerably. The special armature winding for producing the special counter e. m. f. consists of several parts of which any may be made active or inactive, to adjust the speed.—*Elek. Rund.*, Oct. 1.

Tramway Generators.—DETTMAR.—A communication criticizing Hobart's comparison of American and European specifications for tramway generators, the requirement in the United States being more rigid than in Europe (Digest, Sept. 14). The present writer claims that this comparison is unfair, as the specifications, given as usual in Europe, represent only the least requirements which must be fulfilled under any circumstances. He says that the actual machines of German make are much better and very often attain the requirement of the American specifications.—*Elek. Zeit.*, Oct. 3.

LIGHTS AND LIGHTING.

Illumination Effects by Means of Electric Sparks.—SOULIER.—When high-frequency currents are used in combination with condensers to produce sparks, the spark discharge, instead of appearing in a brilliant form, often takes the form of an arc which closes the circuit by a small resistance and does not allow the Hertzian phenomena to take place. To prevent this it has been proposed to extinguish the arc by an air current, but this requires special apparatus and a large consumption of energy. D'Arsonval has instead devised the following arrangement: He revolved rapidly the two metallic globes which form the spark-gap. This produces an air current which extinguishes the arc, and a beautiful illumination effect is obtained, in form of a circle of brilliant sparks.—*L'Ind. Elec.*, Oct. 10.

REFERENCE.

Train Lighting.—PRASCH.—A continuation of his illustrated serial in which he deals with the systems of Dick, Auvert and Kennedy's Columbian system.—*Elek. Neu. Anz.*, Oct. 1.

POWER

Pumping Plant.—In a continuation of the serial on the recent visit of the Brit. Inst. of Elec. Eng. to Germany, a description of the underground pumping plant in the Zollverein coal mine near Essen, Germany, is given. The mine is 400 meters below the surface, and 3 cubic meters of water are pumped per minute to its height. The pump is a duplex differential pump running at the slow speed of 62 r. p. m., and is directly coupled to a 350-hp, three-phase induction motor, supplied with current at 1000 volts and 25 p. p. s. The motor weighs 30 tons, and it was difficult to take it down the shaft and erect it. The motor has been in use for three years, and the installation was very satisfactory.—Lond. *Elec.*, Oct. 11.

Electric Installation of a Sluice.—An illustrated description of the electric power and light installation of the sluice at Poses-sur-Seine, France. The River Seine divides there into two arms, and there is a wear-head, 12 to 30 horse-power being available. There is one turbine and two dynamos, each giving 40 amperes at 275 volts, also a storage battery of 54 cells, with a capacity of 200 ampere-hours. The three-wire system for lighting the sluice is separate from the power circuit for operating the doors of the sluice.—*Le Genie Civil*, v. 39, No. 17; abstracted in *Zeit. f. Elek.*, Sept. 29.

Portable Electric Drill.—A well illustrated description of an electric drill of German make. It is entirely self-contained. The drilling spindle is 2.4 inches diameter, with a stroke of 12 inches, and drills holes up to 3¼ inches diameter. It can drill at any angle in a vertical circle. A 2-hp motor is mounted on a bracket at the end of the horizontal bar. It makes 1250 r. p. m., and drives a second shaft with worm, which transmits through back gear to the drill spindle. The four-step cone is used. It is made for a wedge belt.—*The Eng.; Sc. Am. Sup.*, Oct. 12.

REFERENCES.

Superheated Steam in Engines.—LENKE.—A Glasgow Int. Eng. Congress paper, giving some experiences and results derived from the use of highly superheated steam in engines.—Lond. *Elec.*, Oct. 4.

Crane.—An illustrated description of a 150-ton electric crane, installed at the new repair basins of the port of Bremerhaven, Germany.—*Sc. Am. Sup.*, Oct. 19.

TRACTION.

High-Speed Railways—DOLEZALEK.—A long abstract of a paper, in which he discusses the problem of the construction of high-speed railways. He does not believe that the present track construction of railways can be used, nor the monorail system of Behr. He says much in favor of suspended railways of the Langen system, such as the railway between Barmen and Elberfeld. He recommends building the suspended railways for very high speeds directly above the tracks of the present railways. The slow-speed accommodation trains are to be operated with steam as before, but the high-speed suspended railways are to use electricity. He points out the practical advantages of such an arrangement.—*Elek. Zeit.*, Oct. 3.

Electric Automobile.—MUELLER.—The conclusion of his serial on the problem of electric automobiles, the first parts of which were abstracted before in the Digest. He says that this problem is not yet solved. He gives, however, the following general rules for the construction. The wheels should have large diameters. The wheels and axles should be light and as much as possible free from other parts of the construction. The carriage springs should have a large variation of form with a small variation of load. The upper part of the automobile with all its accessories should be a self-contained unit. He remarks that while these rules are not followed in the German automobile industry, certain types of American automobiles fulfill them nearly.—*Centralblatt f. Accum.*, Oct. 1.

REFERENCES.

Tramway Power Calculations.—HAUSARD.—A sheet giving a tramway tractive effort and power diagram; also a brief explanatory article. Logarithmic scales are used in the preparation of the diagrams which appear to be quite handy. It gives the following information. First, given the weight of the car and the gradient, the draw-bar pull is shown. Second, taking into account the speed, the brake-horse-power required to drive the car may be found. Third, if the efficiency of the electric equipment is known, the kilowatts to be supplied to the motors are shown, the column for which is also scaled in "amperes at 500 volts."—Lond. *Elec.*, Oct. 11.

Wheels for High-Speed Railway Cars.—REYMOND-SCHILLER.—A communication in which he discusses the mechanical construction of the wheels for high-speed railway cars, to ensure safety.—*Elek. Zeit.*, Sept. 26.

Load Factors.—BOOTH.—An article on the station load factor, i. e., the ratio of the mean station output in a given time to the maximum output. He refers especially to traction stations and discusses the relation between the load factor and the number of cars running.—Lond. *Elec. Rev.*, Oct. 11.

British Tramways.—A well illustrated description of the Croydon municipal electric tramways. The overhead trolley equipment is on the side bracket system.—Lond. *Elec.*, Oct. 4.

Automobile.—PETOT.—A French Academy note, of a mathematical nature, on the action of the brakes of automobiles.—*L'Ind. Elec.*, Oct. 10.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electrical Energy.—DE FODOR.—A communication on methods of charging for electric current. He has determined for 12 years the annual time of use of a kilowatt, connection to the station, and he has found that for a certain class of consumers the annual time of use is nearly constant. He divides the consumers into three classes. First, large consumers with which the station has to make special agreements; second, stores, offices, etc.; third, smaller private consumers. For the latter two classes he bases the tariff on his statistical data which state that each kilowatt connected to the mains should be used for so and so many hours per year for each of these two classes. For the hours above these statistical average values he allows discounts which differ according to the time of the year, less in the winter and more in the summer. He thinks that the maximum demand system is unjust.—*Elek. Zeit.*, Sept. 26.

British Lighting and Traction Plant.—An illustrated description of the Croydon municipal plant. For lighting, alternating current is generated at 2000 volts and transformed down to 200 volts in 26 substations. The outlying districts are fed at 5000 volts alternating current through cables. Ferranti rectifiers at the plant convert alternating into direct current for lighting 62 arcs in the central thoroughfares. The more remote districts are lighted by means of low-pressure enclosed arc lamps supplied with alternating current from the same mains as are used for private lighting. For traction the overhead trolley system is used. It is proposed to supply the central portion of the town with direct current for lighting, and a considerable motor load is expected. An interesting feature is the control of the public lighting over an area of 12 square miles by means of a selector system which utilizes the pilot wires as well as the telephone wirs. By this means the whole of the arc lighting, some 400 lamps, can be switched on or off the central station in very few minutes.—Lond. *Elec. Rev.*, Oct. 4.

REFERENCES.

German Three-Phase Plant.—In a continuation of the serial on the recent visit of the Brit. Inst. of Elec. Eng. to Germany, an illustrated description of the Essen station is given. There are four generating sets, two of 1000 kilowatts and two of 500 kilowatts, all generating current at 5000 volts and 50 p. p. s. The station supplies a three-phase motor load and three-phase lamp circuits. Three wires are led into all the consumers' premises except the very smallest. Some 300 motors aggregating 4000 horse-power, and about 30,000 lamps are connected to the mains.—Lond. *Elec.*, Oct. 11.

Lausanne.—Taeuber.—A well illustrated article on the generating station and converter station "Pierre de Plan," of the electric works of Lausanne in Switzerland. It contains five 400-hp, 3100-volt three-phase generators, which are partly driven by steam engines, and partly by direct-current motors. The arrangement of the station which is very spacious, and especially of the instruments, switches, etc., is described in detail.—*Elek. Zeit.*, Oct. 3.

Electro-Physics and Magnetism.

Interference and Polarization of Electric Waves.—Quincke.—An abstract of a Brit. Ass'n Adv. Sc. paper, in which he describes some apparatus for producing plane polarized Hertzian radiation of definite wave-length, and for causing two waves, one displaced a quarter length behind the other, to interfere. An ordinary oscillator is placed at the mouth of a metal tube leading into a square metal box from which two branch tubes curve round to a similar box containing the coherer. This apparatus always gives waves of the same wave-length, whatever may be the nature of the oscillator and whatever the fluid or other substance filling the tubes. He found that the ratio of the velocities of the waves in the tubes to the waves outside, was as four to three in the apparatus which he used. In another form of the apparatus the radiation from the oscillator is passed through a straight tube to the coherer, but midway along this tube there is a T-piece consisting of a vertical tube which may be either closed or open. By adjusting the length of this T-piece the reflected wave from the bottom of it may be made to interfere exactly with the wave passing straight through. These apparatus closely resemble the acoustical apparatus for producing similar phenomena with sound. In the discussion, Larmor suggested that the wave-length was determined by the tubular apparatus, and not by the actual oscillator, the tubes picking out the particular oscillation corresponding to their own natural period of oscillation. Quincke agreed with this.—Lond.*Elec.*, Sept. 20.

Conduction of Electricity Through Mercury Vapor.—Schuster.—A brief abstract of a paper read before the Brit. Ass'n Adv. Sc. He first described the extreme difficulty in obtaining perfectly pure mercury vapor, free from oxygen or other gas. Using "the voltage of about 1000 cells" between the surfaces of the mercury over which the vapor was formed, he found that the discharge commenced at about 100 degs. C., and as the purity increased the temperature at which discharge took place rose to 130 or 160 degs. Even at atmospheric pressure, with the vapor at this temperature a strong discharge was obtainable from 1000 cells, and in every case the much-debated dark space was clearly in evidence. The sparks appeared to spring from the line of contact between the mercury surface and the glass. In the discussion, Lord Kelvin described this as "a very upsetting paper," as from Schuster's experiments it would follow that the mean free path of the mercury molecules might be as much as 2 or 3 cm. in length, even at atmospheric pressure, within the dark space. Schuster replied that he believed that the mean free path has nothing to do with the existence of the dark space.—Lond. *Elec.*, Sept. 20.

Nature of Lighting.—Koch.—He has found that lightning conductors whose connections have become imperfect through rusting or otherwise, act, nevertheless, in quite an efficient manner in the case of a thunderstorm. This is, in his opinion, due to the oscillating character of lightning discharges. Electromagnetic waves are produced, which act upon the imperfect connection as upon a coherer, restoring their conductivity for a more or less long period.—*Phys. Zeit.*, Sept. 14; abstracted in Lond. *Elec.*, Sept. 27.

Ions in the Atmosphere.—Ebert.—Since the researches of Elster and Geitel have made it appear certain that free positive and negative ions exist in the atmosphere, the present author has attempted to arrive at a quantitative estimation of their number under different atmospheric conditions. The results show that the number of free ions is very much larger in clear sunny weather than in air filled with dust or moisture. The number is small in any case. The free charges in 1 cubic meter amount to about 1 electrostatic unit. The amount of ionization is about the 100,000th part of that produced by feeble Röntgen rays.—*Phys. Zeit.*, Aug. 17; abstracted in Lond. *Elec.*, Sept. 27.

Preservation of Standard Magnets.—Klemencic.—Since the discovery of new magnetic steels, it is possible to make permanent magnets which keep a constant moment for a whole year within 0.1 per cent. The question as to the best means of storing them when not in use is answered as follows: He encloses the magnet in a glass tube filled with cotton wool, which, in its turn, is embedded in an iron box with sides 3 mm. in thickness. This prevents both disturbances by jarring and by an external magnetic field.—Lond. *Elec.*, Sept. 27.

Magnetic Properties of Iron.—Mauermann.—A long communication giving an account of experiments, in which he studied the influence of annealing upon the magnetic properties of iron. The values of hysteresis obtained show the great influence of the temperature used, the duration of the annealing and the thickness of the sheets. With a temperature of 700 to 750 degs. the best results were obtained by annealing for 18 hours for sheets of 0.7 mm. thickness, 24 hours for 0.5 mm. thickness, and 9 hours for 0.3 mm. thickness. To anneal for a longer time is disadvantageous. The longer hours for the 0.5 mm. thickness seems to be accidental. Experiments with a higher temperature, 950 to 1000 degs. C., showed that this is disadvantageous, especially for sheets of 0.7 mm. thickness. The fact often observed that the rim of iron sheets for dynamos is worse than the middle part, is probably due to the circumstance that the rim was heated to too high a temperature. The ageing of iron sheets is also intimately connected with the temperature used in annealing. The ageing was found to be due to the ues of too high a temperature in annealing.—*Elek. Zeit.*, Oct. 10.

REFERENCES.

Poynting's Theorem.—Franklin.—A mathematical paper on "Poynting's theorem and the distribution of electric field inside and outside of a conductor carrying electric current." After some general remarks on Poynting's theorem, he deals in detail with the following examples, illustrating this theorem: The slow discharge of two parallel charged cylindrical conductors through a cylindrical current sheet; current in a cylindrical sheet, nearly closed; electric current in two parallel infinite conducting sheets; flow of energy around a metal shield placed near a current sheet. All these examples apply to two dimensions only.—*Phys. Rev.*, Sept.

Induced Radio-Activity.—Max Lennan.—He has found some further cases of the induction of a secondary radio-activity by the action of cathode rays. The sulphates and sulphides of calcium, strontium and barium, show a distinct induced radio-activity on heating slightly after exposure.—*Phys. Zeit.*, Sept. 7; abstracted in Lond. *Elec.*, Sept. 27.

Electro-Chemistry and Batteries.

Electrolysis of Fused Alkali Chlorides.—Fischer.—A note on his experiments in which he has studied the causes of the fact that the sodium yield in the electrolysis of fused sodium chloride decreases as the temperature rises. He finds that the sodium loss is due to stray convection current, which can be avoided by the following arrangement. The two electrodes are arranged horizontally in alignment in an iron box, across which a cooling trough of marble is placed, dipping a little into the mass and cooling, but not freezing it. The anode is a carbon rod, the cathode a hollow iron pipe, through which the sodium which floats on the salt flows off. The arrangement entirely obviates the detrimental convection currents and consequent losses of sodium. But as the sodium spreads on the surface, the current density diminishes, and with it the heating effect of the current. As a result, the fused salt becomes sluggish, and the electrolysis is more and more limited to the neighborhood of the anode. A quick removal of the sodium, desirable in every respect, has, therefore, to be provided for.—Lond. *Eng'ing*, Oct. 4.

U. S. Electro-Chemical Industry.—J. B. C. Kershaw.—The first article of a serial on the electro-chemical and electro-metallurgical industry, dealing with the progress in the United States. The United States output of raw copper in 1900 was 268,000 tons. There exist in the United States eight electrolytic copper refineries, with an aggregate capacity of refining 211,000 tons per year. The United States aluminum output in 1900 was 3190 tons, 10,000 horse-power being available for this manufacture at Niagara. By the end of this year it is probable that 7700 horse-power, all generated from water, will

be utilized in the United States for alkali and chlorine manufacture. A few brief remarks are added on the production of calcium carbide, chlorate of potash and soda and nickel—*Elec. Rev.*, Oct. 12.

Orlyte.—DUSCHAU DE VULITCH.—An account of experiments made by Orlowski on a method of reducing the excessive hygroscopic properties of carbide of calcium. He has discovered a new material "orlyte" in the following way: The pasty mass of carbide, as it issues from the furnace, is dropped into "a mixture of natural tar and mazout or astatki, the proportions and application of which are protected by a patent." This lasts about a minute, during which the carbide absorbs 4 per cent of impregnating material. A yield of 300 to 310 liters of acetylene per kilogram and a lighter and more perfect flame are claimed. Orlyte is not hygroscopic, the greasy material it contains being unaffected by moisture.—*Jour. de l'Elec.*, No. 125; abstracted in *The Elec. Chem. and Met.*, Sept.

Edison Storage Battery.—An illustrated translation of a new Brit. patent by Edison for his battery (May 21, 1901). In an editorial note it is claimed that the methods described in the patent for preparing the ferrous oxide and for the conversion of a lower oxide of nickel to higher ones by means of chlorine are not new. The exact description of the mechanical manufacture of the plates is new.—*Centralblatt f. Accum.*, Oct. 1.

NEUBURGER.—An article on the Edison storage battery and its value for automobilism. The main criticisms made are that long life of the cell has not yet been proven, that he cell requires more space than the lead cell, and that it is more expensive.—*Der Motorwagen*, v. 4, p. 190, 204; abstracted in *Centralblatt f. Accum.*, Oct. 1.

Color of Ions.—VAILLANT.—A French Acad. note in which he shows that in a completely dissociated solution containing only one colored ion, the color is independent of the nature of the other ion. If, on the contrary, the ionization is not complete, the coloration varies with the concentration and with the nature of the colorless ion. The coloration of a solution of whatever possible concentration can be, as a rule, connected with a value of its degree of concentration by a formula containing two, and only two constants, which relatively characterize the complete molecule and the dissociated molecule.—*Comptes Rendus*, Aug. 12; translated in *The Elec. Chem. and Met.*, Sept.

Electrolytic Piperidin.—A note on the production of the valuable stimulant piperidin by the reduction of pyridin in acid solutions. The best conditions for the electrolytic reduction are given by Pip as follows: "The sulphuric acid must be pure, and must be present in the proportion of at least 3 parts to 1 of pyridin. The electrodes may be of lead, silver, mercury or carbon, but not of platinum. The diaphragm must be free from all traces of salts of metals other than the above." A German firm is said to be about to work the process on a commercial scale.—*The Elec. Chem. and Met.*, Sept.

REFERENCES.

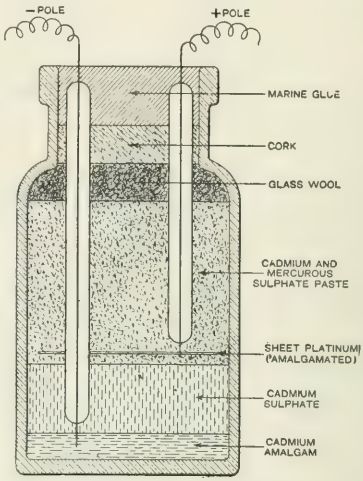
Acker Alkali Process.—ACKER.—An illustrated description of his process for producing caustic alkalies from fused electrolytes.—*Elektrochem. Zeit.*, Oct.

Electrolysis of Fused Salts.—GARRARD.—An illustrated article in which he gives a longer account of Lorenz's paper, abstracted at some length in the Digest, Aug. 10.—*The Elec. Chem. and Met.*, Sept.

AUERBACH.—An account of an experimental investigation of the electrolysis of fused iodide of lead and chloride of lead.—*Zeit. f. Anory Chem.*, v. 28, p. 1; abstracted in *The Elec. Chem. and Met.*, Sept.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Cadmium Standard Cell.—TINSLEY.—A description of a cadmium standard cell, in which he has tried to follow out the ideas advanced by Callendar as to the elimination of the errors due to diffusion lag in the zinc sulphate solution. He, moreover, aimed at obtaining a cell which would bear a perceptible current being taken from it without polarizing, and which would bear a short circuit with a certainty of almost immediate recovery without artificial means. The construction of the cell is shown in the adjoining diagram. Very little free moisture is present. Six cells made on different dates and with chemicals from two different makers, have a voltage varying between 1.0192 and 1.0190. He attributes this closeness in value to be partly due to the method of using only platinum wire for connections, as soldering usually causes a slight local action, especially if any trace of chemical happens to get on the joint. The curve of a discharge of the cell through 520 ohms is reproduced. At the start the internal resistance was about 40 ohms, and the current obtained was 1.8 milliamperes. In the first four hours the voltage dropped to 0.38, and the current to 1.6 milliamperes. In the next hour the voltage dropped quickly to 0.5, the voltage curve showing a sharp bend. This he thinks to be due to the electrode becoming completely covered with hydrogen. At this point the cell appears to become incapable of maintaining a current of any useful value. When once a cell has been allowed to discharge to a point beyond this sharp bend, it is some-



SECTION OF CADMIUM CELL, FULL SIZE.

what difficult for it to regain its normal, healthy condition unless a large amount of liquid is present in the cell. But a standard cell is scarcely subjected to such treatment. This form of cell should be very useful where a small current of, say, about 1 milliampere is required for short periods. The most serious drawback is the liability of the cadmium amalgam to dissociate when subjected to heavy jars.—Lond. *Elec.*, Oct. 18.

Turbine Interrupter.—An illustrated description of an interrupter, devised by Lecarme Brothers & Mitchel for the operation of Ruhmkorff coils from ordinary lighting circuits of about 100 to 120 volts. The contact is made and broken between brass and copper. To avoid the disadvantages of high-current density at the point of contact, the contact pieces have a large surface. The movable part is an axle on which four paddles are mounted with elongations of flexible and elastic brass; the current is supplied to the axle by means of a brush and slip-ring. This movable part is driven by an electric motor and revolves in a bronze case, which, however, is isolated from the movable part. The bronze case is filled with petroleum, and on its inner sides four pieces of copper are fixed which bear copper brushes to make contact with the four rotating brass paddles. The current leaves the interrupter through the brass case. When the movable part makes one revolution, the current is interrupted four times. It is claimed that the wear and tear of the brushes and paddles is small, and that the temperature does not rise above a suitable limit.—*Cosmos*, Oct. 5.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Cables.—WEST.—Calculation shows that the electrostatic capacity of telephone cables is greater with wires laid up in separate pairs than laid up in fours. But cables with wires laid up in fours show the bad effects of mutual induction, such as cross-talk. There should be no mutual induction, if in any cross-section of the cable the arrangement of the four wires and of the copper cores in their insulating covers would be entirely symmetrical, but this is only the case as long as the bundle is not stranded. The process of stranding draws the wires inwards towards the axle of the bundle and round the axle in the direction of stranding. Moreover, in practice some of the bobbins of the stranding machine have a tighter strain on them than others. This disturbs the symmetry of the arrange-

ment of the four wires, hence the mutual induction. He, therefore, suggests mounting the bobbins so that they rotate very easily and then to apply to each an accurately graded brake, but this would only lessen the trouble. He hopes for better results from other remedies, either by means of balancing the cable when the different sections are joined together, or by changing the direction of the winding alternately at intervals. He thinks such arrangements would pay on interurban lines, as they decrease the capacity.—*Elek. Zeit.*, Oct. 3; Lond. *Elec.*, Oct. 11.

Some editorial notes on this article. The starting point of West is denied. It is said that in practice the capacity of the cable for the same number and size of conductors and thickness of insulation is slightly greater instead of slightly less for a cable laid up in fours than one laid up in pairs. But the cost of the former is less, and this speaks in its favor. West's explanation of the reason of the cross-talk is thought to be correct, but it is said that his remedies can hardly be relied on sufficiently to eliminate the fault which is inherent in cables laid up in fours. The conclusion is, therefore, reached that the saving in using this class of cable instead of paired cable is not worth the extra precaution and risks of failure.—Lond. *Elec.*, Oct. 11.

REFERENCES.

Glasgow.—An illustrated description of the Glasgow municipal telephone exchange which is constructed on "the call-wire method," and is laid out to accommodate 10,000 subscribers.—Lond. *Lightning*, Oct. 3.

Block Signals.—Prasch.—An illustrated paper on the block signal system of Krizik.—*Zeit. Oest. Ing. u. Arch. Ver.*, Sept. 27, Oct. 4.

Railway Signaling.—Timmis.—His Glasgow Congress paper in full, with many illustrations, describing and discussing modern pneumatic and electric systems of railway signaling; an abstract of which was recently noticed in the Digest.—Lond. *Eng'ing*, Oct. 11.

Second Annual New York Automobile Show.

The second annual automobile show, given in New York City under the auspices of the Automobile Club of America, was held during the present week and will continue until Saturday night. When it opened last Saturday, preparations were a little backward, but early this week everything was in readiness for the attention of the large crowds which have flocked to Madison Square Garden each day. In some respects the show is different from that of last year, there being no track. A great deal of animation, pleasure and interest was contributed last year by the fine board track which encircled the exhibits on the main floor, upon which various types of vehicles sped around, showing their paces, but in view of the obvious dangers from fire due to the presence of gasoline and the chances of collision, explosion and panic, the officers of the club felt themselves reluctantly but imperatively compelled to dispense with the track feature. In fact, gasoline is practically excluded from the Garden, vehicles being required to discharge their supply before entering. Another feature of great interest missing this year is the sensational grade on the roof garden, where a fine display was made of hill climbing ability. A third element of special interest that has not been repeated are the various tests on the track, as to ease of starting, stopping, avoiding obstacles, etc. The absence of these features would appear to have lessened the attendance somewhat, although it is difficult to judge of that off-hand, as the public has had more room for circulation, while at the same time such exhibition space as was rendered available was taken up by exhibitors, of whom there are over a hundred. The quality of the attendance has been beyond dispute, and the number of sales reported, even of the costliest machines, is quite large. Toward the end of the week the number of "sold" signs appearing on handsome vehicles, with the names of the purchasers, was very noteworthy. One of the moot points among amateurs and manufacturers during the week was that of the best time to give the show. The idea of the club has been that it was a good plan to hold the show at this season of the year, just ahead of the Horse Show, but not a few favor and prefer a spring exhibition. They say that the public finds it hard to reconcile new styles with the approach of winter, and regards the vehicles as, for example, the "1901 model," whereas they are slow to believe that they are in reality being shown the "1902 model." Of course, it would hardly be advisable to hold another club show in the spring of next year, but should the advocates of a change of date prevail, the third show might not take place until the spring of 1903, which seems a long, long way off when dealing with anything so young and progressive as the automobile industry in America.

On entering the Garden, the visitor finds the whole restaurant occupied by the loan exhibit of the club, and a most interesting department it is, inclusive as it is of the vehicles actually owned and used by the members, well-known men of wealth and sporting proclivities, who have taken up with zest and enthusiasm the new amusement. A number of fine, though ponderous, machines are thus shown, in few of which are there any traces of beauty or any attempt at graceful curves, but it seems too much to expect just yet successful attempts at æsthetic effect in vehicles of 20 or 30 horse-power, built for touring over rough, dusty roads or for "hitting it up" to a mile a minute on the race track. One of the neatest machines here is that loaned by Mr. A. L. McMurtry, a 12-hp gasoline, weighing 2100 pounds, built by the Ohio Automobile Company, in which the Packards, so well known in the electrical field, are prominent and have decidedly added to their mechanical and engineering reputation. Mr. Jefferson Seligman, the treasurer of the club, and well known also in electrical circles, has a handsome De Dion-Bouton machine of five horse-power there, and Mr. Spencer Trask shows his fine "Searchmont" of six horse-power. But of chief interest to electrical people visiting the show, as well as to a curious throng always grouped around the most little table on which it stands, is the complete cell of the new type Edison iron-nickel storage battery. Not only is the working cell shown assembled, but the parts are also exhibited in full detail. The cell is 12 inches hight, 2 inches thick, 5 inches wide and weighs 7½ pounds. It gives 120 watt hours, or 46 pounds per horse-power hour. The cell is a loan exhibit, but during the week Mr. J. M. Hill, an active member of the club and now associated with the new Edison battery company, has been in frequent attendance, while Mr. John Ott, of the Edison laboratory, has likewise given some of his time to answering the innumerable inquries to which the unpretentious exhibit gives rise.

On entering the main floor, it is found profusely decorated, while the exhibits follow the customary grouping along two main aisles, cross aisles and the circular aisle flanked by exhibits against the balcony wall, the balcony over the boxes being also fully occupied. In addition, the club has had a headquarters at the Garden during the week in one of the parlors, and the National Association of Automobile Manufacturers has also been in session during the week, closing its convention with a supper at the Hoffman House on Thursday night. Notes are given below as to some of the exhibits of electrical interest.

The Electric Vehicle Company, which had a large space at the main entrance, exhibited two distinct novelties in the way of light electric runabouts. Their "town and country" runabout, finished in black, with seat panels, shutters and running-gear in red, hubs of

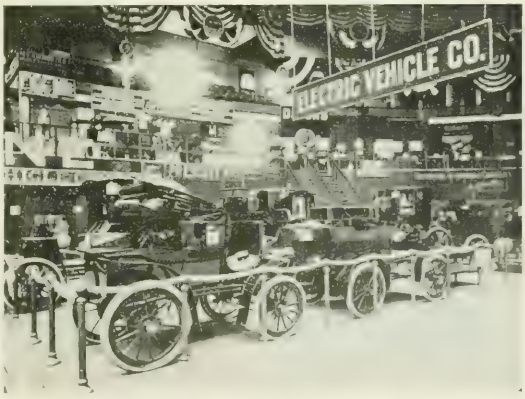


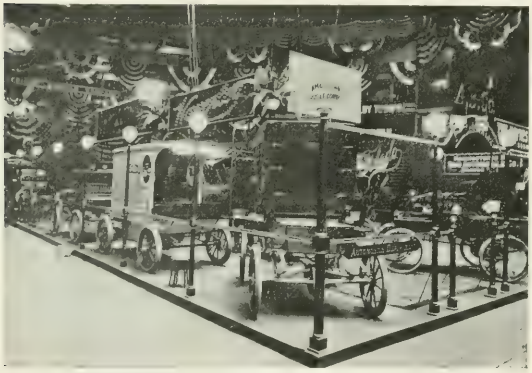
EXHIBIT OF ELECTRIC VEHICLE COMPANY.

nickel and with trimmings in black leather, is one of the lightest electric vehicles ever built. The carriage weighs only 875 pounds, equipped with the new Exide battery, consisting of 40 cells, which give it a touring radius of 40 miles on one charge, at a maximum speed of 14 miles per hour. The "Seabright Runabout," finished in

black, with seat panels and shutters in red, and red running-gear, weighing 1,675 pounds, is a heavier machine of the "town and country" type. In addition to these new models, the company had its usual line of standard types, which recently won a gold medal at the Pan-American Exposition and received commendation for tasteful excellence and beauty at many important automobile shows of the past year. The company was represented during the week by Messrs. Dodge, Riker, Byllesby, Condict, Cox, Armstrong, Jones, Scott, Edwards and McGee.

GENERAL POWER COMPANY, 100 William Street, New York, had an interesting exhibit in the balcony, illustrative of the ease and economy with which its kerosene engines of the new Secor type can be applied to the generation of current for automobile purposes. It still remains a question with many owners of vehicles how they shall procure the necessary current, and the compact little units shown by the company would indicate that there is no trouble in using the kerosene at the stable, with all its defects of odor, etc., and getting all the benefits of electricity for propulsion. The exhibit, which had a sign run from the unit, was the centre of much attention. It was stated that a 2½-hp engine was feeding 40 lamps of 10 candle-power. There was a brilliant searchlight run from the same outfit.

THE AMERICAN BICYCLE COMPANY had a large and fine exhibit at the eastern end of the main floor, heralded by three huge electric signs. For electrical people the chief interest here lay in the excellent Waverley electric automobiles and the Sperry battery. No fewer than six Waverleys were shown, including their Stanhopes, with and without top, a surrey and a delivery wagon. The surrey is a roomy, two-seated vehicle, and likely to be not less popular than the



WAVERLEY ELECTRIC AUTOMOBILES.

runabouts of the same make. In the space were two tables upon which were spread parts used in the construction of these carriages. The features of the Sperry battery, to which much attention has of late been given in these pages, were also the subject of considerable attention and inquiry during the week. Two other divisions of the space were similarly occupied, one being devoted to Toledo steam automobiles and the other to gasolines, one of which finished the Buffalo run without any repairs during its trip. The motive power is furnished by a double-cylinder upright hydrocarbon engine of seven horse-power, using ordinary store gasoline. A number of officials and representatives of the company were in constant attendance, including Messrs. E. A. Sperry and R. H. Hassler, for the electrical end, and Messrs. E. O. Durfee and O. B. Henderson, of the automobile department of the company. Messrs. Coleman, Merseles and Schaaf, of the executive staff, were also present.

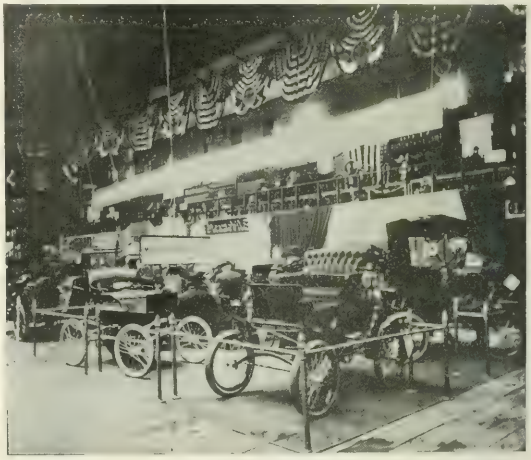
NEW PROCESS RAWHIDE COMPANY, of Syracuse, N. Y., had a very neat exhibit in the balcony, in charge of young Mr. T. G. Meachem, who showed an interesting collection of their rawhide pinions, which, in addition to being in use on over 200 electric railways, are already to be found very generally on the modern automobile. Mr. Meachem had a small electric motor carrying on its armature shaft two pinions, one of rawhide and one of steel, so arranged that either could be thrown into mesh with a steel gear wheel. The contrast between the noiselessness of the one combination and the racket made by the other left no room for argument.

THE PORTER BATTERY COMPANY, of the Monadnock Block, Chicago, had a nice exhibit in the balcony, in charge of Mr. A. S. Moses, who made the welcome announcement that the concern is about to open New York offices. It will be remembered that the remarkable tests lately made with this storage battery in Chicago and Cleveland were lately described for us by Mr. F. C. Philips, of the Elwell-Parker Company. The exhibit embraced parts of the battery, including the "grids," showing the peculiar formation of the cup-like slats to hold the active material, positive plates, negative plates and complete cells, of which five were shown mounted in a box. The special lugs used on the plates, making an excellent solid joint, were also shown. The literature distributed by the company included a neat pamphlet showing curves, and a report of Professors Woodworth and Hatch, of the Lewis Institute of Chicago, on an automobile test.

SEARCHMONT MOTOR COMPANY, of Philadelphia, now controlled, it is understood, by Mr. John Wanamaker, had an excellent display of their hydro-carbon vehicles, being represented by Mr. W. E. Hazelton, for a long time active in the electrical field, and who now has charge also of the interesting Wanamaker automobile station in 57th Street.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., had an exhibit of the excellent gasoline vehicle designed by Mr. H. Ward Leonard and lately shown and described in these pages.

BAKER MOTOR VEHICLE COMPANY, of Cleveland, showed four electric vehicles—runabouts and Stanhopes—of the type already illus-



BAKER MOTOR VEHICLES.

trated in these pages. There is virtually no change in these handy little vehicles, but the Stanhopes are an addition to the line, especially adapted for driving by ladies.

VEHICLE EQUIPMENT COMPANY, of Brooklyn, had up in the southeast corner of the Garden a very striking exhibit in the safe truck devised by them for the Hall Safe Company. In addition to being an electric automobile, the truck is equipped with hoisting gear operated by a small General Electric motor, and it was shown at the Garden elevating and raising a good-sized office safe. The exhibit by Mr. Gibbs included also an ordinary ambulance and a special vehicle built to order for one of the lying-in hospitals of Greater New York.

THE HYDRA DOUBLE BATTERY COMPANY, of 32 Broadway, New York, Mr. W. J. Hart in charge, had an interesting exhibit of their "Hydra" semi-dry battery for ignition purposes in hydro-carbon vehicles, and the usual uses to which batteries of this type are put. It is stated that the battery contains a large sealed carbon inner "storage" cell, filled with a special electrolyte, in which is carried a second zinc cylinder, greatly increasing the active surface. Mr. Hart interested the electricians present by showing the battery working on an ignition plug surrounded by a glass tube about 2 inches long by 1 inch diameter, to which air was pumped, the brightness of the spark when the air was pumped in being unusually bright for the time.

MR. C. E. MILLER, of 97 Reade Street, New York City, had an admirable collection of automobile supplies and specialties, among which may be noted the Pignolet pocket voltmeters and ammeters. The volt-ammeters are used for ascertaining the condition of dry

batteries used for ignition in gasoline vehicles, to show if new batteries are of full strength and when old ones should be renewed, as well as for testing circuits, locating grounds, short circuits and other trouble. There were also low-reading Pignolet voltmeters for testing single cells of storage battery. These instruments are of sufficient size to give readings of considerable range and at the same time are small enough to be carried in the pocket if desired.

Desberon Motor Car Company, of 51st Street and 12th Avenue, New York, had an interesting exhibit, in charge of Mr. E. T. Birdsall, the well-known electrical engineer, who also exhibited a new and effective form of ignition plug.

The "Flexduct" Flexible Conduit for Wiring.

One of the most interesting and important fields of modern electrical development is that of the conduit, and within a comparatively few years the art of interior wiring has been improved out of all knowledge, while a great new industry, that of conduit manufacture, has been added to the resources of electrical application. The gain in safety due to the conduit, as well as the greater beauty and invisibility of wiring work; the greater accessibility of the conductors for inspection; the possibility of providing for extensions and increases; and the facilities afforded for laying out a scientific network of protected circuits under all conditions of interior wiring—these and other features have given the conduit a deservedly high position of late years, so that no really good and first-class installation is now undertaken without its aid.

When it comes to the type of conduit that shall be used, opinions have differed widely, from the extremes of rigidity to those of flexibility, and the subject has received the careful thought of some of the best minds engaged in electrical engineering. The new conduit illustrated herewith is of the flexible type, to which the name "Flexduct" has been given, and its advent has been noted with much interest in the trade and profession. Its basic material is woven fibre, and the general construction can be inferred from Figs. 1 and 2, which show the outer covering, the inner tube and a section of the tube split open to exhibit the interior. The tube is closely woven, and inseparable or integral. The strands of the warp pass over and under the spiral alternately, and the weaving runs longitudinally, so that a smooth and unresisting surface is presented on the inside. The warp forms the inner lining and parallels the tube. It will be evident, therefore, that the spiral cannot be unwound and that the interior cannot be ripped out, the whole constituting practically one member. The smoothness of the channel insures anyhow freedom from any such catching

FIG. 1.—FLEXIBLE CONDUIT.

or ripping, and a peculiarly notable combination is secured of the qualities of toughness, smoothness and flexibility. After the conduit has been woven and built up, it is treated with a special compound which fills up and saturates thoroughly the whole fabric, rendering it absolutely proof against moisture, which is one of the most insidious foes that beset conduits. It is stated that not depending upon mere

FIG. 2.—FLEXIBLE CONDUIT.

adhesiveness in construction, but essentially upon its interweaving, it never "dries out," but remains always supple and yet tough.

The "Flexduct" conduit is made by the Osburn Flexible Conduit Company, which has opened offices for New York at 21 Park Row. The company has constructed a factory at Hoboken, N. J., of adequate capacity to fill a large demand, and equipped with a special plant for the production of the conduit. Mr. W. H. Seaich is president; Mr. C. E. Corrigan, vice-president; Mr. F. B. Thomas, general manager of the Waldorf, treasurer; and Mr. Harry G. Osburn, secretary. The conduit is made under the patents of Mr. Osburn, who is already well known for his storage battery and other inventions. The conduit is being made in all the sizes from ¼ inch up to 2 inches.

Motors in the Printing Office.

The Triumph Electric Company, of Cincinnati, Ohio, has lately brought out a number of special motor applications, as noted in these pages last week. We now illustrate two of these pertaining to the

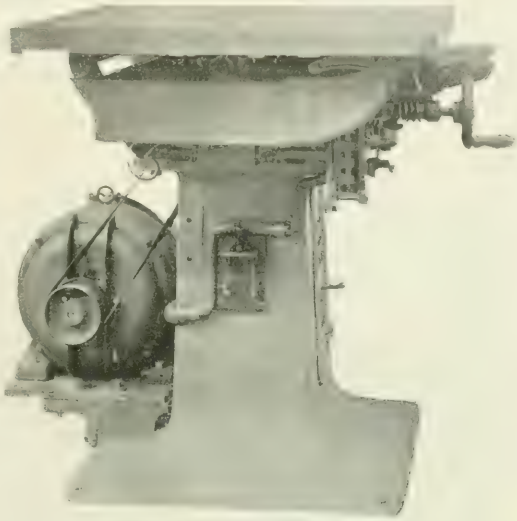


FIG. 1.—ELECTRICALLY DRIVEN PLANER.

printing office. One of the motor-driven tools shown is a jig saw used in printing offices for the purpose of sawing up lead plates. The other tool is a small planer also used in the same class of establishment for planing the edges of the lead plates so as to fit them for the form. In both cases standard-speed Triumph motors are

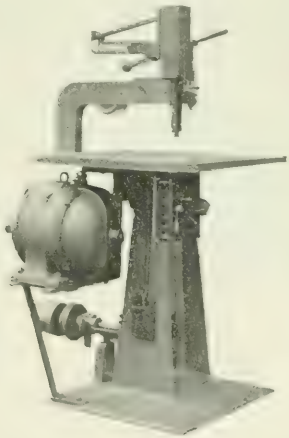


FIG. 2.—ELECTRICALLY DRIVEN JIG SAW.

used, the motors being placed on brackets fastened to the tools and short belted between the shaft of the motor and the shaft of the tools. In this manner floor space is not occupied, and the motor is associated very closely and economically with the work that it has to do. It will be noted that in each case a standard, rather than a special, motor has been found better and cheaper for this work.

Universal Sign Receptacles.

The Brewster universal sign receptacles and appliances, manufactured by the Electric Motor & Equipment Company, Newark, N. J., constitute a system of units from which may be quickly formed, wired and installed anything in the shape of electric signs or electric decorations. The appliances are weather-proof and are particularly adapted for outdoor use.

The illustration shown below exhibits the method of connecting and hanging the receptacles. Any one owning an equipment of these receptacles and the connecting clamp hooks possesses a ready means of effective advertising by the use of electric light. There is no limit to form or extent, and the sign or decoration of to-day can be changed to something different to-morrow with trifling labor. These receptacles were shown at the meeting of the New York Electrical Society, on Oct. 30, and were commended by the lecturer of the evening.

The S. K. C. System at the Pan-American.

ONE of the largest and best exhibits in Electricity Building at the Pan-American Exposition was that of the Stanley Electric Manufacturing Company, which is illustrated on this page. Its chief features were a relief map of the Standard Company's transmission lines in California; a 60,000-volt combination switch and fuse; a standard S. K. C. frequency changer in operation in the service of the Exposition Company, and a 300-kw, two-phase standard S. K. C. inductor, with separate phase-regulating device in operation in the Exposition power house. The performance of this machine was very gratifying to the Exposition authorities, and especially so to the power house attendants. This machine supplied current to all of the arc lamps on the Midway, and did part of the incandescent lighting.

Forming a part of the exhibit was a small motor-generator outfit in operation; a synchronous motor of the well-known S. K. C. inductor type connected by a special form of flexible insulated link coupling to a Northern direct-current generator, the latter occupying a position in the Northern Electrical Manufacturing Company's exhibit, which adjoined that of the Stanley Company. This motor generator outfit was brought up to speed by a direct-current back-geared motor.

Included in the S. K. C. exhibit were the following: A 6[illegible] slide oil switch, the latest development in ordinary tension c[illegible] switches. The switch was shown arranged for 2400 volts and a[illegible]proximately 250 amperes. It is made in all sizes up to 10,000 volts. It is a two-pole, single-throw switch. The special features of design are simplicity of mechanism, and a special long break between terminals and blade supplying an ample factor of safety. As is usual with S. K. C. apparatus, small details are carefully looked after, and proportions are liberal and robust. The switch is thoroughly insulated from the front of the board protecting the operator, and its design permits of installation to suit a variety of conditions. Although the break is in oil, zinc tips are provided to take the slight pitting on the blades which is inevitable, and which in time make a bad contact. The zinc tips are readily removable. The tank is porcelain lined, providing additional insulation, and is self-contained, and by taking out four machine screws is easily removable, exposing the mechanism of the switch. The terminals on top of the switch are provided with wooden boxes protecting against improper contacts.

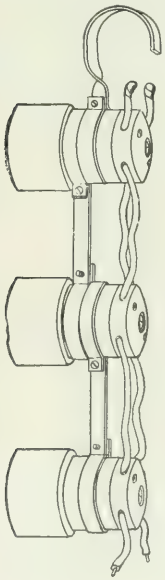
Among the transformers on exhibition were the type T, oil insulated and self-cooling, used by the great power transmission companies in California, some of which transform to and from 60,000 volts. Another was the S. K. C. subway, oil insulated, self-cooling transformer, designed particularly for installation in subway manholes. The extreme diameter of all sizes of this transformer is the same, viz., 24 inches, so that it can be passed readily through the opening of a standard manhole, the length increasing with the capacity. This type of transformer can be safely operated when entirely submerged in water. Being used for incandescent lighting particularly, they are built with very close regulation without sacrificing efficiency, and with low temperature rise. A special junction box was also shown for use where it is desired to run several secondary circuits from a single transformer.

The S. K. C. type A. O. (oil insulated) lighting transformer shown, is the latest transformer placed on the market by the Stanley Company. It is built in 15 sizes, from ½ to 30 kilowatts capacity.

Special attention was called to the device of Mr. John F. Kelly, which is used in all Stanley transformers, a magnetic iron core having in its composition an alloy preventing hysteresis growth. The object is the prevention of increase in core loss.

A complete line of their hot-wire measuring instruments and of dynamometers, wattmeters and power factor indicators, static voltmeters and static ground detectors were shown very effectively arranged, and hot-wire ammeters and voltmeters were also on view in both switchboard and portable types.

Reference has already been made to the 60,000-volt combination switch and fuse, and a detail description of this very interesting device is given in ELECTRICAL WORLD AND ENGINEER of June 29, 1901. Many hundred of these switches are in use in California at the present time, and they are doubtless the highest voltage switches in practical operation. One of them occupied a prominent position in the Stanley exhibit. Next to the 60,000-volt switch and extending



SIGN RECEPTACLES.

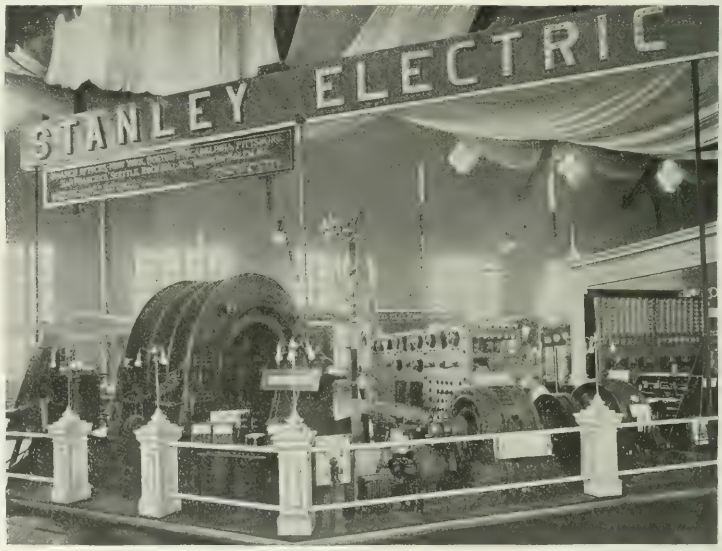


EXHIBIT OF THE S. K. C. SYSTEM.

practically the whole width of the exhibit was the standard S. K. C. switchboard, of marble, mounted on a steel frame. The exciter panel of this board is designed for single and multiple running of two exciters. The generator panel is designed for the control of a standard two-phase generator and provided with two three-pole switches and separate phase-regulation apparatus.

The complete line of S. K. C. switchboard instruments were shown mounted on the switchboard. The circuit panel was arranged for separate circuit regulation and for control of two circuits. Thereon were also mounted standard S. K. C. plugs and cables. This arrangement of plugs and cables allows any circuit to be plugged upon any phase of two two-phase machines. On the larger outfits the installation can be made to provide any combination. Another panel contained exclusively fusible cut-outs, and all of their well-known types. The well-known ball fuse was also shown in a variety of sizes. This fuse is so constructed that when the fuse proper blows carbon balls are blown into cavities arranged as receptacles, and the arc is effectively ruptured. Thirty thousand volts, with large capacity behind it, has been repeatedly short circuited through this device without a failure.

The lightning arrester exhibit was a particularly interesting one, and included the well-known cylindrical lightning arrester, standard S. K. C. choke coils and line dischargers. One of the most unique and striking figures of this exhibit was the use of the condensers connected in multiple with the field of the alternating-current motors, making a motor take current in proportion to its load, substantially as direct-current motors do. When so placed they supply the lagging combination of the current, or, in other words, the false current. With this arrangement the false current instead of flowing back through the transformer line and generator, thereby disturbing the whole system, simply flows to a local circuit through the condensers.

A new form of combined slide switch and circuit breaker was shown. This is a novel device and is virtually the simple addition of the circuit breaker attachment to the standard S. K. C. slide switch. When used as a switch the circuit breaker is not acted upon. Therefore the attendant does not have to close the switch against a spring. When the combination is closed, any overload immediately operates the circuit-breaker attachment, the combination acting as a circuit breaker. It is obvious that the one apparatus performs the functions which usually require two. This is especially desirable for crowded switchboards and is itself installed in small compass. Naturally the pecuniary saving is considerable. A double-pole, double-throw combination is made in the same form. Many makes of switches require twice the amount of room for double-throw as for single-throw. The device shown takes up no more room double than single.

A Pan-American Switchboard.

One of the switchboards exhibited at the Pan-American Exposition and in constant service there is shown in Figs. 1 and 2 on this page. This board was manufactured and installed by the D'Olier Engineering Company, of Philadelphia, and was well worth inspection.

The large switches, of which there were five, presented some unique features, among which were the handles and the laminated clips, giving good contact between the blades and clips, and allowing the switches to be easily handled. The switches were 1000 amp. each, and had the studs cast in solid with the clip bases. The connections to the studs were made by means of heavy brass castings clamping tightly around the studs and made to receive the connecting bar. These connecting pieces were forced tightly into the clamps and the studs were made of different lengths, which allowed a symmetrical arrangement of the bus bars.

Clamp connections were used entirely for the bus bars, making a piece of work easily erected and absolutely free from heating. The general design of the bus bars, etc., is shown in the accompanying cuts. The board was equipped with Weston instruments, Cutter laminated type circuit breakers and American Electric Heating Company's rheostats.

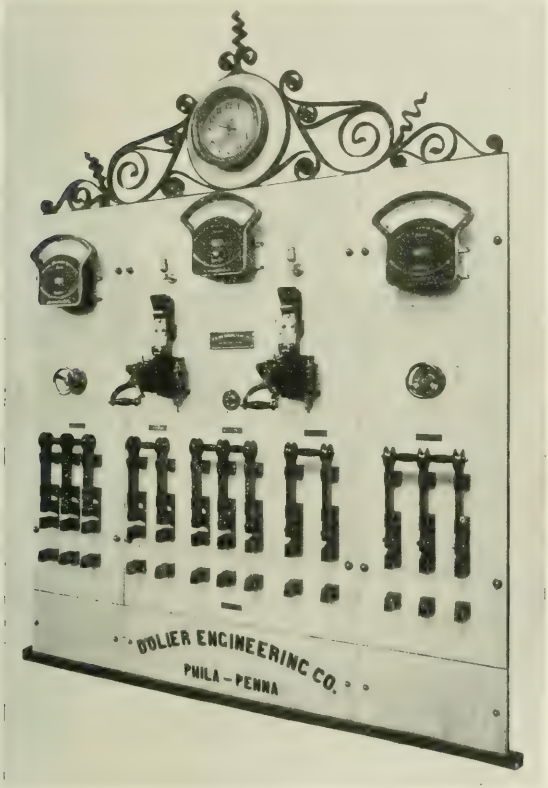


FIG. 1.—FRONT OF SWITCHBOARD.

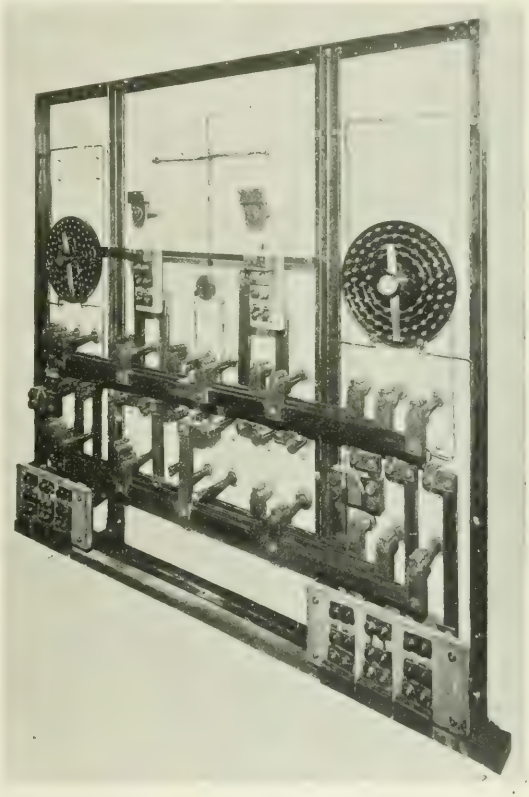


FIG. 2.—BACK OF SWITCHBOARD.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 4 per cent; time money, which was easy, closed at 4¾@5 per cent. Quiet and fairly steady conditions prevailed in the stock market—evidences that security values warrant present quotations. In the traction list, Brooklyn Rapid Transit closed with a net gain of 2½ points, the quotations fluctuating between 60⅜, the lowest, and 63¼, the highest, which was also the closing price on Saturday. Metropolitan Street Railway was weaker, closing with a net loss of 1 point, the range of prices being confined to narrow limits, 154¼ being the lowest and 156¼ the highest, closing at 155. General Electric was firm and steady, transactions being somewhat limited, only 1566 shares having been sold. The lowest figure was 255 and the highest 258¾, which was also the closing price, the net gain for the week being ¾ of a point. Western Union closed at 91⅝, a net gain of ⅛, the sales being 4040. American District Telegraph continues to increase in price, and gained 1¼ points, closing at the highest figure, which was 38¼. This stock has been steadily advancing for several weeks past. Following are the closing quotations of Monday, Nov. 4:

NEW YORK.

	Oct. 29.	Nov. 4.		Oct. 29.	Nov. 4.
American Tel. & Cable..	—	98	General Carriage.....	⅞	¾
American Dist. Tel.....	37½	37	Hudson River Tel.....	112	114
Brooklyn Rapid Transit..	62	62½	Illinois Elec. Veh. Trans.	—	1½
Commercial Cable.....	—	180	Metropolitan Street Ry..	156	154⅛
Electric Boat	19½	18	N. E. Elec. Veh. Tran...	—	1½
Electric Boat pfd.....	40	45	N. Y. Elec. Veh. Tran...	7	7⅛
Electric Lead Reduc'n..	2¾	2½	N. Y. & N. J. Tel.....	166	107
Electric Vehicle.....	1½	1½	Tel. & Tel. Co. of Am...	—	6
Electric Vehicle pfd....	3½	3½	Western Union Tel.....	91¼	91¼
General Electric.....	256	256			

BOSTON.

	Oct. 29.	Nov. 4.		Oct. 29.	Nov. 4.
Am. Tel. & Tel..... ..	158	157	Mexican Telephone.....	2	—
Cumberland Telephone ..	—	—	New England Telephone.	—	—
Boston Electric Light....	—	—	Westinghouse Elec.....	72*	—
Erie Telephone.....	·	22¼	Westinghouse Elec. pfd..	78*	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Oct. 29.	Nov. 4.		Oct. 29.	Nov. 4.
American Railways.....	39½	39½	Phila. Traction.....	95½	95½
Electric Storage Battery.	65	65	Philadelphia Electric.....	5	5
Elec. Storage Batt'y pfd.	65	75	Pa. Electric Vehicle.....	½	¾
Elec. Co. of America....	6⅜	6⅝	Pa. Elec. Veh. pfd.....	½	1

CHICAGO.

	Oct. 29.	Nov. 4.		Oct. 29.	Nov. 4.
Central Union Telephone	—	—	National Carbon pfd.....	84	84
Chicago Edison.....	160	159	Northwest Elev. com....	39	39
Chicago City Ry.....	200	—	Union Traction.....	15¼	13¾
Chicago Telep. Co.....	235*	—	Union Traction pfd.....	53	53
National Carbon.....	20⅜	20½			

*Asked.

VULCANIZED FIBRE COMBINATION.—The details of the plans of the American Vulcanized Fibre Company, recently incorporated with a capital of $4,000,000, are set forth in a circular from the directors to the stockholders of the Kartavert Company, one of the four companies consolidated. The circular says, among other things: "The new company will have an authorized capital stock of $3,400,000, of which $900,000 will be 7 per cent cumulative preferred stock and the balance, $2,500,000, will be common stock, and will also have an authorized bond issue of $600,000 of 6 per cent, 20-year gold bonds, secured by a mortgage on the entire property of the new company, such bonds to be redeemable at the option of the new company after three years at 105 and accrued interest. To facilitate the consummation of the transaction outlined above, the directors are requested to deposit their stock with the Security Trust & Safe Deposit Company, of Wilmington, Del., on or before Nov. 15, and such company will issue a receipt by which it obligates itself to either return the stock without any cost on the first of December, 1901, in case the option referred to is cancelled, or on the exercise of the option and a consummation of a sale thereunder to the new corporation to deliver the pro rata proportion to the purchase price paid for the company's stock." This consolidation had been in contemplation for two years. George B. Hanford, of New York, one of the leading organizers, has devoted much time to the perfection of the plan, and largely through his efforts has it been made effective. The next 60 days will see the perfection of the new organization. All the plants are to continue in operation and without material change in the working forces.

CENTRAL UNION TELEPHONE.—Director C. H. Brownell, of the Central Union Telephone Company, while in Boston, stated that the company is seadily extending its business, and that since President Sabin assumed the management fully 15,000 additional subscribers have been secured. The largest development has come in the cities of Indianapolis and Toledo. Plans are now under consideration for new construction work that will involve an expenditure in the immediate future of nearly $1,000,000, and will provide an additional modern equipment that will not be surpassed elsewhere in the country. President Sabin is bringing into vogue very largely the ideas that he used so successfully while he was on the Pacific Coast, and in this connection he is putting into service many new methods which are becoming very popular with telephone subscribers. Mr. Brownell is quite confident that the company has now started in under its reorganization, and with ample working capital in hand, for a greatly enlarged prosperity.

DIVIDENDS.—The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred, payable Nov. 15. The directors of the Cincinnati, Newport & Covington Railway have declared the regular quarterly dividend of ¾ per cent, payable Nov. 2. The directors of the National Bridge Company have declared the first quarterly dividends of 1¾ per cent on the preferred stock and 1¼ per cent on the common stock, payable Nov. 6. The capital stock of this company is $1,500,000, one-half of which is preferred.

ELECTRIC VEHICLE.—At the annual meeting of the stockholders of the Electric Vehicle Company the number of directors was reduced from 13 to 9. The following retiring members were reelected: H. M. Byllesby, George Chapman, G. H. Day, P. T. Dodge, T. W. Goodrich, Albert A. Pope, A. L. Riker, I. L. Rice and F. C. Stevens.

BOSTON EDISON.—The gas commissioners gave a hearing last week on the petition of the Edison Electric Illuminating Company, of Boston, for authority to issue $750,000 (par) new stock to fund its floating debt and for extensions. The Edison Company was represented by President Edgar and J. Otis Wardwell. There was no opposition.

KEYSTONE TELEPHONE STOCK.—It is stated from Philadelphia that while all the $5,000,000 Keystone Telephone Company stock now being offered has not been taken, subscriptions are stated to have been substantial and to have far exceeded expectations. This is the new independent system to be run in opposition to the Bell.

Commercial Intelligence.

THE WEEK IN TRADE.—The complaints of car shortage of the past few weeks continued last week, and although the latest railway returns indicate that transportation facilities have greatly improved, the Nation's business has expanded more rapidly. From all sections of the country, and many lines of industry, complaints are heard regarding the inability to move goods. The delay has been most aggravating in the case of coal, the unseasonably warm weather alone preventing serious inconvenience in this line. Not only are domestic requirements enormous, but coal is becoming an important article of export, partly owing to labor controversies in France and Great Britain, and also to the British export tax. Notwithstanding the loss of much freight movement through inadequate rolling stock, railway earnings for the month were 7.2 per cent larger than for the same month last year. While the mild weather affects retail distribution to a very marked degree, it is evident that the volume of legitimate business is not being curtailed, since the gain in bank exchanges at New York was 27.4 over the same period last year. There is no particular change in iron and steel; an advance in steel rails of $1 to $2 per ton for next year's delivery is talked of. There is an unprecedented demand at Chicago for finished products and structural material, and at Pittsburg the structural material is largely called for. Copper maintains its former strength, an agreement to restrict production being reported among the great interests. The market is thought to be artificially sustained by closing mines. Quotations are 16.85 cents to 17 cents for Lake, 16.30 to 16⅝ cents for electrolytic, and 15⅝ to 16.30 for casting stock. The business failures for the week, as reported by *Bradstreet's*, aggregated 172, as against 233 the week previous, and 165 the corresponding week last year. *Dun's Review* computes the liabilities of the concerns failing in October at $10,680,627, as against $9,072,791 the same month last year.

ELECTRIC POWER IN BRICK PLANT.—Griese Brothers, Cleveland, Ohio, are preparing to erect a large brick plant. There will be 15 buildings, including a power house, and machinery will be electrically driven.

ANOTHER EXTENSION TO THE BULLOCK WORKS.—Another extension to the Bullock Electric Manufacturing Company's plant has become necessary on account of the volume of orders for heavy machinery that has come to them in the past 60 days. Work has been commenced upon a building to be 250 ft. wide, having a main aisle 75 ft. wide, two side aisles 60 ft. each, and two side aisles 27½ ft. each. This building is planned to be 750 ft. long, but will not be built in its entirety at the present time. Contracts are being let for one-half the contemplated length. It will be electrically driven throughout, having electric traveling cranes in all the aisles, the head room under the crane of the main aisle being 50 ft., with 30 ft. head room in the 60-ft. aisles. The architectural features of the building will conform to those already erected, the walls being of buff brick with structural steel framework. The building is to be rushed to completion with all possible haste, and will provide facilities much needed. The company is also installing at the present time in its own power house a 1000-kw generator direct connected to a cross-compound Lane & Bodley Corliss engine. Its foundry is also being connected by side tracks to the system in the main works, which will permit of the use of its locomotive crane car for delivery of material to and from this portion of the plant.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended Oct. 20 shows:

	1901.	1900.	1899.	1898.
Gross output	95,655	67,198	50,861	33,639
Returned	23,374	30,737	18,044	11,823
Net output	72,281	36,461	32,817	21,816
Since Dec. 20:				
Gross output	778,826	524,362	539,598	278,363
Returned	324,663	220,698	163,271	120,082
Net output	454,163	303,664	376,327	158,281
Total outstanding..	2,406,979	1,884,169	1,501,577	1,077,402

THE NEW PROCESS RAWHIDE COMPANY, Syracuse, N. Y., through its English agents, Messrs. George Angus & Co., has received during the month of October trial orders for its noiseless pinions from no less than eleven of the leading electric railway companies in Great Britain. These trial orders will doubtless lead to a considerable trade in the near future. The company reports its trade in the general machinery line as steadily increasing, especially in the case of motor-driven machine tools where noiselessness is very essential. Since the company's announcement a couple of months ago that it is in position to furnish accurately cut metal gears also, the number of orders received for work in this line has been very gratifying and points favorably to an extended trade.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, has recently closed a number of contracts for the installation of batteries of Chloride accumulators in Edison stations. The Chicago Edison Co. has added two batteries to its Adams Street Station, this building now containing the greatest capacity of storage batteries located under one roof in the world. The Philadelphia Electric Company has added another battery to its system, and the Edison Electric Illuminating Company, of Detroit, has doubled the capacity of its installation. The Edison Electric Light Company, of York, Pa., and the St. Paul Gas Light Company, of St. Paul, Minn., have each contracted for a large battery to be installed in their lighting stations.

NEW STURTEVANT FACTORY.—Work is rapidly progressing upon the foundations for the new plant of the B. F. Sturtevant Company at Hyde Park, Mass. The buildings, including storage space between, will occupy a tract measuring in extreme dimensions about 500 ft. by 700 ft. This will provide space for the foundry, pattern and pattern storage building and power plant as well as the machine shop, 120 ft. by 500 ft., and a three-story structure of the same length, both terminating in a large head house, which will serve for the work of erecting, testing and shipping. The office will be a separate building of considerable dimensions.

SECOND-HAND EQUIPMENT.—The Standard Machinery & Equipment Company, of Cleveland, has recently assisted in closing a deal for the purchase by McDowell & Co., of Pittsburg, of a large lot of power and electrical equipments from the various sub-stations of the Cincinnati Gas & Electric Light Company, which is dismantling the plants, having a large central station under erection. Among the apparatus were four 500-hp Corliss engines, two 450-hp engines, twenty 150-hp boilers, three 150-kw direct-connected Westinghouse generators, and two 200-kw Wood alternators. Two of the plants were sold complete to Rossiter, MacGovern & Co., New York.

THE S. MORGAN SMITH COMPANY, York, Pa., has lately received an order for six single 39-inch and one 18-inch McCormick turbines from the Metabetchouan Pulp Company, Quebec. Each turbine will be mounted in an iron flume connected to a supply pipe 16 ft. diameter. Five of the 39-inch turbines will develop 4000 horse-power, and drive 10 pulp grinders. Another of the same size will drive the wet machines, screens and other machinery. The 18-inch will operate a dynamo. The head is 46 ft. The mill will have a daily capacity of 60 tons pulp, dry weight.

PRICE LISTS FOR SIBERIA.—Consul-General Hughes, of Coburg, under date of Oct. 10, 1901, says: The trade bureau of the Siberian Railroad publishes a notice that it wishes to have price lists, illustrated catalogues, etc., of all kinds of goods which are necessary and useful in Siberia. The chief of the bureau requests that price lists, sample cards and catalogues be addressed to Monsieur N. Selikhoff, Service Commercial du Chemin de fer Grand Siberia, Tomsk, Russia.

POWER PLANT PROPOSALS.—The McMyler Manufacturing Company, of Cleveland, manufacturer of hoisting and conveying machinery, is erecting a new plant at Warren, Ohio, and has called for proposals on the equipment of a power plant. Among the apparatus required are a 100-kw, 250-volt generator, direct connected; two 100-hp horizontal boilers, with mechanical stokers; feed-water heaters for 300 horse-power and feed pumps for the same. A number of motors will also be required.

WESTINGHOUSE EQUIPMENT FOR TORONTO.—The projected plant of the National Portland Cement Company, Limited, to which reference was made in our last issue, is to be equipped electrically with some $60,000 worth of machinery manufactured by the Westinghouse Electric & Manufacturing Company. The John A. Mead Manufacturing Company, New York offices, the Bowling Green Building, is to furnish apparatus to be utilized for the handling of hot clinkers in the Canadian plant.

THE ECONOMY ELECTRIC COMPANY, of Warren, Ohio, opened a new factory building a few days ago and celebrated the occasion with a banquet to its employes and those of the Warren Electric & Specialty Company, an affiliated company. The plant gives the Economy Company double its former capacity. Officers of the company have recently been elected as follows: T. H. Gillmer, president; P. L. Webb, vice-president; E. W. Gillmer, secretary-treasurer, and J. W. Holloway, assistant secretary-treasurer.

VARIOUS CAMP CONDUIT CONTRACTS.—The H. B. Camp Company, of Akron, Ohio, New York offices, Park Row Building, reports receipt of contracts calling for the furnishing of 350,000 ft. of vitrified clay conduits for the United Electric Company, Newark, N. J.; 150,000 ft. for the Interstate Telephone Company, of Trenton, N. J., and a substantial order from the North Jersey Street Railway Company, of Newark, N. J.

CRANE COMPANY ERECTS PLANT IN RUSSIA.—The Crane Company, of Chicago, Ill., has just completted the erection of an extensive plant at St. Petersburg, Russia, for the mannfacture of piping and other products of the company. The new works adjoin those of the Russian Westinghouse Air Brake Company, and are the second shops of the kind to be built in Russian territory for the turning out of American specialties.

ELECTRIC TRAIN LIGHTING.—The Pullman Company has just finished and delivered to the Louisville & Nashville Railroad Company three elegant dining cars equipped with the "Axle Light" system of the Consolidated Railway Electric Lighting & Equipment Company. No auxiliary light has been provided in these cars. One of these cars will run between Cincinnati and Louisville, and two between Birmingham and New Orleans.

CITIZENS' ELECTRIC LIGHT COMPANY at Rochester, N. Y., which proposes to offer an active competition to the existing system there is understood to have just closed a large and important contract with the Stanley Electric Manufacturing Company for five or six large two-phase generators to be used with three-wire circuits. Other contracts are being placed.

THE ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, Ohio, will occupy part of the new plant being erected by the Wellman-Seaver Engineering Company as soon as it is completed, which will be about the first of the year. The new quarters will give the company several times its present capacity for turning out electric controllers.

BOLT AND NUT MACHINERY FOR ENGLAND.—The Acme Machinery Company, of Cleveland, manufacturer of bolt and nut machinery has just made a large shipment of tools to the British Westinghouse Company.

CONTRACTS FOR POWER PLANT.—The Vulcanus Forging Company, of Cleveland, will soon close contracts for a new power plant, and will be on the market for a lighting generator; also motors.

TROLLEY BRIDGES.—It is announced from Cincinnati, that the Lackawanna & Wyoming Electric Railway has contracted with the Dayton (Ohio) Construction Company for 50 bridges to be built on its lines in Pennsylvania.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, announces Government orders for its Cross oil filters for the battleship "Illinois" and the torpedo boat "Bainbridge."

FEDERAL BATTERY COMPANY is announced to have been dissolved by the stockholders.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Oct. 30: Antwerp—Material, 18 pkgs., $1,038; machinery, 2 pkgs., $61. Bristol—Materials, 2 pkgs., $50; machinery, 12 pkgs., $1,073. Bucharest—Machinery, 1 pkg., $30. Bremen—Materials, 3 pkgs., $148. Berlin—Machinery, 14 pkgs., $100. British Possessions—Machinery, 1 pkg., $100. Bolton—Machinery, 6 pkgs., $520. British Australia—Materials, 1 pkg., $10. British Possessions in Africa—Machinery, 2 pkgs., $235; materials, 85 pkgs., $5,308. Baden—Materials, 5 pkgs., $750. Brazil—Materials, 8 pkgs., $351. British East Indies—Materials, 5 pkgs., $278; machinery, 14 pkgs., $4,600. Cuba—Machinery, 24 pkgs., $1,560. Central America—Materials, 15 pkgs., $301. Ecuador—Machinery, 2 pkgs., $89. Glasgow—Materials, 7 pkgs., $88; materials, 7 pkgs., $312; machinery, 4 pkgs., $421. Genoa—Materials, 1 pkg., $67. Havre—Machinery, 3 pkgs., $280. Hamburg—Machinery, 5 pkgs., $170; materials, 30 pkgs., $1,090. London—Machinery, 82 pkgs., $7,935; 36 pkgs., $1,841. Mexico—Materials, 13 pkgs., $371. Manchester—Machines, 21 pkgs., $3,035; materials, 1 pkgs., $21; materials, 10 pkgs., $283; materials, 3 pkgs., $126. Nova Scotia—Machinery, 12 pkgs., $1,000. Southampton—Machinery, 122 pkgs, $809; machinery, 3 pkgs., $188. San Domingo—Material, 6 pkgs., $232. Venezuela—Material, 108 pkgs., $1,699. British Guiana—Material, 2 pkgs., $17. British East Indies—Material, 16 pkgs., $438. Cuba—Material, 152 pkgs., $4,586. Dutch East Indies—Material, 4 pkgs., $72. Florence—Material, 8 pkgs., $532. Liverpool—Machinery, 22 pkgs., $3,264; materials, 153 pkgs., $10,723. London—Materials, 214 pkgs, $9,294. Mexico—Railway material, 303 pkgs., $9,945. New Foundland—Material, 8 pkgs., $206. Peru—Machinery, 118 pkgs., $2,188. U. S. Colombia—Material, 2 pkgs., $30.

AS TO COPPER.—Messrs. Hayden, Stone & Co. are sending their correspondents and customers the following review of the copper situation: The production of the metal for 1900 in this country was 602,000,000 lbs., and the figures so far as published for 1901 do not indicate that there will be any increase. During 1900 domestic consumption was 348,000,000 lbs. and the exports 352,000,000 lbs., amounting to 700,000,000 in all, and as the imports were 103,000,000 lbs., that accounts for the entire production. This year present figures indicate that the exports for 1901 will not exceed 250,000,000 lbs., and that, owing to the reselling of stocks on hand held abroad, the imports will be from 150,000,000 to 160,000,000 lbs., so that, whereas last year there was a net export over imports of 250,000,000 lbs., this year the net exportation will be less than 100,000,000 lbs. One of the large items in this decrease is in exports to Germany. The situation there seems to us to be practically parallel with the situation that exisited here eight years ago. The electrical concerns in Germany are besieged with orders and could easily obtain $30,000,000 of new business if they could swing it, but they have already accepted between $40,000,000 and $50,000,000 of business which they have been filling where they have received their pay in notes or securities, and they have burdened the financial institutions of the country with the carrying of these notes by discount or rehypothecation as collateral. We have no doubt that so soon as these financial obligations have been taken care of by proper distribution and digestion, that the demand for electrical machinery will cause another period of prosperity in the trade such as the General Electric Company in this country is enjoying to-day.

BALL ENGINE ORDERS.—The Latrobe Steel Company, Latrobe, Pa., is about to install an electric power plant in its works. One 300-hp and one 80-hp engine will be furnished by the Ball Engine Company, Erie, Pa. The Sagamore Coal & Coke Company, Bramwell, W. Va., will be equipped with an electric power plant. The Ball Engine Company will furnish a 300-hp side crank engine for the necessary power. The Cloquet Lumber Company, Cloquet, Minn., has recently ordered for its electric plant a Ball 225-hp horizontal tandem compound engine, direct connected to 132-kw Westinghouse alternating machine. The Ball Engine Company will furnish engines direct connected to generators for the post office at Philadelphia, and is installing a 450-hp vertical cross-compound engine in the plant of the Minneapolis General Electric Company. It is also building for the same company a 700-hp vertical cross-compound with Corliss valves. The city of Bangor, Me., has recently purchased a 500-hp engine for its electrical plant, from the Ball Company. The Brown Hoisting Machine Company, Cleveland, Ohio, has purchased from the Ball Engine Company, Erie, Pa., for power and lighting, two 450-hp tandem compound direct-connected engines. The contract for the engines for the electric power plant of the Chicago University has been awarded to the Ball Engine Company. There will be one horizontal Corliss valve cross compound of 600 horse-power and one of 450 ihp.

COAL-HANDLING EQUIPMENTS FOR VARIOUS POWER PLANTS.—The John A. Mead Company, whose New York offices are in the Bowling Green Building, reports receipt of several substantial contracts for its coal and ash handling machinery to be installed in various electrical power stations throughout the country. The list includes a $35,000 equipment, having a capacity for handling 45 tons of coal and ash per hour, for the northern power station of the St. Louis Transit Company. A $10,000 outfit is to be furnished the Denver Tramway & Power Company. The United States Electric Light Company, of Washington, D. C., has requisitioned for an outfit to be installed in an extension of its present boiler plant. The value of this contract is $6,000. The boilers are being supplied by the Babcock & Wilcox Company. The St. Louis Belleville & Suburban Railway Company is to have a $9,000 coal and ash handling equipment. The Mead Company has also lately secured some important contracts for its specialties from the United States Government, mining companies, etc. The principal contract obtained through the latter source came from the Quincy Mining Company, of Houghton, Mich., which is to be equipped with some $150,000 worth of coal handling machinery. The equipment will be utilized for taking coal from vessels to storage and from there to cars for reshipment. The plant will have an hourly capacity of 300 tons.

THE OLD WALKER PLANT.—It is denied at the Cleveland office of the Westinghouse Electric & Manufacturing Company that the old Walker plant which has been operated by the company for the past two years is to be abandoned and the entire plant removed to Pittsburg. The report arose from the fact that the local factory manager has called for bids on a large list of tools used in the manufacture of motors, the production of these goods having been abandoned in Cleveland.

LIGHTING BEET SUGAR PLANTS.—The Kilby Manufacturing Company, Cleveland, has just closed contracts for four large beet sugar plants to be erected in various parts of the country. Each will be equipped with a lighting plant, which will be purchased by the Kilby Company.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY, of Cleveland, will soon open a Chicago office in charge of Harry C. Dodge, who was formerly identified with the company in Cleveland. The company has recently commenced making shipments of the small exchange magneto switchboard, which it has recently brought out. Within the past 30 days 50 have been shipped to various parts of the country. In the near future the company will announce a new central energy board, which is now under construction. The company reports that there has been a marked improvement in business during the past month.

MOSSBERG & GRANVILLE MANUFACTURING COMPANY.—Several important changes have recently been made in the management of the Mossberg & Granville Manufacturing Company, Providence. At the recent election the following, who have not heretofore been associated in the management, were made directors: W. W. Orr, V. I. Cunnock, E. C. Moen, A. R. Whitney, Jr., and Joseph W. Harriman, all of New York, and Elisha H. Howard, of Providence. The board of directors organized by electing Howard C. Smith, of New York, president; Elisha H. Howard, vice-president, and E. C. Moen, secretary and treasurer. V. I. Cunnock was made chairman of the executive committee. The resignation of W. W. Gibbs, for some time past general manager, was accepted, and in his place George A. Clark, formerly of Lowell, Mass., has been appointed. The business of the company at the present time is in a flourishing condition, and various new patterns of tools and machines have been added to its already extensive list. The New York office of the company (secretary and treasurer) is at 100 William Street.

SCHLESINGER & MEARS is the name of a new firm of manufacturers' representatives which has appeared in New York City, Mr. F. H. Schlesinger, formerly manager of sales for the Peru Electric Manufacturing Company and Mr. James A. Mears being the members of the firm, with offices at 220 Broadway. The object of the new firm is the sale of electrical specialties to the trade as manufacturers' representatives, and they have the following specialties to offer: Incandescent lamps, a full line of sockets, rosettes, cut-outs, receptacles, mains and branches, insulators, cleats, tubes, knobs and special porcelains for the trade.

ALUMINUM.—An American aluminum association has recently been formed by concerns manufacturing or dealing in aluminum goods, an indication of the growing use of the metal. The president is Mr. J. A. Steinmetz, of Janney, Steinmetz & Co., of Philadelphia; first vice-president, W. F. Pflueger, of the Manitowoc (Wis.) Aluminum Novelty Company; second vice-president, W. H. Wagner, of the Wagner Manufacturing Company, Sidney, Ohio; and secretary-treasurer, Palmer H. Langdon, of New York.

THE REMY ELECTRIC COMPANY, which has been recently incorporated at Anderson, Ind., will manufacture the Remy magnetos for gas and gasoline ignition purposes. The capital stock is $10,000. They have a well-equipped factory plant, working 20 men, with a capacity of 15 machines daily. The active members of the concern are Messrs. B. P. Remy and F. I. Remy.

General News.

THE TELEPHONE.

HARTFORD, CONN.—Plans have been completed by the officials of the Southern New England Telephone Company for doubling the facilities of the company in this State.

AUGUSTA, GA.—The City Council has decided that all wires must go underground in 1912. This was the result of a proposed amendment to a previous ordinance offered, requiring corporations in the city to put their wires underground in two years.

WILMINGTON, DEL.—The Inter-State Telephone Company has just completed an extension of its lines to Middle Sound.

EDWARDSVILLE, ILL.—The war on telephone rates caused by the entrance of the Kinloch Telephone Company into territory which had previously been exclusively that of the Central Union system has commenced by the latter company announcing a general reduction of rates.

WASHINGTON, IND.—An independent telephone company has been granted a franchise at Washington.

TERRE HAUTE, IND.—The Central Union Telephone Company will in the near future run a line from Terre Haute to Sandford.

INDIANAPOLIS, IND.—The Big Springs Co-operative Telephone Company has been incorporated; capital stock, $200. Directors: J. O. Parr, J. W. Reed, W. E. Beatty, E. H. Stephenson and A. C. Poppino.

MORGANTOWN, IND.—The Morgantown Telephone Company, recently organized, opened its exchange for business on Nov. 1. It has 40 subscribers, and a switchboard capacity of 100 drops. It is constructing 20 miles of toll line, and other extensions are projected. The American system is used.

MONONA, IA.—The Monona Telephone Company has decided to extend its lines from Whiting to Sloan by way of Lossing and Albaton.

SLOAN, IA.—Harter Bros., proprietors of the Correctionville telephone exchange, have purchased the local exchange at Cherokee and will connect the two.

SMITHLAND, IA.—The Town Council at Smithland has granted a franchise to the New State Telephone Company, which is building a line up the Little Sioux Valley from Mapleton to Correctionville.

DES MOINES, IA.—The Protivin Telephone Company has been incorporated; capital stock, $4,000. Frank J. Fencl, John Fencl, Joseph Bouska, Fred. Lukes and Frank Galishek, Albert M. Kesh, John Bouska and John A. Dostal are the incorporators.

DES MOINES, IA.—The Vinton & Benton County Telephone Company has filed articles of incorporation with the Secretary of State. It has a capital stock of $100,000, and its directors include F. G. Ray, Geo. Knox, W. C. Ellis, C. C. Griffin, M. McNie, W. H. Hanna and G. M. Gilchrist.

WICHITA, KAN.—The City Council granted a franchise to Frank T. Brown to construct and maintain a telephone and conduit system in this city.

TOPEKA, KAN.—For the purpose of constructing telephone lines in Oklahoma and Indian Territory Frank L. Brown, Cyrus Leland, Morton Albaugh, Orie Morse, I. E. Lambert and C. A. Jobes have formed a company and secured a franchise to put in an exchange at Wichita.

COVINGTON, KY.—The Kentucky Telephone Company, recently organized here, will start its exchange about Dec. 1, using the National Automatic system. It will have a switchboard capacity of 100 drops, and 50 subscribers. Its charges will be $1 per month for residence instruments and $1.50 for business.

BRUNSWICK, ME.—A syndicate of Brunswick men are to establish a telephone line to Harpswell connecting at Brunswick with the line already established.

BATTLE CREEK, MICH.—The Calhoun County Telephone Company of this city has increased its capital stock to $100,000.

IONIA, MICH.—The Citizens' Telephone Company of Grand Rapids, Mich., is building its manholes at Ionia of Portland cement, and Superintendent Stacey claims that they are the first telephone manholes in the world, so far as he has been able to learn, constructed of this material. Manholes are generally constructed of brick, but the company is experimenting with cement, and believes them to be far superior to those of brick in a number of respects, while the cost is said to be much less. All of the company's manholes in the State will hereafter be constructed of cement.

JACKSON, MISS.—The Booneville & Tupelo Telephone Company has been chartered; capital, $2,000. Phillips, Hinds & Company, W. R. Whiteside & Company, B. A. P. Selman and others are the incorporators.

FARMINGTON, MO.—The Farmington Telephone Company has filed a statement of increase of capital stock from $5,000 to $10,000.

JEFFERSON CITY, MO.—The Citizens' Telephone Company of North Missouri, of Monticello, has been incorporated; capital, $1200. Incorporators: Cyrus C. Raine, Pike Hanna, Charles Little and others.

HAMILTON, MO.—Leo Brown, who recently purchased the Breckenridge telephone exchange, has been granted a franchise by that city, and will pay the city two per cent. of the gross receipts and furnish the city hall a free telephone.

AURORA, NEB.—An independent telephone company has been organized at this place, which will have exchanges at Aurora and Bromfield and supply farmers with telephones.

PLATTSMOUTH, NEB.—An independent telephone company has been organized at Aurora, Neb., which will be known as the Hamilton County Farmers' Telephone Association. Exchanges will be put in at Aurora and Bromfield and the entire county will be wired and telephones placed in many of the farm houses.

STATESVILLE, N. C.—The Statesville Telephone Company has been chartered, with a capital of $10,000. Mrs. Burton, of Marion, N. C., is the principal stockholder.

TRENTON, N. J.—The Inter-State Telephone Company intends to erect a new exchange building in Paterson, to cost $50,000.

TRENTON, N. J.—Hugh H. Hamill and Barker Gummere, of this city, representing the Inter-State Telephone Company, have signed papers for the purchase of the Atlantic Telephone Company, which has 100 telephones in operation.

LOWVILLE, N. Y.—The Black River Telephone Company will build a line from Copenhagen to Adams, Henderson, Sacketts Harbor and Watertown.

ALBANY, N. Y.—The Otsego County Telephone Toll Line Company has been incorporated; capital, $10,000. Directors: John Geer, L. Barker and John A. Losee, of Richfield Springs.

ROCHESTER, N. Y.—The Rochester Telephone Company has determined to add long-distance connections to its service. A contract between the local company and the Inter-Ocean Telephone & Telegraph Company has been entered into, whereby the Rochester Company is to have connections east and west. The work of constructing the long-distance line will be commenced at once.

SOUTH SOLON, OHIO.—The Bell Telephone Company will have about 50 subscribers in opening its new exchange at this place.

COLUMBUS, OHIO.—The property of the Columbus Citizens' Telephone Company has been placed on the tax duplicate at $250,000.

HAMILTON, OHIO.—Wire thieves cut down a large section of overhead cable here a few days ago, greatly demoralizing the telephone service of the city.

JACKSON, OHIO.—The Jackson County Home Telephone Company has over 700 subscribers and has from 100 to 150 instruments connected in Jackson and the same number in Wellston.

TIFFIN, OHIO.—The Flat Rock Telephone Company, of Flat Rock, Seneca County, has been incorporated with $5,000 capital stock by C. C. Pfund, T. E. Wygant, S. D. Huff, E. L. Leinhard, W. H. Gardner and F. E. Harris.

LISBON, OHIO.—The Columbiana County Telephone Company is installing an additional switchboard in its exchange here. The company has 300 telephones in operation in the town and many applicants for service are waiting the completion of the board.

POMEROY, OHIO.—Franchises have just been granted to L. K. Mihill and associates, the Home Telephone Company, of Coolville, and to John McQuigg and W. H. Osborn, of this city. Each of the three companies has agreed to furnish the city six telephones free of charge.

FINDLAY, OHIO.—An injunction has been granted against the Findlay Home Telephone Company restraining it from charging more than $12 per year for residence service. Recently the company improved its residence lines and attempted to increase the figure over that agreed upon in its franchise .

CINCINNATI, OHIO.—The City & Suburban Telegraph Association is extending its service gradually into all the important suburbs. Wyoming, Madisonville and Delhi are now all possessors of independent exchanges under control of the Cincinnati office, and Norwood is the latest applicant for an exchange.

MILLERSBURG, OHIO.—The Millersburg, Wooster & Orrville Telephone Company, which controls exchanges in Holmes and Wayne counties, held its third annual meeting a few days ago. Frank L. Beam, John M. Ewant and D. E. Sapp were added to the directorate and Mr. Beam was elected vice-president.

CLEVELAND, OHIO.—Hon. H. D. Critchfield, general counsel of the Federal Telephone Company and allied properties has returned to his duties at headquarters after an illness of several months. A month ago he attempted to take up his work, but after a day or so he was obliged to return to his home at Mt. Vernon.

TOLEDO, OHIO.—The capital stock of the Toledo Home Telephone Company has all been subscribed, nearly all of it being taken by Toledo people. Over 100 residents of the city have subscribed amounts ranging from $5,000 to $20,000. The day after the subscription closed, a Toledo capitalist offered to take $100,000 of the stock, but he could not be accommodated. A contract for the erection of a fine exchange building has been awarded.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company (independent) is making a special canvass for farmer lines through the surrounding country. Contracts enough have been secured to warrant the installation of exchanges in Harrisonville, Wallace Mills, South Webster, and all intermediate points between Portsmouth and Rarden have been canvassed and contracts secured. Lines will be built to Maysville, Ky., and connecting with the independent exchange at that point.

WEST JEFFERSON, OHIO.—The Farmers' Mutual Telephone Company has closed a deal with the Central Union Telephone Company, whereby its system will be connected with the long distance system of the Bell Company. The Farmers' Company is one of the most extensive of its kind in the country, and it was started several years ago by a farmer who built a line to connect with his nearest neighbor. Others were soon connected and each farmer built and paid for his own line. Jointly they paid for individual switchboards located in various farm houses which they attended to without compensation, receiving service for less than $5 per year. The affiliated lines at present touch the following towns: Mechanicsburg, Roseville, Rosedale, Lafayette, Milford Center, Plumwood, Catawba, Alton, Galloway, Rome, Hilliards, Georgesville, Lilly Chapel and Gillivan, giving connection to about 700 subscribers. Recently they organized the company mentioned. Under the new arrangement an exchange will be located at West Jefferson, and long distance telephones with metallic circuits will be leased by the Bell Company.

CLEVELAND, OHIO.—President B. G. Hubbell, of the Consolidated Telephone Company, which is building an extensive system in New York State, has completed a deal for the purchase from the Rochester Telephone Company of over 100 miles of toll lines connecting towns in the vicinity of Rochester. The lines will be improved and will be connected with the long distance system of the Consolidated Company. The Rochester exchange, which is the largest independent system in New York State, having about 4200 subscribers, is to be improved and equipped with new switchboards giving an ultimate capacity of

10,000. The Consolidated Company has also acquired the automatic system at Geneva, N. Y., and will equip it with a multiple central energy board. The exchange has 200 subscribers. The Inter-Ocean Telephone Company, which is the long distance branch of the Consolidated, is just completing its line to Olean, N. Y., the western terminus of the system, where connection will be made with the lines of the Union Telephone & Telegraph Company, of Erie, Pa., which in turn connect with those of the United States Telephone Company, of Cleveland. The Consolidated Company has just completed a deal with the Friendship Telephone Company of Friendship, N. Y., whereby the company ceases on Jan. 1 to be a licensee of the Bell Telephone Company and becomes affiliated with the independent system. The company has paid an annual tribute of $5 per year for the use of each transmitter and receiver and has been obliged to buy the balance of the telephone instrument. Under the new arrangement the Friendship Company will buy its instruments outright from the Century Telephone Construction Company, which is the manufacturing company affiliated with the Consolidated Company.

EL RENO, OKLA.—A telephone company has been granted a franchise at El Reno.

NORTH EAST, PA.—The new telephone line from Sherman to Mina is to be extended to Findlay Lake.

WELLSBORO, PA.—Efforts are being made to establish a telephone line between Liberty Borough and Roaring Branch and Canton.

McKEESPORT, PA.—It is reported that the Federal Telephone Company, which recently purchased the McKeesport Telephone Company's lines here, and the Pittsburg & Allegheny Telephone Company, will consolidate their lines in McKeesport.

MONTREAL, QUE.—The directors of the Windsor Hotel Company, of Montreal, have decided to establish a system of inter-communicative telephones throughout the big hotel. These telephones will number 400 or more, the idea being to place one in each of the guest's rooms. They will have communication with the Bell Telephone system of the city, as well as the long distance telephone, so that without leaving their rooms, those in the hotel may be able to converse with business houses outside and arrange business concerns. Tenders will be invited soon for the installation, which it is anticipated will be completed during the coming winter months.

BRISTOL, TENN.—The Holston Telephone Company is extending its lines and otherwise improving the property owned by the company in Carter County.

NASHVILLE, TENN.—The Richland Telephone Company, of Grainger County, has been incorporated by W. A. Frazier, A. C. Foster, W. S. Stone, Samuel McKinney and Samuel McBee.

SALTILLO, TENN.—The Cumberland Telegraph & Telephone Company is having poles placed between this place and Swallow Bluff, and will at once extend its line to that point. This town has never before had any telephone service.

NASHVILLE, TENN.—The telephone companies of Tennessee are coming forward in a satisfactory manner with the cash for the payment of their privilege taxes. The Cumberland Telephone Company reports privilege taxes amounting to $4,400.

CHATTANOOGA, TENN.—Information has been received that the Supreme Court has handed down a decision sustaining Chancellor Bearen in the Wilcox injunction case appealed. In the bill it is alleged that the City Council through questionable methods passed a franchise for an underground telephone system and all underground rights for gas, etc. Taxpayers filed a bill for an injunction and to declare the ordinance void. Now the Supreme Court upholds the decision of the Chancellor in favor of the taxpayers.

HOUSTON, TEX.—The Mansfield Telephone Company has amended its charter so as to extend its line.

LONE OAK, TEX.—The Citizens' Telephone Company, capital stock $4,000, has been incorporated by W. W. Pattillo, W. C. Bellah, W. G. Patterson, and others.

AUSTIN, TEX.—The Trans-Texas Telephone Company, of Caldwell, Burleson County, has been chartered; capital stock, $50,000. Incorporators: J. D. Giddings, James S. Giddings and Robert S. Leonard.

SALT LAKE CITY, UTAH.—Geo. W. Wotten, a representative of the Rocky Mountain Bell Telephone Company, Salt Lake City, has been in Rexburg making arrangements to put in a telephone exchange. Mr. Wotten has succeeded in getting the assurance of twenty business firms to take the service, with the probability of several other firms joining later on.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has been making some extensive changes in its lines in Ogden during the past few weeks. The lines have been extended to many parts of the city and county. Three new cables have been placed, with 100 wires in each cable, and provision for 100 more wires were made. This will enable the company to meet the demands of the public for telephones. The reduced limited rates which the company has introduced in Ogden has led many of the business men to put telephones in their homes. Besides the extensive line work that has been necessitated by the increase of the company's business, a new switchboard has been placed in position and two more operators have been added to the force, making seven operators in all.

FREDERICKSBURG, VA.—The Snickerville Telephone Company will extend its line from Bluemont to Upperville.

JANESVILLE, WIS.—The Badger State Long Distance Telephone Company has been reorganized.

MADISON, WIS.—The Antigo Telephone Company has been incorporated; capital stock, $25,000. The incorporators are M. Spencer Koebke, J. C. Spencer and Richard Koebke.

RHINELANDER, WIS.—The capital stock of the Oneida & Vilas County Telephone Company has been increased to $40,000 for the purpose of building a toll line from this city to Merrill.

ELECTRIC LIGHT AND POWER.

WHITTIER, CALIF.—An electric plant is to be established at Whittier.

ALAMEDA, CALIF.—The City Trustees of Alameda have planned to install additional generators and an engine at the municipal electric lighting plant in that city.

SAN FRANCISCO, CALIF.—The Southwest Gas & Electric Company has been incorporated, with Los Angeles as the principal place of business. Directors: H. Fisher, F. Ringe, J. S. Torrence, J. B. Miller, H. H. Sinclair, W. R. Statts, J. H. Holmes, J. S. Cravens and W. S. Wright. Capital stock, $1,000,000; subscribed, $4,500.

WILMINGTON, DEL.—The United Railway & Light Company, of Wilmington, has been chartered at Dover. It is to furnish light, heat and power for electric railways. Capital, $1,000,000.

GRIFFIN, GA.—The development of High Shoals in Monroe County, which is said to be one of the finest water powers in the State, will be started as soon as plans are perfected. It is rumored that the capital stock of the new company will be $100,000. Hon. Seaton Grantland, of Griffin, is interested.

CHICAGO, ILL.—The Economy Light & Power Company, Chicago, has increased its capital from $400,000 to $850,000.

LAFAYETTE, IND.—The Consolidated Railway, Electric Lighting & Equipment Company has provided for Purdue University a complete electric car lighting outfit. This is being installed in the electrical laboratory for the use of engineering students in studying train lighting appliances. The dynamo and controlling apparatus, which make up the chief part of the equipment, are all of special design and embody in a very skillful way principles for the control and regulation of the electric pressure supplied to lamp terminals.

BALTIMORE, MD.—The Patapsco Electric Light & Power Company will have its wires strung to Catonsville within a few weeks. Mr. Arthur C. Montell, cashier of the First National Bank, of Catonsville, is soliciting subscriptions for incandescent lights and is meeting with much success.

FORT BENTON, MONT.—Causey Brothers, of the electric light company, have sold the plant to a stock company, which has been incorporated. The principal stockholders are J. H. Causey, Charles Causey, C. E. Duer, T. C. Power, W. K. Harbor, James Townsend, J. V. Carroll and L. D. Sharp. Mr. Sharp will be secretary and treasurer.

LEBANON, MO.—The entire stock of the Lebanon Light & Magnetic Water Company, a corporation composed exclusively of local capitalists, was sold Oct. 30 to James Garneau, of St. Louis, for $25,000.

ST. CHARLES, MO.—The St. Charles Electric Light & Power Company has been incorporated, with a capital stock of $30,000, with the following incorporators: J. D. Houseman, F. E. Meseu and W. J. Murray.

GREENSBORO, N. C.—The Greensboro Electric Company has awarded to Mr. A. J. Dunn a contract for the erection of its power-house in this city.

ALBANY, N. Y.—The Ithaca Light & Power Company has been incorporated with a capital of $400,000, with the right to acquire and operate a lighting and water supply plant in Ithaca. The directors are George S. Sheppard, Thomas W. Summers and William T. Morris, all of Penn Yan.

VERSAILLES, OHIO.—Citizens of Versailles have decided to issue $10,000 bonds for an extension of the waterworks and municipal lighting plant.

ST. CLAIRSVILLE, OHIO.—A proposition to issue $25,000 in bonds to improve the electric light plant has carried by the voters of St. Clairsville.

MADISONVILLE, OHIO.—This village will vote Nov. 11 on the question of issuing $25,000 in bonds with which to enlarge the electric light and water plant.

AKRON, OHIO.—The Northern Ohio Traction Company has announced that it will make a reduction in its lighting rates in Akron about Jan. 1, when a new 1000-kw Westinghouse generator will be placed in operation exclusively for lighting purposes.

CLEVELAND, OHIO.—Councilman Springborn is back of an agitation to secure a municipal lighting plant in Cleveland. At his instigation a bill may be introduced in the next Legislature to provide for a bond issue for the purpose of establishing a plant.

CINCINNATI, OHIO.—The Fordyce syndicate, which is improving the Miami and Erie Canal, with a view of operating boats by electricity between Cincinnati and Toledo, has offered to purchase all the boats of the various lines operating between Cincinnati and Dayton.

OTTAWA, ONT.—The Capital Power Company, of Ottawa, has awarded its contract for the improvements it intends making to its water power at Deschenes, six miles from the city. The work will consist chiefly in cutting a large channel, about 250 feet long to a depth of seven feet beneath the surface of the water. It is expected by this means to add about 3000 horse-power to its present capacity. A large amount of machinery will be required in the operations, which will be submarine in character. The work will cost in the neighborhood of $25,000.

THE DALLES, ORE., is to be lighted by electricity generated at the 2000-hp electric plant now being constructed by the Wasco Warehouse & Milling Company. The new plant, which will be installed at the company's new flouring mills on White River, 26 miles from The Dalles, will probably be ready for operation Dec. 1. The mills will be operated by electric power.

LANCASTER, PA.—The Lancaster County Railway & Light Company has awarded the contract for additions to its power plant, which, when completed, will make it the largest plant of its kind in the State.

GEORGETOWN, S. C.—It is reported that a Philadelphia firm has purchased the Georgetown electric light plant.

SALT LAKE CITY, UTAH.—The Pocatello Water Company is repiping the water conduit in the hills, and building a large dam on Mink Creek. It is thought that this dam will be used in the near future for the much talked of municipal lighting plant for Pocatello, Idaho.

The Electric Railway.

SAN FRANCISCO, CALIF.—The Del Monte, Monterey & Pacific Grove Electric Railway Company was recently incorporated. Monterey is the principal place of business. Directors: J. D. Carr, Charles Carr, J. P. Sargent, H. R. Robins and R. F. Johnson. Capital stock, $200,000; subscribed, $5,000.

DENVER, COLO.—With a capitalization of $500,000 the Great Western Railway Company has filed articles of incorporation at Denver. The incorporators are Charles Boettcher, S. D. Willing, J. C. Buck, William Byrd Page and C. S. Morey, of Denver; J. R. McKinnie, of Colorado Springs, and John F. Campion of Leadville. The road will be built from Loveland to Berthoud, and later from Loveland into Denver. Work will be begun as soon as bids can be prepared and accepted, and, it has been determined to use electric power.

HARTFORD, CONN.—The Connecticut Railway & Lighting Company is purchasing land along the survey of its proposed road from Waterbury to Southington, and it is understood that the construction of the line will be undertaken early in the spring.

ATHENS, GA.—The Athens Electric Street Railway Company has executed a deed of trust to cover a bond issue of $400,000. Two hundred thousand dollars is to be taken up now; $100,000 for the present bonded indebtedness and $100,000 to complete the development of Tallulah shoals and the equipment of a larger power plant.

EDWARDSVILLE, ILL.—The controversy between the Litchfield and Madison Railway and the Mississippi Valley Electric Railway has been settled. The latter has been barring the street car line out of Edwardsville by maintaining a patrol of four locomotives at the crossing point.

MORGANTOWN, IND.—There is a field here for an electric railway.

KOKOMO, IND.—The Union Traction Company has entered a petition for a franchise for an electric railway through this city. The line will run from Kokomo to Indianapolis.

ELKHART, IND.—James F. Rothwell, of St. Louis, was granted a franchise Oct. 29, to build an electric railway along highways from Goshen through the southern quarter of the county.

INDIANAPOLIS, IND.—The Franklin & Indianapolis Electric Railway Company has been incorporated, with a capital stock of $50,000. The purpose of the company is to build a railway between Indianapolis and Frankfort, a distance of 47 miles.

SIOUX CITY, IA.—The promotors of the proposed electric railway from Sioux City to Le Mars have enlarged their plan, and now propose to construct the line to Spirit Lake. The total length of the road will be ninety miles.

LEXINGTON, KY.—Ex-Senator Davis is interested in an enterprise having for its purpose the building of an electric railway system and establishing related industries, with Lexington as the centre. It is stated that the Blue Grass Rapid Transit Company will be organized for the purpose of carrying out the plans, and will have a capital of $7,000,000.

BOSTON, MASS.—The Old Colony Street Railway Company, one of the sub-companies of the Massachusetts Electric Company, has been substituting aluminum feeder cables for copper.

BOSTON, MASS.—The Boston & Maine has asked the New Hampshire Railroad Commissioners for authority to issue $500,000 bonds to build the Concord, Manchester & Nashua Electric Railway.

LANSING, MICH.—The Battle Creek & Marshall Traction Company, with $200,000 capital, has filed articles of incorporation with the Secretary of State.

NATCHEZ, MISS.—The contract has been let for the iron and a large part of the material for the Natchez Electric Railway. Preparatory work will be started as soon as engineers reach the city.

HARTVILLE, MO.—The citizens of Ava, Douglas County, have taken initiatory steps toward connecting their town by an electric railway line with Cedar Gap, Wright County. Local capitalists will take the stock of the Ava Northern Railway Company. The following directors were elected for the ensuing year: S. B. West, J. H. Murray, W. J. Turner, M. C. Reynolds, J. M. Adams, A. H. Buchanan, B. J. Smith, H. S. Wilson and J. A. G. Reynolds. W. J. Turner was elected president, J. H. Murray vice-president, J. A. G. Reynolds treasurer, H. S. Wilson secretary and A. H. Buchanan, auditor.

HENDERSONVILLE, N. C.—It is rumored that an electric railway may be built from the town of Hendersonville to Flat Rock, N. C.

ALBANY, N. Y.—The State Board of Railroad Commissioners has granted permission to the Rochester & Eastern Rapid Railway Company, incorporated in 1900, with a capital of $500,000, to construct and operate an electric railway 40 miles long from Rochester to Geneva, with a branch from Pittsford to Fairport.

ALBANY, N. Y.—The Subway & Suburban Construction Company, of New York City, has been incorporated, with a capital of $300,000. It is proposed to construct railways and to do work incidental thereto. The directors for the first year are Frank V. Ainslie, of Brooklyn, and Emile Dreyfus, William F. McCombs, Jr., Dunbar Hunt, and Henry D. McGowan, of New York City.

ALBANY, N. Y.—The Orange County Traction Company, a reorganization of the Newburg Electric Railway Company, has been incorporated, with a capital of $325,000. The directors are F. H. Moffatt, of New Brighton; L. H. Clark, F. H. Pouch, P. D. Pouch and B. J. Bloodgood, of Brooklyn; A. B. Pouch, of Tompkinsville; J. B. Kilsheimer, of New York City; E. O. Alyea, of Newark, and W. C. Hascey, of Montclair, N. J.

AKRON, OHIO.—The Northern Ohio Traction Company has applied for a franchise in Akron.

CIRCLEVILLE, OHIO.—The village of Circleville has established two street railway routes through the town and proposals have been called for.

CINCINNATI, OHIO.—The Mansfield, Savannah & Wellington Electric Railway Company recently increased its capital from $100,000 to $1,500,000.

COSHOCTON, OHIO.—The Newark, Zanesville & Coshocton Railway has been granted a franchise in Coshocton enabling it to enter the center of the town.

ASHLAND, OHIO.—The Norwalk, Ashland & Southern Railway Company announces that all right of way has been secured, and that construction work will start early in the spring.

TOLEDO, OHIO.—A. K. Detwiler, George Detwiler, George Metzger, Irving Squire and other well known promotors have taken up the project of a line from Toledo to Ypsilanti, Mich.

CONNEAUT, OHIO.—Power has been turned on at the power-house of the Pennsylvania & Ohio Railway at Conneaut. The road will be in operation between Conneaut and Ashtabula within a few days.

SIDNEY, OHIO.—The Western Ohio Railway Company has agreed to post a forfeit of $15,000 with the Sidney Board of Trade to insure the building of its road between Loramie and Sidney within 26 months.

DAYTON, OHIO.—President Valentine Winters, of the Dayton & Western Traction Company, has applied to the county commissioners of Preble County for a franchise to extend the road to Richmond, Ind.

MARIETTA, OHIO.—The Washington Traction Company, of Marietta, has been incorporated, with $250,000 capital stock, by Ralph J. Sensor, Rufus Underwood, D. H. Buel, Willis Morris, and John H. Reilley.

PAINESVILLE, OHIO.—P. W. Tuttle, C. W. Goodrich, C. E. Barnum and F. S. Turner, of Geneva, promoters of a line from Ashtabula to Painesville, have applied to the Lake County Commissioners for a new franchise.

CLEVELAND, OHIO.—Thomas W. Latham, D. A. Dangler, D. H. Kimberley and others have completed a deal for the purchase of franchises and right of way of a company organized some time ago at Wabash, Ind., to build a line from Wabash to Rochester, thirty-four miles.

CLEVELAND, OHIO.—The Collinwood Council has granted the Cleveland Electric Railway a franchise to extend its line to Nottingham. The company agreed to carry passengers to the Public Square, Cleveland, a distance of 12 miles, for five cents. The franchise is for twenty-three years.

STEUBENVILLE, OHIO.—It is stated that the Steubenville Traction Company and the Steubenville, Mingoe & Ohio Valley Traction Company are soon to be absorbed by the Philadelphia Company of Pittsburg, with a view to forming part of a system which will extend from Wheeling, W. Va., to Pittsburg.

CINCINNATI, OHIO.—The Cincinnati, Blanchester & Columbus Electric Railway Company, of Blanchester, has been incorporated, with $10,000 capital stock. The incorporators were E. D. Smith, Roy J. Rice, H. L. Day, M. V. Whitacre, Fred. C. Rice, D. W. Hogan, all of Blanchester, and Simeon G. Smith, of Wilmington.

CLEVELAND, OHIO.—The Lake Shore Electric Railway has purchased a private right of way several miles in length near Woodville which will be graded and track laid as soon as possible. This eliminates one of the worst curves on the Toledo, Fremont & Norwalk division, besides giving private right of way and saving time.

CLEVELAND, OHIO.—Prominent Cleveland people have pledged themselves to subscribe $1,115,000 for the purpose of building two electric street railways in this city to be operated on a three-cent fare basis and with universal transfers, to compete with the present companies. Mayor Johnson denies that he has any connection with the roads.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company is arranging with the theatre managements in Cleveland, Sandusky, Fremont and Toledo, to advertise in the surrounding towns the theatre attractions to be given in these centers, and to provide special theatre cars which will carry people direct to and from the places of amusement.

TOLEDO, OHIO.—The recently organized Everett-Moore Managers' Association met in Toledo a few days ago. Plans for the adoption of certain types of interurban and city cars, as standard, were discussed, and such cars will be designed to be used on all the various city and interurban roads owned by the syndicate, thereby making it possible to buy in quantities and reducing the cost of maintenance.

COLUMBUS, OHIO.—The Columbus, Grove City & Southwestern Railway has brought an injunction suit against the Franklin County Commissioners to restrain them from carrying out their threat of annuling a portion of the Grove City franchise leading into Columbus. Another company is now securing consents of property owners along the same route with a view to ousting the Grove City company.

CLEVELAND, OHIO.—The report comes from Canton that the Everett-Moore syndicate has closed a deal for the purchase of the city lines in Canton and the Canton-Massillon Railway, which are owned largely by Hon. W. A. Lynch, of Canton. The original price asked for the property was $1,000,000, but this was more than the syndicate would pay for the twenty-five miles of road and it is stated that they have finally agreed upon $700,000.

CINCINNATI, OHIO.—The Ft. Wayne, Dayton & Cincinnati Traction Company, which is projecting one of the longest electric railways in the country, extending from Ft. Wayne to Cincinnati, has secured control of the Cincinnati & Westwood Railway (steam) which extends almost to the center of Cincinnati, thus affording private right of way to the city. The officers of the company are: Dr. S. F. George, Dayton, president; D. W. LaFetra, New York, vice-president; C. L. Hyde, Pierre, S. D., second vice-president; C. W. Gebhart, Dayton, secretary-treasurer.

CLEVELAND, OHIO.—The Everett-Moore syndicate has purchased at Toledo a large tract of land adjoining its present freight station on Huron Street, and will erect a fine office building and terminal station for the interurban roads entering Toledo. It is also the intention to soon erect a large plant which will be utilized as machine and repair shops, paint shop, etc., for the city lines, the Detroit & Toledo Shore Line, the Toledo & Maumee Valley and the Western division of the Lake Shore Electric Railway. Eventually similar shops will be erected in Cleveland and Detroit.

TORONTO, ONT.—The Toronto Electric Street Railway carried during the week when the Duke and Duchess of York were in Toronto, no less than 1,200,000 passengers, not counting transfers. During one day of that week 282,000 people were carried.

PORTLAND, ORE.—The City & Suburban Railway Company's East Side electric power plant in Portland will soon have its capacity increased to 3,000 horse-power. A 1200-hp direct connected generator and Corliss engine and additional water tube boilers are now being installed. Condensers and pumps are included in the new apparatus, which will increase the economy of operation.

YORK, PA.—The York & York Furnace Traction Company, soon to be chartered, with a capital of $420,000, has planned a trolley line from York parallel with the Pennsylvania & Maryland Railroad through several prominent towns in this section.

NEW CASTLE, PA.—The Sharon & New Castle Railway Company announces its intention of at once beginning the construction of the line from Sharon to this city. To this end the company has just negotiated a loan of $500,000, which was placed with the New York Security & Trust Company.

EBENSBURG, PA.—The building of the street car line from Ebensburg to Johnstown, recently projected by the Conemaugh Valley Street Railway Company, is now assured, and will probably be commenced soon. The company is already chartered and the capital stock all subscribed by Philadelphia and Johnstown men.

SCRANTON, PA.—A charter has been granted to the Berwick & Nanticoke Electric Railway. The road will connect Berwick, Beach Haven, Hicks Ferry, Shickshinney and Nanticoke, and will pass through a rich farming district. The right of way has been secured along the greater part of the route, which is twenty miles in length. The officers are: President, C. W. Miller; Treasurer, L. E. Waller; Secretary, C. C. Peacock, Bloomsburg; Directors, C. M. Creveling, Almedia; C. H. Campbell, Briar Creek; F. E. Miller, C. W. Miller, C. C. Peacock and L. E. Waller.

MONTREAL, QUE.—At a meeting of the Board of Directors of the Montreal Electric Street Railway, held Oct. 23, the annual statement for the year ending Sept. 30 last was submitted. During the year the company's earnings amounted to $1,888,967. In dividends, the street railway paid out the sum of $551,700. There was transferred to the contingent account the sum of $50,000. There was also transferred to the surplus account the sum of $47,551. The income of the Montreal Street Railway, over and above expenses and fixed charges, exclusive of dividends, amounted to $649,251, as compared with $647,246 for the year 1900.

KNOXVILLE, TENN.—Mr. W. T. Goffe, of Toronto, Canada, announces that Canadian capital will build an electric line from Knoxville, Tenn., to Sevierville, Tenn. The line will be 48 miles long.

SPOKANE, WASH.—The Chelan Transportation & Smelting Company, now building a smelter on the Columbia, near Lake Chelan, and building a railroad from the lake to the Holden mines, has secured a 40-year franchise for the construction of an electric railway from Lakeview to the Columbia River, where the smelter is located.

EDUCATIONAL.

MICHIGAN STATE AGRICULTURAL COLLEGE.—The 1900-1 catalogue of the Michigan State Agricultural College contains a list of officers and students for the year 1900-1, together with other general information concerning the college. This is the forty-fourth year of this institution. This college gives a course in electrical engineering, also one in mechanical engineering.

McGILL UNIVERSITY.—The mathematical laboratory at McGill University is being moved from the engineering to the physics building. The space it occupied will be used partly by the civil engineering department in extending its laboratory for testing materials, and partly by a new lecture-room, none of the old ones being large enough to hold the classes of this year. A 300-kilowatt storage battery has been installed in the engineering building, so that the building can be lighted without keeping the steam-plant running. It is charged by one of the 50-horse-power steam dynamo units, remodeled for the purpose. Several pieces of apparatus, mostly electric measuring instruments, have been given by the Canadian General Electric, the Westinghouse, and other electric companies.

THE AUTOMOBILE.

THE LONG ISLAND MOTOR COMPANY, of Brooklyn, has been incorporated to build motors, motor vehicles, and vessels; capital, $100,000. Directors: Charles Rockliff, A. R. Pardington, and F. G. Webb, Brooklyn.

BOSTON, MASS.—An official of the New England Electric Vehicle Company, says: "There is no foundation for the report that the Armstrong Transfer Company is to take over the business of the New England Electric Vehicle Company. The report probably developed from the fact that the Armstrong Transfer Company recently purchased two or three of our busses."

PATERSON, N. J.—The rapid transit service which the Passaic Auto-Transportation Company started in Passaic several months ago has been suspended. The five large machines used by the company are stored in the stables awaiting the action of the managers. For several weeks the automobiles were well patronized, but the novelty wore off, and the people refused to ride any longer, despite the fact that the fare was less than that charged by the hackmen. The cost of the Passaic plant was $12,000, while the cost of operation was $1,000 a month. The incorporators, Isaac W. England, John V. Kehoe, Charles Denholm, W. F. Gaston, and William Ryan, are the principal losers.

PHILADELPHIA CLUB PARADE.—The second annual parade and review of the local automobilists under the auspices of the Philadelphia Automobile Club was held on the afternoon of Nov. 2, the line of parade starting from Broad and Walnut Streets shortly after 3 o'clock. It was expected that there would be a large turnout of automobiles, but the display, for some unexplained reason, fell far short of last year's parade. There were only thirty-four machines in line, including all the various makes of vehicles, steam, electric and gasolene, steam and electric seeming to predominate. Most of the vehicles were of the runabout type, carrying two persons, although many were built to carry four. The parade was in charge of a committee of members of the Philadelphia Automobile Club, consisting of Messrs. Henry J. Norris, John L. Wilson, Herbert M. Warden, Captain John S. Muckle, J. Maxwell Bullock, H. Bartol Brazier, Nathan Baird, Jr., and Frank C. Lewin. Captain Muckle acted as marshal, and Messrs. Brazier and Bullock were his aides.

OBITUARY.

MR. JOSEPH VIRAG, inventor of a fast telegraph system, with Mr. Pollak, is reported from Budapest, Hungary, to have died there at the age of only 31 after an illness of three days. The system attained a speed of over 70,000 words per hour, and has been tested in this country.

PERSONAL.

MR. C. R. CRANE, vice-president of the Crane Company, of Chicago, has just returned from an extended trip to Europe, where he recently went in the interests of the company.

PROF. G. F. SEVER, of Columbia University, superintendent of electrical exhibits at the Pan-American Exposition, has been presented with a handsome gold watch by a number of the exhibitors in Electricity Building.

MR. JOHN MARTIN, of John Martin & Company, the Stanley Electric Manufacturing Company's California representative, was at the Waldorf-Astoria during the past week, accompanied by Mr. Henry Hine, now of Colorado, but formerly so prominent in the company's affairs.

MR. CHAS. R. HUNTLEY, general manager of the Buffalo General Electric Company, has become a director in the new Electrograph Company of America, just formed in Cleveland to exploit the Palmer electrograph, which has already been described and illustrated in these pages.

MR. A. V. ABBOTT has in the October journal of the Western Society of Engineers a very interesting paper presented a few months ago, on electrical oscillations of high frequency. It is an admirable, popular presentation of the subject and is illustrated with several half-tones and diagrams.

MR. J. G. WHITE, the well known electrical engineer, and president of J. G. White & Company, is now on a trip home from London, and expects to spend a month or two in this country before returning to England, where he has become engaged in various important enterprises.

MR. ANTHONY N. BRADY, who is so prominent in lighting and other enterprises, rarely breaks silence, but he has a pithy little article in the *North American Review* for November on "The Services of Electricity," in which he sums up the development of electrical applications and points out their growing magnitude.

MR. G. H. KOHLER, superintendent of works of the Union Elektricitäts Gesellschaft, Berlin, is in this country on a trip of investigation, during which he will probably purchase some of the latest machine tools. He will visit all the recent plants in lighting, railway work, etc. Mr. Kohler is familiar with American practice and is a graduate of Lehigh.

MR. CHARLES W. MORSE, of the Telephone, Telegraph & Cable Company, is said to have his plans completed for a telephone service in New York City which will cover the entire field, and to expect to have subscribers there within six months. That is not quite the same thing, however, as giving service, but activity is also promised in that direction.

MR. PHILIP G. GOSSLER has, it is stated, been elected general manager of the Royal Electric Company, of Montreal, Canada, with a salary of $12,000. He has for some time past been actively engaged in connection with the enterprise as electrical engineer, etc. He is a member of the American Institute of Electrical Engineers, and is well known in this country.

MR. M. C. SULLIVAN, the electrical engineer and contractor who has given considerable attention to signal service work, is corporal in the First Signal Corps of the National Guard of New York State. Last week he received the championship medal decoration for 1900 for the corps, won by his work ranging from field line construction through the whole line of signal drill and operation.

DR. F. A. C. PERRINE, we learn, is on the Pacific Coast, and it is hoped that it will be feasible for him to go up into the mountains and view some of the splendid work which he personally and the Stanley Company have done so much to render possible. Dr. Perrine was consulting electrical engineer of the great Standard Company, of California, prior to his incumbency as president of the Stanley Electric Manufacturing Company.

MR. CHAS. W. PHIPPS, a pioneer in the Brush electric light industry and for some years connected with the General Electric Company has been sent by that concern to England, where he will have a prominent position in the management of the new shops at Rugby. Mr. Phipps is English by birth, and it is understood he will stay in his native country. He has a great many warm friends in the United States who regret his departure.

MESSRS. L. B. STILLWELL, the electrical engineer, and his assistant, Mr. John Van Vleck, the mechanical engineer of the Rapid Transit Commission, have just returned from Europe after a tour of inspection of underground roads there. Other members of the party abroad were Messrs. J. B. McDonald, the contractor; Mr. E. B. Bryan, who may operate the road, and Mr. W. B. Parsons, the chief engineer of the Commission. Messrs. Stillwell, Van Vleck and Bryan visited also the works of Brown, Boveri & Company at Baden, Switzerland, and the Ganz three-phase road at Lecco, Italy.

MR. R. R. BOWKER, formerly first vice-president of the Edison Electric Illuminating Company, of New York, and editor of the *Publishers' Weekly*, has a slashing article in the October *Atlantic Monthly* entitled, "The Piracy of Public Franchises," but devoted chiefly to a discussion of the manner in which the stocks and bonds of the "public service" companies of New York have been watered, under the Whitney-Brady regime. Mr. Bowker expresses his opinion quite frankly against the methods by which, according to him, the obligations of these properties have been carried far beyond the proper point.

Trade Notes.

MR. FRANCIS RAYMOND, the manufacturer's agent, Chicago, announces his engagement to Miss Louise Norfleet Black, of Hyde Park, Ill.

CROSS OIL FILTERS.—Two important orders of Cross oil filters are on their way from the Burt Manufacturing Company, of Akron, Ohio, to help German manufacturers cut down their oil bills.

PRESIDENT ROOSEVELT.—The November calendar of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, is of very handsome design in gold and colors. It is of a patriotic nature and contains a medallion of President Roosevelt.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been caught in the act of "pointing with pride" to its No. 36 cabinet type wall telephone. It is made in several styles which are described in the circular it is now sending out to the trade.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has an unusually large demand for its new type Peerless incandescent lamp. It is sold under the very strongest guarantees, and the company is always glad of an opportunity to submit sample lamps for test.

THE CENTRAL ELECTRIC COMPANY, Chicago, has published a new price-list dated Nov. 1, which is devoted exclusively to the telephone trade. It includes telephones, telephone parts, batteries, and various other supplies. Any one desiring a copy can obtain the same by addressing an application to the Central Electric Company.

REVISED PRICE LISTS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued revised price lists No. 61, 66, 70 and 70A, of reversible controllers for electric cranes and hoists, reversible drum controllers, self-starters for non-reversible motors operating belted elevators, pumps, etc., and self-starters for electric elevators.

G. I. APPARATUS.—Recent bulletins of the General Incandescent Arc Light Company, 572 First Avenue, New York City, relate to high-tension circuit-breakers, enclosed arc lamps, water-tight floor outlet box, and the new panel board with removable enclosed fuse carrier, which was described and illustrated in a recent issue of Electrical World and Engineer. Each bulletin is illustrated.

ACTON VALVES.—Mr. John Acton, 118 John Street, Brooklyn Borough, New York City, has issued a 32-page pamphlet describing and illustrating the Acton special valves manufactured by him. These goods include reducing valves for all kinds of service, relief valves, thermostats, boiler check valves, filter and oil collector, safety valves, steam traps, water separator or grease extractors, etc.

THE JAEGER MINIATURE LAMP MANUFACTURING COMPANY, New York City, has found it necessary, owing to the continual increase of business, to enlarge its plant so as to produce 1000 lamps per day. This, its anniversary of one year of unbroken success, is attributed to Mr. C. T. Jaeger's unswerving efforts to produce only the highest grade of goods, and he feels deeply grateful for the appreciation shown.

HUBBELL PENDENT PULL SOCKETS.—A new socket called the Hubbell pendent pull socket is being advertised by the Central Electric Company of Chicago, as most convenient for chandeliers, wall brackets, etc., it being provided with a chain 10 inches long, in place of a key. This socket has been approved by the National Board of Fire Underwriters, and the Central Electric Company will be pleased to furnish additional information, and quote prices upon request.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has upon the press a catalogue, or, more properly, a treatise upon the Sturtevant steam hot blast apparatus and dry kilns. The process of drying is thoroughly discussed in a purely technical manner, and from this discussion are drawn manifest conclusions as to the advantages of the blower system of drying. The treatise relates principally to the drying of lumber and illustrates different forms of kilns, methods of piling, etc. It will be a valuable addition to the decidedly limited literature on this subject.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., has removed its offices from the Banigan Building to the building at 15 Custom House Street, where it now has offices, shops and show rooms together. Its large new show room has been handsomely fitted. The company will install its Pan-American exhibit as soon as it arrives, extending and adding to it as the larger space at command will permit. This will enable it to show at a glance its system "from factory to installation."

THE CHRISTENSEN AIR-BRAKE.—The Christensen Engineering Company, of Milwaukee, Wis., has issued a very handsome catalogue giving a list of patrons using the Christensen air-brake. Many illustrations are used showing some of the equipments on many of the principal electric railways throughout the country, including the Boston Elevated, the Metropolitan Street Railway Company of Kansas City; Union Traction Company, of Indiana; the South Side Elevated of Chicago; Brooklyn Elevated, New York; New Haven & Hartford, and others. Illustrations are also given of the brake mechanism.

McKENZIE STOKERS.—Among prominent steam users who have adopted the McKenzie stoker may be mentioned the Chicago Edison Company, of Chicago; the Toledo Railways & Light Company, Toledo, Ohio; William J. Moxley Butterine Company, of Chicago; James S. Kirk & Company, soap manufacturers, Chicago; The Aurora, Elgin & Chicago Electric Railway Company, Batavia, Ill.; the Fulton Market Company, Chicago, and the Department of Electricity of the City of Chicago. The McKenzie Furnace Company, Chicago, also manufactures the latest improved stationary and locomotive grate bars.

A. E. G. PUBLICATIONS.—Of all the foreign electrical manufacturers the Allgemeine Electricitäts Gesellschaft stands easily first in the quality of its trade literature. In fact, the pamphlets it issues are rather technical treatises of a high order than having the character of trade bulletins. Among recent publications are one by its Chief Engineer, Herr Lasche, on the Zossen railway equipment; an account by Dr. Benischke, of protective devices for high-tension lines; a pamphlet describing and illustrating a number of polyphase plants and details of polyphase machinery, and a description of an electric wind vane. All of these publications are profusely illustrated, not only with half-tone views of machinery, but with diagrams and curves elucidating technical points.

THE VALUE OF MACHINERY.—Why is it that during the last century the number of farm workers has only doubled while the quantity and value of farm produce has multiplied by twenty? It is because labor-saving machinery and improved processes have been working their magic in the country. In "Marvels of Modern Production" (*McClure's* for November) George B. Waldron, the great statistician, says: "The wideawake Western farmer of today attaches to a traction engine half a dozen gangs of four ploughs each, with a seeder and harrow to each gang. As the engine moves forward it leaves a trail twenty feet wide of land sowed ready for the harvest. One man's work thus is worth that of twenty by the old method." And in all lines of industry, Mr. Waldron points out by figures which are startling, how wonderful is the saving of labor by modern machinery. It is, indeed, the great emancipator.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 29, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

685,242. ELECTRIC RAILWAY; R. Arno and A. Caramagna, Turin, Italy. App. filed April 21, 1897. The contact box is made in two parts, each assuming opposite polarity when the pole of a magnet carried by the car is presented to them. Inside of the box is a Z-shaped armature hung on a shaft and adapted to be rotated when the magnet becomes energized to close the working circuit.

685,274. ELECTROLYTIC DECOMPOSING APPARATUS; Max Haas, Aue, Germany. App. filed June 14, 1900. (See page 782.)

685,278. BATTERY; G. Heidel, St. Louis, Mo. App. filed Aug. 20, 1900. A storage battery in which the containing vessel is one of the active elements, the other being located in the vessel.

685,279. SWITCH CONTROLLING DEVICE; G. H. Hill, Glen Ridge, N. J. App. filed Aug. 5, 1901. The switch comprises an actuating mechanism which locks it in its normal position against any moving force not applied at a prescribed point.

685,286. MAGNETO ELECTRIC GENERATOR; J. S. Mead, Buffalo, N. Y. App. filed March 18, 1901. The generator is provided with an adjustable device by which the circuit can be interrupted at any point desired between no current and maximum current.

685,290. SYSTEM OF ARMATURE WINDING; T. J. Murphy, Montreal, Canada. App. filed May 4, 1901. Machine wound coils so arranged that the outer span of the coils is some multiple of the inner portion, necessitating the outer span being two or more layers in width, for the purpose of easy winding and repairing.

685,295. CONTACT KEY FOR SOCKETS OF ELECTRIC INCANDESCENT LAMPS; G. H. Proctor, Somerville, Mass. App. filed May 15, 1901. Details.

685,301. TELEGRAPH KEY; C. Shirley, Brooklyn, N. Y., and J. F. Skirrow, East Orange, N. J. App. filed Aug. 6, 1901. The key can be rotated on its support so as to be operated by the right or left hand at will, and it is of such construction that it can be manipulated in the palm or other portion of the hand as well as the fingers.

685,308. CONTROLLER REGULATOR; A. D. Thomas, Keokuk, Ia. App. filed May 10, 1900. A regulator for the controller which permits the movement of the controller handle from step to step only after an enforced pause, the length of which can be pre-arranged by suitable adjustment.

685,313. ELECTRICITY METER; R. S. White, Chicago, Ill. App. filed Jan. 30, 1901. The armature of the motor is horizontally supported by means of a relatively frictionless bearing which also operates as a collecting device, and on which the armature by its weight normally seats itself, so that any tendency of the armature to move laterally will be resisted by gravity.

685,314. ELECTRICITY METER; R. S. White, Chicago, Ill. App. filed Aug. 24, 1901. A modification of the preceding patent.

685,326. ELECTRIC ELEVATOR HOISTING MECHANISM; T. W. Eaton, Chicago, Ill. App. filed March 26, 1901. The armature and shunt field circuit each contain resistances and means are provided for manipulating the resistances from the car.

685,390. PRINTING TELEGRAPH; J. E. Wright, New York, N. Y. App. filed Oct. 5, 1900. The invention is described by one of the claims as follows: In a printing telegraph instrument, the combination with a type-wheel having two rows of characters, of a printing-magnet and armature-lever, two printing-levers provided with platens adapted to print from the two rows of characters respectively, a pivoted plate carried by the armature

lever and having arms adapted to engage with the two printing levers respectively, according to the position in which said plate may be set, an escapement-wheel and a shaft therefor having pins or stops thereon adapted to set the plate in either of its two positions.

685,393. ELECTRIC BRAKE; P. P. Crafts, Boston, Mass. App. filed Nov. 30, 1900. A winding drum having an intermediate groove, a chain extending from the brakes and arranged to be wound in the groove, and flanges on either end of the drum containing the energizing-coils of magnetic clutches for engaging the drum with the axle.

685,394. ELECTRIC BRAKE; P. P. Crafts, Boston, Mass. App. filed Nov. 30, 1900. A locking device for holding the brake applied; said device is electromagnetically operated, and will automatically permit the further application of brakes beyond a given locked point.

685,426. ELECTRIC ARC LAMP; J. A. Mosher, Chicago, Ill. App. filed March 25, 1901. An arc headlight adapted to be attached to the back of the dashboard of a street car, the frame being constructed in two parts, one carrying the works of the lamp and the other the glass front, the two sections being secured together upon and to the opposite faces of the dashboard and around an aperture therein.

685,430. AUTOMATIC SYNCHRONIZER; J. Pearson, St. Paul, Minn. App. filed Feb. 19, 1901. Two or more synchronous, alternating-current machines and circuits therefor, an automatic switch to couple the same in parallel, a trip for the switch and an automatic synchronizer controlling said trip, which synchronizer is responsive only to a coincidence of phase and frequency between the currents in circuits to be coupled.

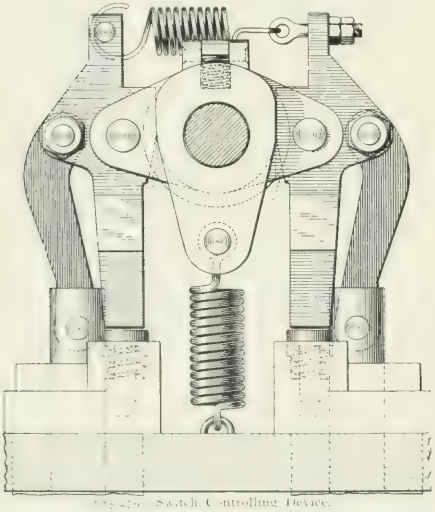
685,431. MAGNETIC DEVICE FOR USE IN ALTERNATING CURRENT CIRCUITS; J. Pearson, St. Paul, Minn. App. filed Feb. 19, 1901. A main magnet and its armature lever, a minor magnet acting on said armature in opposition to the main magnet, whereby the armature is held in engagement with the minor magnet until the main magnet attains a predetermined strength.

685,461. PROCESS OF MAKING PRINTING SURFACES; Claude A. O. Rosell, New York, N. Y. App. filed May 12, 1900. (See page 783.)

685,462. PROCESS OF MAKING PRINTING SURFACES; Claude A. O. Rosell, New York, N. Y. App. filed Nov. 4, 1898. (See page 783.)

685,470. WINDING FOR ELECTROMAGNETIC SPOOLS OR COILS; J. A. Heany, Philadelphia, Pa. App. filed Oct. 18, 1900. Bare wire is wound alternately with asbestos cord and layers of asbestos are interposed between the layers of wire.

685,471. THERMO-ELECTRIC COUPLE; Eugene Hermite and Charles Friend Cooper, Paris, France. App. filed Feb. 23, 1901. (See Current News and Notes.)



685,472. Switch Controlling Device.

685,472. PROCESS OF MANUFACTURE COPPER-SULFID RODS FOR THERMO-ELECTRIC COUPLES; Eugene Hermite and Charles Friend Cooper, Paris, France. App. filed Feb. 23, 1901. (See Current News and Notes.)

685,485. RHEOSTAT; T. S. Perkins, Idlewood, Pa. App. filed Nov. 9, 1900. Details of construction.

685,486. CONTROLLING SYSTEM FOR ELECTRIC LAMP HEATERS; Henry Noel Potter, Gottingen, Germany. App. filed Aug. 9, 1899. (See page 783.)

685,487. BALLAST CUT-OUT FOR ELECTRIC LAMPS. Henry Noel Potter, Gottingen, Germany. App. filed July 14, 1900. (See page 783.)

685,488. HEATER CUT-OUT FOR ELECTRIC LAMPS; Henry Noel Potter, Gottingen, Germany. App. filed Aug. 15, 1900. (See page 783.)

685,494. SYSTEM OF ELECTRICAL DISTRIBUTION; Norman W. Storer, Edgewood Park, Pa. App. filed Sept. 6, 1900. (See Current News and Notes.)

685,501. DESK OR TABLE LAMP; Alexander Jay Wurts, Pittsburg, Pa. App. filed Feb. 21, 1900. (See page 783.)

685,507. SWITCH FOR ELECTRIC CIRCUITS; H. P. Davis, Pittsburg, Pa. App. filed Nov. 9, 1900. A switch for electric circuits comprising two blades pivotally supported a distance apart approximately equal to their individual length so as to be moved in parallel planes through an angle of approximately one hundred and eighty degrees and stationary contact-terminals respectively in alignment with said blades.

685,512. METHOD OF TREATING NERNST LAMP GLOWERS; Marshall W. Hanks, Pittsburg, Pa. App. filed April 24, 1900. (See page 783.)

685,516. MOUNTING AND DRIVING DYNAMOS ON CARS; P. Kennedy, Brooklyn, N. Y. App. filed Feb. 5, 1901. The tension of the spring belt tightener is maintained constant by an equalizer.

685,528. HEATING DEVICE FOR ELECTRIC LAMPS; Henry Noel Potter, Gottingen, Germany. App. filed Sept. 11, 1899. (See page 783.)

685,549. ELECTRIC CUT-OUT; Alexander Jay Wurts, Pittsburg, Pa. App. filed April 17, 1901. (See page 783.)

685,571. TELEGRAPH OR OTHER SYSTEM; J. Burry, Fort Lee, N. J. App. filed Oct. 23, 1899. Details including a circuit breaker and connector comprising two metal terminals and a series of springs each fast to one of the terminals and normally bearing against the other, whereby the circuit through the breaker may be broken by forcing the springs one after the other away from the terminal each bears against, and may be made in the reverse manner.

685,575. ELECTRIC RAILWAY TROLLEY; E. R. Coon, Burlington, Va. App. filed May 25, 1901. The trolley is a sphere of conducting material, suitably mounted on the end of a pole and capable of rotating in all directions.

685,577. APPARATUS FOR REGULATING ELECTRIC GENERATING SYSTEMS; A. De Dion and G. Bouton, Puteaux, France. App. filed June 4, 1901. An arrangement by means of which the speed of the engine is regulated by the dynamo, so as to insure a constant difference of potential at its terminals, the dynamo acting on the eduction valve of the explosive engine so as to vary its speed.

685,590. ELECTRICAL INDICATOR; H. Faltermayer and E. W. Faltermayer, Philadelphia, Pa. App. filed July 19, 1900. An indicator for weather vanes in which a commutator is traversed by an arm carried by the vane and thus closes circuits leading to various magnets at a distant point which move an indicator in accordance with the motions of the vane.

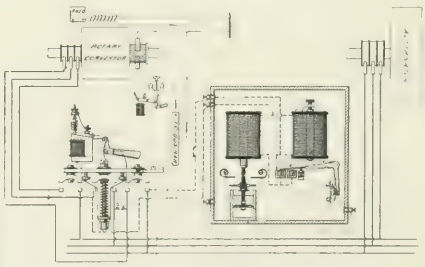
685,604. ELECTRIC SWITCH; J. W. Hearn, Brooklyn, N. Y. App. filed Jan. 27, 1901. Details of construction of an electric railway switch operating device.

685,613. SWITCHBOARD AND FUSE BOX; M. H. Johnson, Utica, N. Y. App. filed March 26, 1900. Details of construction.

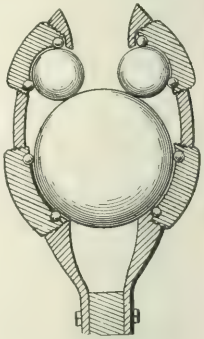
685,614. SUPPORT FOR ELECTRIC PUSH BUTTONS; H. F. Keil, New York, N. Y. App. filed Feb. 13, 1901. A sheet-metal base having a thread to receive a sheet-metal cap for the button.

685,645. WATER PURIFIER; John F. Rose, Brooklyn, N. Y. App. filed July 8, 1901. The water to be purified passes through a trough, the opposite sides of which are insulated from each other and connected to the two poles of an electrical circuit; the sides contain projecting legs or teeth.

685,717. ELECTRIC FURNACE; Oscar Frolich, Steglitz, Germany. App. filed Sept. 27, 1898. (See page 782.)



685,430.—Automatic Synchronizer.



685,575.—Electric Railway Trolley.

685,720. ELECTRIC FAN; G. C. Hawkins, Boston, Mass. App. filed Jan. 24, 1901. Details.

685,724. METHOD OF ELECTRIC LIGHTING; Walter Nernst, Gottingen, Germany. App. filed April 23, 1898. (See page 783.)

685,725. ELECTRIC GLOW LAMP; Walter Nernst, Gottingen, Germany. App. filed April 28, 1898. (See page 783.)

685,726. ELECTRIC LIGHTING APPARATUS; Walter Nernst, Gottingen, Germany. App. filed April 28, 1898. (See page 783.)

685,727-8. ELECTRIC GLOW LAMP; Walter Nernst, Gottingen, Germany. App. filed April 28, 1898. (See page 783.)

685,729. GLOWER FOR ELECTRIC LAMPS; Walter Nernst, Gottingen, Germany. App. filed Aug. 24, 1899. (See page 783.)

685,730. MATERIAL FOR ELECTRIC LAMP GLOWERS; Walter Nernst, Gottingen, Germany. App. filed Aug. 24, 1899. (See page 783.)

685,731. BALLAST DEVICE FOR ELECTRIC GLOWER LAMPS; Walter Nernst, Gottingen, Germany. App. filed Sept. 29, 1899. (See page 783.)

685,732-3. GLOWER FOR ELECTRIC LAMPS; Walter Nernst, Gottingen, Germany. App. filed Aug. 24, 1899-Nov. 8, 1900. (See page 783.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, NOVEMBER 16, 1901. No. 20.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 16, 1901.

CONTENTS.

	PAGE
Editorial	805
A Modern Trolley Net Work	808
Electrical Engineers of the Day—XX; L. B. Marks	808
The Debt of Electrical Engineering to C. E. L. Brown—I; by B. A. Behrend	809
The Development of Trolley Net Works in Michigan. By Edward J. Hart	812
Electrical Incomes and Outputs per Ton of Coal. By Alton D. Adams	814
Telegraph Systems, Operating Speeds and Economies. By Romyn Hitchcock	816
Data as to the Use of Calcium Carbide and Acetylene	818
Electrical Pigment Furnace	818
Electric Lighting for New York Elevated	818
Lighting the St. Louis Exposition	819
New Telephone Patents	819
Current News and Notes	820
LETTER TO THE EDITORS:	
The English Electrical Industry. By H. W. Knott	822
Digest of Current Electrical Literature	823
New Books	827
Small Alternating Current Single-Phase Motors	828
Maywood Gas Engine	829
Meeting of Automobile Manufacturers	830
Electrical Illumination in Australia	830
New Telephone Exchange at Jackson, Mich	830
A New Direct-Connected Generating Set	831
Interior Marine Cable Box	831
Grant Milling Machine	831
DEPARTMENTS:	
Financial Intelligence	832
Commercial Intelligence	833
General News	835
Trade Notes	839
Record of Electrical Patents	839

C. E. L. BROWN.

Elsewhere in this issue we print the first of several articles by Mr. B. A. Behrend, giving an account of the work of Mr. C. E. L. Brown, whose name is so intimately associated with the development of electrical engineering from its earliest days. We say, "from its earliest days" advisedly, for though the electrical industry had reached considerable proportions when Mr. Brown first placed his great abilities at its service, he was the most notable of the pioneers whose labors and example brought the department of electrical design and construction to a real engineering basis. In tracing back the more important types of electrical machinery which have become permanently established in the art, we are apt in many cases to find as a prototype a Brown machine, designed and constructed at a date when, outside of a very few factories, design was interpreted to mean "cut and try," and when mechanical improvement usually only followed from indications furnished by the complaints of users. Aside, therefore, from the personal interest involved in the account of the work of a great engineer, the articles of Mr. Behrend will have an additional interest in that they also give an account of the origin of many of the standard types of electrical apparatus of to-day

ALTERNATING CURRENT TERMINOLOGY.

In a recent article in *L'Industrie Electrique* the editor has drawn attention to the incongruity of certain names appearing in connection with alternating-current electric quantities. An American author of prominence is accused of employing the terms "wattless power" and "wattless watts" to the product $Ei \sin \phi$ in an alternating-current circuit. Of course, every one knows what is meant by this product; it is the product of the effective alternating e. m. f. into the component of alternating current which is in quadrature therewith; or more correctly speaking, the product of the effective alternating current into the component of e. m. f. which is in quadrature therewith. In either case the component considered does no work upon, or receives no work from, the other element.

At the same time the term *"wattless watts"* is certainly rather a misnomer, and likely to give rise either to misunderstanding or despair on the part of the student. *L'Industrie Electrique* proposes the term *fictive power* for this product, which is convenient and well chosen. The following terminology is suggested by our contemporary and appears to be worthy of general approval. I in an alternating-current circuit represents the effective current strength; $I \cos \phi$ is the current in phase, or the component of current in phase; $I \sin \phi$ the current in quadrature, or the component of current in quadrature; EI the apparent power; $EI \cos \phi$ the real power; $EI \sin \phi$ the fictive power; $\cos \phi$ the power factor, and $\sin \phi$ the factor of impotence.

LOCAL TELEPHONE SERVICE ALWAYS THE WORST.

To one who has noted the attitude of the public and press in many of the large cities and towns of the United States in regard to telephone service, the protests which go up in each individual city are rather amusing. It seems to be the firm conviction of various newspapers that the service in their own cities is the worst that exists anywhere, and this, too, in spite of the fact that in the cities where the service is of the highest grade there is some of the most outrageous kicking as to the quality of service given.

Of course, it is not reasonable to suppose that the service in any city is perfect, but, on the other hand, it is equally unreasonable to

suppose that subscribers are always warranted in their complaints. The Chicago press has recently seen fit to break loose on the subject of telephone service in that city. As "kickers" are always easy to find, it is not a difficult matter to get up an extended article made up of interviews with dissatisfied subscribers in any city, large or small. If the cold, scientific facts could be tested it is probable that Chicago service would rank in quality the equal of any in the United States, although it does not approach in number of subscribers per thousand population that of some smaller Pacific Coast cities. That it is likely soon to do so under President Sabin's management any one who is acquainted with his vigorous policy will know.

One trouble seems to be that people expect service on two and ten-party lines equal to that on single lines, and all for the price of the party-line service, which is considerably below that for an individual telephone. Party-line service is designed expressly to meet the wants of a class of subscribers who do not make extensive use of the telephone, and, therefore, do not feel able to pay the higher price which the company must necessarily charge for single lines. As such, the two and ten-party line service meets a demand that has not heretofore been catered to, as is shown conclusively by the enormous increase in the number of subscribers which has been the accompaniment of the introduction of such party-line service, particularly in "independent telephone" work. This being the case, the offering of party-line service is more than justified even if it is the cause of unjustified complaints from subscribers who expect something for nothing. Moreover, any telephone man familiar with the complaints that are received, knows that a considerable per cent of them is the result of carelessness or ignorance on the part of the person using the telephone. Some men are so constituted that they honestly believe they have waited five minutes for a call when the actual period is nearer five seconds. We have often wished that every telephone subscriber could visit an exchange and see not only how the work is done, but what a costly outfit is required by the modern exigencies of the service.

Wireless Telegraphy at Sea.

A great stride has been taken in the direction of developing wireless telegraphy by an agreement which seems to have been concluded between Lloyds Agency and the Marconi International Marine Communication Company. Lloyds Agency is the great shipping agency which plays so prominent a part in the marine transportation of the world. According to the agreement, Lloyds adopts the Marconi system exclusively for a period of 14 years, and will receive commercial telegrams from their signal stations on the coast of Great Britain as well as on the Atlantic coast of the United States. On the other hand, they will not exchange messages with vessels which have not been supplied with the apparatus of the Marconi Company. Lloyds' signal stations are all connected by land telegraph with the large cities. At the present time signals are exchanged between passing vessels and Lloyds agencies by means of flags, using the international code of flag signals. The distance at which such signals can be read is necessarily limited to about five miles, and this only under favorable conditions as regards daylight, weather and direction of wind. The substitution of the wireless telegraph for the visual flag signal will not only greatly increase the effective radius of transmission, making it probably from 20 to 100 miles, but will also enable these signals to be sent at night as well as during the day, and in fog as well as in sunshine.

This facility will be of enormous practical value to the navigator. It will also mean that large Atlantic passenger steamers may receive important items of news, and information of general interest, before coming within sight of their land of destination. By the adoption of this system it may be said that the trans-Atlantic journey has been virtually shortened by hundreds of miles, since a vessel in signaling touch with the land is practically out of Neptune's realm. The result of this agreement is likely to be that commencing with the large passenger steamers, vessels will gradually be equipped with Marconi wireless telegraph apparatus, by means of which they will not only be able to signal to Lloyds agencies, but also to other vessels similarly equipped. Within a few years possibly all principal lighthouses of the world will be equipped with Marconi apparatus. But many problems will have to be worked out before the system can be considerably extended. There will no doubt be a tendency to interference between a plurality of signaling vessels in proximity to each other. It will take time and study before the apparatus can be so far systematized as to render mutual confusion impossible. Except in the case of large vessels which can afford to carry the requisite talent, it will be necessary to place the wireless telegraph apparatus on board the average vessel in the hands of sailors, a class of men who are so thoroughly practical in all that they do, that no apparatus short of ropes and cast iron can be expected to withstand unscathed the exigencies of their manipulation.

It is stated that the agreement permits of a free use of the wireless telegraph system for the transmission of the usual Lloyds Agency reports but that a tariff of 12 cents per word will be charged on all commercial messages exchanged across the sea with the shore telegraph office. The advantage of the agreement will be the probable rapid extension of the wireless telegraph system throughout the civilized world. The disadvantage is, of course, the monoply of the system in the hands of the Marconi Company for the period of 14 years. It seems at first sight altogether unfair that messages should be exclusively exchanged with vessels equipped by the Marconi Company, when it is quite possible that equally good apparatus might exchange messages, although supplied by other manufacturers. However, it would seem that the general advantage to be derived for the community outweighs the disadvantage.

Factors Governing High Voltage vs. Direct Distribution.

A problem which is coming up with increasing frequency in engineering practice is the advisability of distribution of power over a large area by high voltage and sub-stations, as against the use of a number of smaller generating plants and distribution direct from these lower voltage stations without the interposition of high-tension distribution. Each time the question arises it is, of course, necessary to contrast by calculation the merits of the two plans for the individual case under consideration, for no general rule covering all the conditions has been or ever will be laid down indicating when the use of one or the other system is advisable. There are, however, certain principles that may be applied in arriving at a conclusion. It is hardly necessary to say that the use of high-tension distribution from one power house over large areas is on the rapid increase, not only for railway but for electric light and power service. This is due fully as much to the change in commercial requirements that are gradually increasing the areas over which current must be distributed, as to any recent advance in the art of high-tension distribution, although the advance in the art was, to be sure, a necessary forerunner. Taking the high-voltage distribution systems employing steam plants which are in use to-day, the results of practice seem to have shown the general principle that alternating-current distribution from steam plants at high voltages by means of sub-stations, is best adapted to cases where the total power generated is large in proportion to that used near any one point. This point—that the relation between the amount of power generated and the amount of power re-

quired near any one center, largely governs the relative applicability of the high-tension single plant with sub-stations as against several generating plants—is one that has not been very clearly enunciated, though it is the principle which is, consciously or unconsciously, followed by the engineering world in practice.

Taking, for example, alternating current transmission for electric railway current supply, we find that polyphase currents have found their greatest use in connection with either interurban lines or heavy city systems, as in New York City. Here we surely have conditions as widely different as they could well be. On an interurban line the demand for current per mile of track is small. In New York City it is enormous. The distances are long in interurban work and short in a city like New York. The New York City systems and interurban lines do, however, have the one point in common, that the total power required is large in proportion to that called for near any one point of the area supplied. In all other respects, city and interurban systems are as different as they can well be and yet come in the same branch of electrical application. In the city the high cost of real estate on which to build generating plants enters, of course, into the problem, while in the country this factor is of little moment. In the country, on the other hand, the difference in operating economy between one large station and several small ones is probably more marked. In either case, however, conditions exist which make power generated on a large scale more economical than when generated on a smaller scale, be other conditions what they may.

The same rule that the successful use of alternating-current high-voltage distribution is dependent on the total power required being large as compared to the quantity used near any one center, is found to hold with respect to alternating-current distributing systems for light and power. The three-wire network in a downtown district, considered alone, can usually be most economically supplied by a generating station nearby and delivering to the network direct. When the network grows to cover a large area or extends into outlying districts we find the large high-voltage alternating station either erected or in prospect. But it is not until the outlying districts become an important factor in the total load, and until the total power called for is large in proportion to that needed near one point, that such stations are planned.

Electric Lighting Statistics.

Comparing electric stations on the basis of income per ton of fuel consumed is the interesting novelty presented this week in Mr. A. D. Adams' discussion of Massachusetts electric lighting statistics. In a measure this ratio defines the operative characters of the plants excellently, but the local commercial conditions are, we think, too thoroughly mixed up with the matter to be effectively eliminated. The figures must be taken for what they are worth rather than at their face value. The indeterminate genius who divided untruths into plain lies, past-participled lies, and statistics, was perhaps lacking in tact, but he assuredly possessed rare sociological insight. From the United States Census up—or down—we have a lurking, ill-defined distrust of official statistics that it is hard to put aside. We always see them written down in the mind's field of vision with various coefficients of mendacity permanently attached thereto. This psychological variable has hitherto been much neglected, but we purpose to give it greater prominence, and to search for a new and horrible block-letter type, of Chinese of Armenian design maybe, in which to print it. Were it not for a certain existing prejudice against new units we would suggest the "Ananias" as a fitting designation, with, of course, the appropriate prefixes for its multiples and submultiples.

Joking aside, we feel that even statistics from so reputable a source as the Gas and Electric Light Commission of Massachusetts must be taken with great caution as a basis for matters pertaining to engineering. Frankly, we think that most of the widest variations found in Mr. Adams' skillful analysis of the figures as he finds them are due to errors, accidental or other, in the data reported. An examination of the original reports as furnished to the Commission does not leave, to put it mildly, any abiding sense of mathematical precision, particularly if the figures of several consecutive years are compared. Certain of the quantities, like the prices paid by municipalities for arc lights, are matters of public record and are doubtless precise save when an attempt is made to reduce them to a lamp-hour basis. Other figures, like the gross amounts of coal consumed, are presumptively accurate if the blank were filled out by one who knew the facts. But in financial matters, where the method of bookkeeping enters as a dubious factor, we think such reports furnish a very slender basis for further computations of a character requiring precision. It needs a rather careful examination to get beyond the mere gross receipts. The incomes per ton of coal burned, as given by Mr. Adams, form a curiously varying assortment ranging from a little over $12 to more than $47. A very curious feature is the excellent showing made by some of the very small plants, burning less than 1000 tons of coal per year, while among the plants of medium size are found both the best and the worst results. We fancy that one cause of such discrepancies may be sought in the very different grades of fuel burned in the several stations. A low income per ton may simply mean that in the plant considered it has proved to be good economy to burn low-grade coal, while a large income per ton would result if transportation charges were such as to make it desirable to burn the best fuel obtainable. In certain plants an unproductive day load is a fruitful source of fuel consumption, while in others the fault may be with the general character of the engineering.

If one knew or could compute the output of the various plants in kilowatt-hours, a vast amount of valuable information would be put at the disposal of one making comparisons of plants. But we do not think it too much to say that any figures on annual kilowatt-hours derived from the source Mr. Adams has taken, by however ingenious a system of computaion, involve uncertainties so great as to make comparisons utterly futile. The prices obtained for electrical energy delivered to private consumers can only be found in the books of the companies, and sometimes not even there. Considering these facts, we think it remarkable that the results obtained by Mr. Adams as to the probable consumption of coal per kilowatt-hour do not present greater and more obvious discrepancies than appear. Exact data on this subject are greatly to be desired, but it is a fact that very few stations could report the facts accurately even if they were disposed to make them public. Very few stations keep a complete record of their annual output, more's the pity, or know the working efficiency of the plant itself. What the Honorable Gas and Electric Light Commissioners get as the result of their inquisitorial blanks is presumably what all persons get who have officially to stick their noses into other people's business—as few and uncertain data as will avoid legal complications. The statistics resulting are probably somewhat more reliable than those elicited by the income tax schedules of a few years ago, and possessed of less certitude than a table of logarithms. Just where in the uncertain region between these extremes they lie, we will not pretend to say. They present a great mass of information, such as it is, but what is drawn from it by the investigator depends more upon his ingenuity than upon the logic of the facts. Our correspondent's treatment is an admirable study of methods of statistical analysis, although we have to turn the cold, unfeeling eye of skepticism on some of the deductions.

A Modern Trolley Network.

The extension of some of the modern trolley networks in the Middle States is remarkable. The plans for the absorption by the Everett-Moore syndicate of the so-called Appleyard road in Ohio seem about to be consummated. According to a capitalist who is closely identified with the syndicate, there is under way a deal which is more gigantic than any yet attempted by the Everett-Moore syndicate. It includes the absorption of roads which will place under one control a line from Cleveland to Columbus and Cincinnati; a line from Cincinnati to Toledo, with probably a line from Toledo to Columbus. This project is separate and distinct from the aims of the Pomeroy-Mandlebaum syndicate, of Cleveland, for lines touching the same terminals. It will include about 415 miles of road under construction or in operation, or right of way secured. The lines owned by Tucker, Anthony & Co., of Boston, are the Canton & Akron Railway, 20 miles, under construction, and the Columbus, Buckeye Lake & Newark Traction Company, 45 miles, under construction. From Canton to Newark, with a spur line to Zanesville, aggregating 105 miles, a private right of way nearly the entire distance has been secured. The deal for the control of these has already been closed. A. E. Appleyard, of Boston, who is closely associated with Tucker, Anthony & Co., represents Boston capitalists who own the controlling interest in the following roads, which are either in operation or under construction: Columbus, London & Springfield, 45 miles; Columbus, Grove City & Southwestern, 15 miles; Dayton, Springfield & Urbana, 42 miles; Columbus, Delaware & Marion, 45 miles; Dayton, Lebanon & Cincinnati, 25 miles. Between Urbana and Findlay, 50 miles, a right of way has been secured. At the latter point connection will be made with the Toledo, Bowling Green & Southern Railway, which is owned by George B. Kerper, of Cincinnati, and held under option by the Everett-Moore syndicate. This road has a mileage of 40 miles partially in operation. The syndicate will abandon its intention of extending the Northern Ohio traction line to Canton, and the line will be deviated to Massillon, so that there will be but one road between Canton and Akron. In connection with the roads already owned by the syndicate the complete system will connect 36 county seats in Ohio.

Electrical Engineers of the Day—XX.

L. B. Marks.

Louis Benedict Marks was born in New York City, Jan. 25, 1869. He began the study of electricity as early as 1882, and the following year entered New York College. Most of his time at college was devoted to the study of chemistry and physics, and in order to carry on experimental work he established a small private laboratory for this purpose. Graduating as a Bachelor of Science from the College in 1888, he entered the senior class of Cornell University in the same year, and was graduated from the electrical engineering course with the degree of M. E. in 1889. Taking up a post-graduate course, he received the degree of M. M. E. in 1890.

While at Cornell University Mr. Marks made the study of the arc light a specialty, but he also made researches in widely different branches of physics. In a paper read at the 1890 meeting of the American Institute of Electrical Engineers in Boston, entitled "Life and Efficiency of Arc Light Carbons," he presented the results of original investigations in the physical laboratory of Cornell University made by him under the direction of Dr. E. L. Nichols. During this period Mr. Marks devised a small voltameter which furnished the subject of a paper presented before the American Institute of Electrical Engineers by Professor Harris J. Ryan. He also made experimental researches on transformers, especially with respect to heating of the cores, the results of which were communicated through the A. I. E. E. *Transactions*.

In 1890 Mr. Marks entered the service of the Washington Carbon Company, of Washington, Pa., and continued with this company for three years, during which time he made a number of improvements in arc light carbons and their manufacture. Among inventions during this period was an apparatus for securing great homogeneity in the granular structure of molded carbons.

Mr. Marks is doubtless best known from his invention of the enclosed arc lamp. It is well known that when an arc is formed between carbon points in air, the points must be drawn apart a certain distance before the light becomes steady, and if they are drawn apart too far the light again becomes unsteady. The normal, or steady open arc of commerce is a 45-volt arc, about ⅛ inch long. If the voltage falls appreciably below 45 "hissing" occurs. If the voltage rises materially above 45 "flaming" sets in. In either case the light becomes too unsteady for commercial use. The invention of the enclosed arc lamp was based upon the discovery that while the life of the carbons is greatly extended by enclosing them in a small sealed globe, the admission of a small quantity of oxygen to the globe with means affording an increased time limit for permitting chemical combination of the dissociated carbon particles, results in an arc of an entirely new character.

In the lamp devised by Mr. Marks to operate according to the above principles, provision was made for drawing a long arc (about four times as long as the open arc) operating at a high voltage and a low amperage. Such a lamp can be continuously maintained without hissing or flaming or other irregularity, at a voltage and amperage which are impracticable in the open air. Thus, while the ordinary open arc operates at 45 volts and 10 amperes, it was demonstrated that an inclosed arc can be efficiently operated at double or more than double this voltage, and at half or less than half the current. It was also found that the carbons when thus enclosed would last many times as long as in the air. For example, a pair of carbons which, in the ordinary lamp would burn eight hours, will last 150 hours or more when operated under the above-named conditions.

The first public announcement of this invention was in a paper which Mr. Marks read before the International Electrical Congress

at the Chicago World's Fair in August, 1893. In the following year the same subject was presented in a paper read before the Washington meeting of the National Electric Light Association, and which led to an extended discussion on the enclosed arc and its future. The tone of the discussion was decidedly discouraging, but nothing daunted, Mr. Marks continued to present the claims of the enclosed arc. His persistence finally began to have effect, though it was not until about 1897 that the great value of the enclosed arc began to receive general recognition. Since then its adoption has been very rapid, and at the present time it has almost entirely driven the open arc light from the circuits of this country, over 500,000 having entered into use up to date.

Mr. Marks did not, however, confine his advocacy of the enclosed arc lamp to America. In 1896 he delivered a lecture on his invention before the Societe Internationale des Electriciens in Paris, the audience including the most noted savants and electrical engineers of France; and early the following year he gave an exhibition before the Royal Institution in London. Though this type of arc lamp has not yet made the headway in Europe that it has in this country, a jury of the recent Paris Exposition comprising the leading electrical authorities of European countries, placed upon it a seal of approval through the award of the highest prize—a gold medal. The General Electric Company purchased the Marks enclosed lamp patents in 1900, and has retained Mr. Marks as a member of its expert staff.

Mr. Marks is a member of the American Institute of Electrical Engineers, the Societe Internationale des Electriciens, the National Electric Light Association, and several other similar bodies.

The Debt of Electrical Engineering to C. E. L. Brown—I.

By B. A. Behrend.

THE rapid progress of electrical engineering, followed by a tremendous tide of industrial development unequaled in rapidity and force in the history of civilization, has almost entirely effaced the landmarks on the road it has taken. Scientific progress is dependent upon the work of the men who have impressed a mark upon the intelligence of their time. But this is true only with qualification of the development of industry. In it, as in science, the development is brought about by men who, characterized by energy, genius and ability, lead their fellowmen in progress. But the facility with which intelligence spreads all over the civilized globe, makes a new idea almost instantly the possession of all who have learned to read, and thus often deprives a man of the legitimate fruits of his labor. Another man picks up the salient points of his design, perhaps in another country, and turns them to material account unless prevented by the patent law. Often the knowledge of the mere fact that a thing *has* been done without knowing *how* it is done, is a great help to a constructing engineer, and takes from his mind the awful doubt that his design may be a failure.

It is thus that many of the younger generation have been materially assisted in their work by what they have seen the older ones do. What seems a dream and a vague possibility as long as it has not been shown that it *can* be done, becomes a hard fact as soon as it is *seen* done, and it is then usually contemplated with that unphilosophical scorn that makes the tyro in science or engineering belittle the work of former generations. In industry, more than in any other branch of human labor, men after the manner of successful persons would gladly ignore the means by which they have risen, being slow and reluctant to remember the debt that they owe to their predecessors. But to men whose minds have been trained along scientific lines, it becomes a problem of profound interest to trace to its sources the development of a great idea, or of a material change in industrial development, and to the younger mind there is often a great satisfaction in paying a tribute, however modest, to the men who have been its chief promoters.

Charles Eugene Lancelot Brown.

The succeeding pages are written with this chief end in view, to point to the work of one who has in a remarkable degree influenced the development of electrical engineering, and to whose designs might be traced most of our modern electrical machinery. The year 1901 is particularly appropriate for such a tribute, being the tenth anniversary of the experiment between Lauffen and Frankfort, which demonstrated for the first time the possibility of transmitting so large an amount of energy as 300 horse-power over a distance of 115 miles at a pressure of 30,000 volts, an experiment in whose successful execution, beside M. von Dolivo Dobrovolsky, Mr. C. E. L. Brown stood out most prominent. There is no need of apology for a tribute of this nature. The work of C. E. L. Brown is interesting enough to command the attention of electrical engineers, and he who writes about it must almost write a treatise on the design of electrical generators and motors.

"One increasing purpose" seems to run through Mr. Brown's work, and thus even his early work, in spite of the rapid strides of progress, is still worthy of our study and most serious consideration. His modern work, evincing a keen penetrative insight into the principles that lie at the root of all electrical designs, stands out prominently among that of other engineers through its boldness, through its careful electrical design, and through its fine and graceful constructions. To the present writer it is a matter of deep gratification that he may pay this tribute to Mr. Brown, as through seeing the work of Mr. Brown in former years, he owes, in large measure, the knowledge that he has gained of the principles of designing. Mr. Brown, with great liberality and fairness, has put at the writer's disposal most of the material that forms the structure of this article, and which will best serve to commemorate and illustrate the vast amount of work that has been done by Mr. Brown during the past fifteen years.

The designs of Mr. Brown are so typical, their general principles have become embodied in the designs of all other engineers, they have been imitated and copied so numerously in full and in detail, that those who imitate his imitators are often not even aware of this fact.

A good design is an adaptation as perfect as possible to the conditions under which it is to be operated. As these conditions are different in Europe from what they are in this country, it follows that there must be essential differences between European and American designs which find their explanation readily in the difference of the conditions to which they have to be adapted. The closed slots, for instance, commonly used by Mr. Brown, are feasible in Europe even at this period, as skilled labor is more easily obtainable and cheaper than in this country, and as the high development of tools and labor saving machinery has not reached the stage to which this country has obtained.

During the past half dozen years this country has at least equaled, if not overtaken, the electrical industry of Europe. The grandest electric central stations are now in this country, the finest, best designed and most durable electrical machinery is now made here, and Europe can be proud of having taught the intrinsic elements and foundations to her excellent pupil America, while, on the other hand, we should not forget the debt we owe to those who, at a time when there was little material benefit to be gained, put all their ability and energy to the service of man.

EARLY WORK.

Charles Eugene Lancelot Brown is the son of Charles Brown, an engineer of exceptional ability, who had devoted his energies to the perfection of the steam engine in the works of Sulzer Brothers in Winterthur, Switzerland. Born in Winterthur on June 17, 1863, Mr. Brown, after one year's apprenticeship in M. Burgin's shops in Basle, organized a small electrical department at the locomotive works in that city. Hardly 21 years old, he was engaged by the Oerlikon Engineering Works, becoming two years later director of the electrical department. From this time dates his career whose fruits have excited the unanimous admiration of electrical engineers all over the world.

Early in 1886 we find Mr. Brown engaged in the development of the direct-current dynamo, and in its adaptation to the electrical transmission of energy, and in November of the same year he had already scored a success that might well be called a landmark in the history of electric power transmission. We can best illustrate the state of affairs by quoting from an article in the *London Engineering*, March 11, 1887. After reviewing the attempts made at the electrical transmission of energy, pointing out how the uncertainty about the results had shaken confidence, so that when it became known finally that the commercial efficiency had not risen above 45 per cent, many a practical engineer returned to his old opinion that, after all, the transport of coal was cheaper than the transport of power in any form, the article continues as follows:

"Under these circumstances all further experience is most welcome. We are to-day enabled through the courtesy of Mr. C. E. L. Brown, of the Tool & Engine Works at Oerlikon, near Zurich, to place before our readers the results of some tests on the electrical transmission of power, made with Mr. Brown's new dynamos and motors. The tests were conducted by the maker in conjunction with independent and competent experts, Professors Amsler-Laffon, Gysel, Veith and Weber, and Messrs. Keller, Lang, Meier, Naville, Waldner and Zschokke; the report was compiled by Professor Amsler-Laffon. The machines were constructed for the transmission of a water power of about 50 horse-power from Kriegsstetten over a distance of 8 kilometers (5 miles) to the works of Mr. Mueller-Kaiber at Solothurn, in Switzerland. The tests were made in the works of Mr. Brown on conditions as nearly as possible equal to those to be fulfilled later on. Their object was a practical one to answer the questions: What power must be supplied to the primary machines so

that the secondary machines can do a certain work? What relations exist between the speed of the primary and of the secondary machines? How does the speed vary with varying work? Electrical instruments were used only so far as electrical magnitudes were concerned, the power measurements were taken mechanically, Mr. Brown being aware of the diffidence with which the practical engineer regards electrical power tests, in which he has to trust electrical

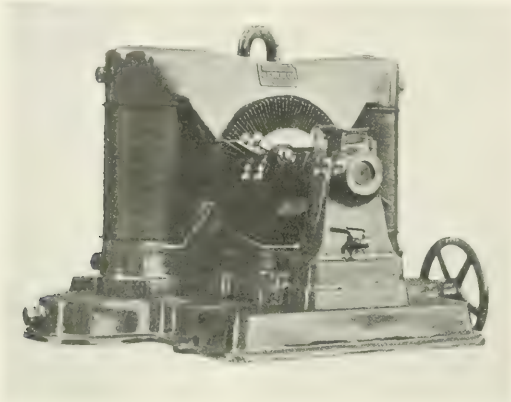


FIG. 1.—LOW-TENSION MANCHESTER TYPE, WITH TUNNEL ARMATURE.

instruments of whose reliability he cannot convince himself through tests of his own. We will conclude these introductory remarks by adding that a commercial efficiency of over 70 per cent was obtained."

There is a brief passage in the article from which we have cited, that expresses in a few words the cause of the great success that Mr. Brown's designs have met with. "It appears clear," says the writer, "*that the remarkable efficiency of Mr. Brown's dynamo must be ascribed to the ingenious though simple alterations which he has made in the armature and its relative position to the field-magnets.*" And Professor Amsler-Laffon added to his report that "the Brown dynamos are distinguished by a simple, solid and judicious construction." If, after fifteen years, we wanted to sum up briefly the main characteristic features of Brown's various designs adapted as they are to all sorts of conditions, we could not do it better than by repeating the above statements, and the constructions to be described in this article will amply bear us out.

The dynamos for the Kriegstetten Solothurn transmission were

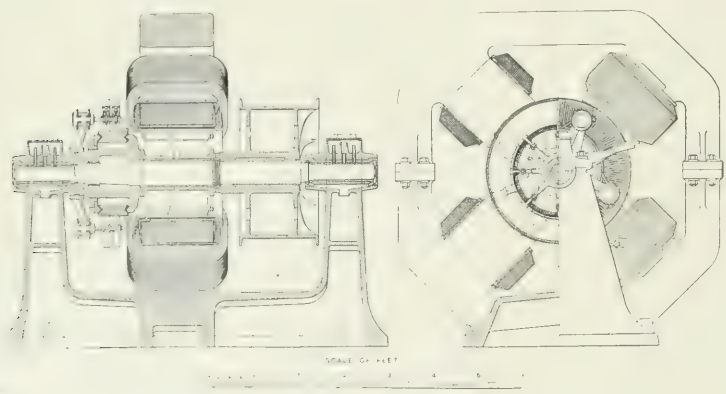


FIG. 2.—FOUR-POLE, 600-VOLT GENERATOR, BUILT 1888 FOR TRANSMISSION OF ENERGY IN ITALY.

of the Manchester type, as illustrated by Fig. 1, which shows a low-tension machine, with the only difference that they had a smooth core instead of a tunnel armature. Their magnetic circuit was carefully designed, and the high efficiency obtained is evidence that the core losses were small as well as the losses in the armature and field copper. The report on the tests that were conducted in November, 1886, at the Oerlikon works, says that "the brushes are easily accessible, showed very little sparking, and did not require any adjustment during the tests when more and more lamps were added. There would thus be very little wear to both brushes and collectors. The field magnets became only slightly warmer during a run of several hours."

Mr. Brown employed the hole armature as early as November, 1885, for his direct-current, low-tension generators and motors.

There seems little doubt that he employed hole armatures at a very early date and used them to practical advantage. Whether Wenstrom actually anticipated Brown or not in regard to tunnel armatures, or in regard to slotted armatures, is after all a very unimportant matter. Both men have proved their fertile genius in electrical designs, and, as must always happen with men working in the same field, they may have independently struck upon the same construction. Questions of priority are only too often idle and unworthy

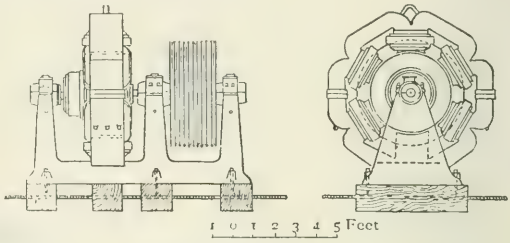


FIG. 3.—300-HP GENERATORS FOR SCHAFFHAUSEN SPINNING MILLS.

questions that lead to endless squabbles. What matters it after all whether a man has got hold of a new idea five minutes before another one does? The electrical world will be indebted to both if there is no intellectual piracy in the play, and in the case in question we should honor both Brown and Wenstrom for their improvements on direct-current armatures. We shall later on describe some low-tension generators of Brown's, and shall now return to his direct-current machines for power transmission.

The success of the Solothurn plant led of necessity to larger undertakings on the same plan. Among these we mention especially an installation in Italy for transmitting 270 amperes at 625 volts over a distance of 500 yards. We here reproduce a drawing of these generators, as their construction has undoubtedly given a mighty impetus to the construction of railway generators all over the world. The plant was sold to Signor Gaetano Rossi, in Piovene, near Schio, in Upper Italy. The generator ran at a speed of 500 revolutions. From an article in *Industries*, London, August 10, 1888, we take the following data, which will supplement Fig. 2. The generator was

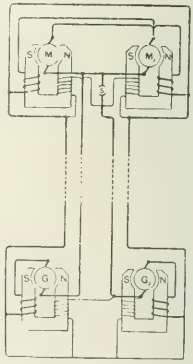


FIG. 4.—CONNECTION OF GENERATORS AND MOTORS IN SCHAFFHAUSEN SPINNING MILLS.

designed for 270 amperes at 625 volts when running at 500 r. p. m. The field magnets were of cast iron, and of the four-pole type. There were four exciting coils, each containing 58 turns of square wire, all coils being connected in series. The armature of the generator was 960 mm. in diameter by 500 mm. long, and was Gramme wound with

400 turns of 6 mm. square wire having a sectional area of 36 sq. mm. The core of the armature consisted of wrought iron disks, which were mounted upon a gun-metal flanged cylinder made in two parts. The joint between the two parts was a broken line, so that even those disks which were over or close to the joint were well supported, and after the insertion of the disks the two parts of the supporting cylinder were drawn together by the bolts shown, and the outside of the flanges was insulated by wooden rings.

Comparing the design of these generators with modern practice, we find that we have about 230 ampere-wires per inch periphery of the armature, a value which is low as compared with modern American practice, but only a few years ago was quite common in Europe. The excellent commutation secured in Brown's early machines, is in large measure due to the large flux that he utilized. It is difficult for us to realize—armed as we are with magnetizing curves of all kinds of material—how one could design machines without having any such data at one's disposal. But this is exactly what Mr. Brown had to do, and when the writer in *Industries* speaks of the "talented young engineer who is at the head of the electrical department of the Oerlikon works," we cannot but join him in his admiration.

Mr. Brown had to develop numerous protective devices for his plants, such as lightning arresters and automatic circuit breakers which avoided breaking the whole current suddenly, but acted in such a manner as to cut down the field excitation of the generator if the line current increased beyond a certain value. The device consisted in an automatic switch which short circuited the field coils of the generator, being released by an electro-magnet which was excited by the main line current. We cannot, for lack of space, enter into a more detailed description of this "ingenious and simple" device, but must conclude by citing once more from Professor Amsler-Laffon's report, which speaks of the "excellent provision made by automatic short-circuiting devices against too strong currents."

The plant described above was operated with series-wound generators and motors. Mr. Brown had succeeded in obtaining almost entirely constant speed of the motor. He now installed the plant for the Schaffhausen Spinning Mills, which is still in successful operation, with compound generators and motors. The distance between the generating station and the mills was 750 yards, and Brown transmitted 600 horse-power over this distance with two 300-hp generators of 625 volts in series. How Brown avoided a starting resistance for the motors, and how he made the generators mutually control each other by crossing the connections between armatures and fields, is of such general interest that we cannot forego quoting at length from a lecture on this subject by Mr. Kapp, delivered as one of the Cantor Lectures at the Society of Arts, in London, in 1891.

"The generating station contains two 300-hp dynamos (Fig. 3), which are over-compounded, so as to produce a constant pressure of 600 volts at the motor tsation, the loss in the line being with full current 24 volts. These machines have series wound drum-armatures, running at 200 r. p. m. Their more important electrical data, as well as those referring to the motors, are given in the following table:

SCHAFFHAUSEN TRANSMISSION PLANT.

	Generators.	Twin motor.	Small motor.
Number of machines	2	1	2
Normal horse-power	300	380	60
Number of poles in magnet field	6	6	2
Revolutions per minute	300	300	350
Terminal voltage	624	600	600
Normal current amperes	330	500	81
Diameter of armature inches	47½	42½	23⅝
Length of armature core inches	20	20⅜	22½
Radial depth of armat. core in.	8	7	4¼
Section of armat. conduc. sq. in.	.103	.078	.0287
Number of armature conductors	316	316	540
No. of commutator segments	153	153	90
Loss in armat. resist. per cent.	1.46	1.52	2.7
Induct. in armat. C. G. S. meas.	7500	7600	15,800
Shunt resistance ohms	140	143	205
Loss in shunt excitat. per cent.	1.35	1.68	...
Main turns per magnet	6	4	...
Loss in main excitat. per cent.	3	2	...
Type of armature	Drum	Drum	Cylinder

"An interesting and novel feature of the plant," continues Mr. Kapp, "is the arrangement adopted for starting gradually, and yet without the use of resistance. To start the motor gradually, and prevent sparking at the commutator, we are obliged to insert into the armature circuit a variable resistance, which is withdrawn after the motor has gathered enough speed to make this safe. There is no inconvenience in using such a resistance when we are dealing with small currents; but when it is a question of several hundred amperes, and the absorption of as many horse-power, the resistance becomes a very cumbersome and unwieldy appliance. To get over this difficulty, Mr. Brown has devised a very ingenious method of coupling between the line and machines, the essential features of which are shown in Fig. 4. There are four main cables, two positive and two negative. Three of thse cabls contain no switches which need be used for starting, although, of course, they contain the switches and fuses which may be required for testing purposes and as safety devices, but these, not being essential to the explanation of the starting arrangements, are not shown in the diagram. Call the two outer cables positive and the two inner cables negative. The positive cables are looped at both terminuses, and the inner cables are also looped in this way, but a switch is inserted in the right-hand cable at the motor station. Now imagine all the machines at rest, and this switch to be open. To start the plant, the turbine-driven generator, *G*—1, is set in motion, and the machine run up until this machine excites itself by its own shunt. If you will follow the connections you will find that the shunts of the other three machines will at the same time also become excited. The motors have now made their fields, and if we start the second generator, *G*—2, slowly, a current of gradually increasing strength will be sent through both motors, and the latter will gradually start. As they gather speed, their counter e. m. f., which is indicated by a voltmeter at the motor station, gradually rises; and if it has become equal to the e. m. f. indicated by a second voltmeter in connection with the current from the first generator, *G*—1, the attendant closes the switch, and the operation of starting is completed. It should be noted that on closing this switch there is no sudden rush of current since the pressure on both sides of the switch is approximately equal.

"Originally the motors were intended to be pure shunt machines, but it was soon found that owing to the very small armature resistance and armature reaction, it was very difficult to get the load equally divided between them. Mr. Brown, to overcome this difficulty, hit upon the ingenious device of making the machines mutually control each other by putting on demagnatizing main coils, and crossing the connections between armatures and fields, so that the machine, which might at any moment develop a tendency to take more than a fair share of current, would have its field strengthened by the deficiency of current passing through its main turns to the other armature, and would thus immediately raise its counter e. m. f., and check the excess of current, whilst the other machine which was not taking enough current would have its field weakened, and would thus be forced to take more current. It is clear that by this cross connection even a neglect on the part of the attendant to set the brushes properly cannot materially influence the even division of current and load between the two machines, as the demagnetizing influence of the main coil has the same effect as if the armature reaction were increased, and insures thus constancy of speed."

New Australian 15,000-Mile Cable.

On Nov. 1 the new cable of the Eastern and Eastern Extension Telegraph Companies between Durban, Natal, and Perth, Australia, was opened for general traffic. This cable is a part of a new system of the above-named companies, involving the laying of no less than 15,000 miles of cable to connect England with South Africa and Australia. The new line has been completed between Cornwall and the Cape. The extension from Durban to Perth has just been completed, as above noted, and the remaining section, between Perth and Adelaide, will be laid early next year. The new route takes in the islands of Ascension and St. Helena in the Atlantic, and Rodrigues and the Cocos-Keeling Islands in the Pacific Ocean, all of which were hitherto outside the pale of telegraphic communication. It is a notable fact in this connection that the entire enterprise was carried out without any government assistance whatever in the shape of subsidy or guarantee. The business will be handled entirely by the companies' employes, and not by operators of the different administrations, thus rendering the system independent at all times.

The Development of Trolley Networks in Michigan.

BY EDWARD J. HART.

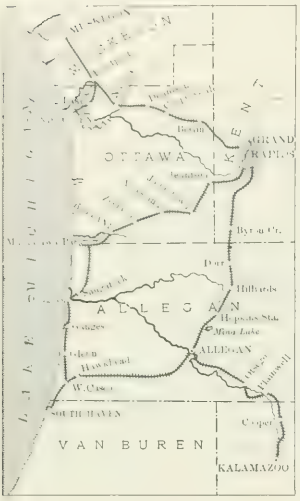


FIG. 1.—MAP OF SYSTEM.

WESTERN MICHIGAN is being covered with a remarkable network of interurban railway lines, radiating from Grand Rapids—the little metropolis in the western part of the Wolverine State that James G. Blaine called humorously the "largest city of its size in the country"—and connecting it with all the important Lake Michigan ports in four counties. There will be three of these roads in operation next summer. Work is progressing on all three of them, two are practically completed, and one is operating cars over a part of its lines.

The whole world knows Grand Rapids as the "Furniture City," the busy mart where furniture buyers from all over the country and from abroad congregate for the trade of the semi-annual furniture seasons, but only a few of the States adjacent to Michigan remember that Grand Rapids is the shipping center of the Michigan fruit belt. It is on account of agricultural growth that Eastern capital is investing itself in Michigan interurban railways, for the commercial and rural conditions of this section of the country seem to vie with each other in offering the greatest promise for such projects. Six months ago no less than six roads were being surveyed or projected out of Grand Rapids, and of these three have become material things, while of the other three at least one offers every promise that it will be doing business within a year. The Grand Rapids, Grand Haven & Muskegon Interurban Railway Company and the Grand Rapids, Holland & Lake Michigan Interurban Railway Company will be operating a passenger and freight service over all their lines early in the spring, and the Grand Rapids, Kalamazoo & South Haven Traction Company will have its lines in operation next summer at the latest.

Some of the experts say that when it is completed the Grand Rapids, Grand Haven & Muskegon road will be the finest and most perfect of the kind in this country, and it certainly seems that if all the good things promised for it are realized and every detail looked after in the careful manner that has characterized the construction work on the road and its buildings, it ought to be a difficult matter to build a better interurban road. The general alignment is for a direct line between Grand Rapids and Muskegon with a branch to Spring Lake. The distance between Grand Rapids and Muskegon, though the line is in a northwesterly direction is one mile shorter than the shortest steam railroad. In order to accomplish this it was necessary to cut diagonally through some of the finest peach orchards in Michigan, incidentally giving the best possible service to this peach growing district.

The road is built upon private right of way the entire distance. The bridges are of steel furnished by the American Bridge Company. The steam railroads are crossed by overhead bridges, so that there are no grade crossings, and in several instances important highways are crossed in the same manner to avoid risk or expensive accidents. The road is laid with 75-pound steel rail, American Society of Civil Engineers standard, with 2640 full-size steam railroad ties per mile. The rail is double-bonded with Mayer & Englund protected rail bonds under the fish plates, one bond being placed each side of the rail, it being possible thereby to obtain a smaller cross section of bond and prevent pinching of the bond between the rail and fish plate, insuring flexibility to the joint.

In order to construct a road having a minimum cost of maintenance, a number of places which would usually have been temporarily piled have been provided with solid fill. At Fruitport, near the power house, there is a trestle 1200 ft. in length, which is of the heaviest steam railroad construction. It is on piles from 60′ to 120′ in length, and the bridge is so designed that any part of the frame may be removed and replaced without interrupting the operation of the road. At Mona Lake there is a pile bridge 1200′ in length. The grades have been kept at a minimum and the road has been designed for high speed so as to better serve the community and reduce cost of operation. The entire road has been built with a view to making each detail so thorough that the cost of maintenance should be reduced below that of any other electric line of its kind at present in operation. Down at Fruitport, a small town about 40 miles northwest of Grand Rapids, at the head of Spring Lake, one can get the best general idea of the elaborate way in which everything is being equipped and of the money that is being invested. Michigan men and Eastern capitalists are in the company, and the road is being built by Westinghouse, Church, Kerr & Company.

The car barns and shops at Fruitport, all in one building, occupy a ground area 128 by 166 ft. in dimensions—a handsome building of brick and steel, with a fire wall separating the shops and barns. The latter is provided with six tracks, furnishing facilities for storing 24 cars. The shops are partitioned into the following departments: Repair shop, blacksmith shop, armature room, office, locker room for employes, stock room, tool room and main shop. This main shop will be equipped with a fine assortment of machine tools and 2 overhead traveling cranes and overhead trolley hoists. The power house is a building 105 ft. in length and 110 ft. in width, of brick and steel

FIG. 2.—VIEW ON THE LINE.

construction, with Ludiwici tile roof and concrete foundations. Coal bunkers, constructed entirely of brick and iron, with a capacity for 300 tons are provided. The power units are five 300-kw Westinghouse generators, three A. C.-D. C. type machines and two regular three-phase alternators. Direct current will go at once to the line instead of reaching it through a sub-station. The generators are all of engine type construction and connected direct to Westinghouse compound condensing engines of 600 horse-power each. The generators are arranged to operate in multiple, and are excited by two 37½-kw engine type direct-current machines direct connected to two 100-hp engines of the same type as the larger ones. The boiler plant consists of four Babcock & Wilcox boilers of 300 horse-power each, equipped with Roney mechanical stokers. Draft is furnished by vertical tandem fans, and the plant is equipped with Westinghouse economizers and heaters. One Worthington elevated jet condenser is used. The transformers of the main plant are of the Westinghouse pattern, connected in delta, and will step the current to 16,500 volts for the lines to the sub-stations. The switchboard is provided with static interrupters, high-tension fuse switches and low-equivalent lightning arresters. There are two sub-stations, one at Coopersville and the other a few miles outside of Grand Rapids, both constructed entirely of brick and iron. Each is provided with a passenger room, express room and office, in addition to the machinery room. In the latter is the step-down transformer plant and two rotaries of 250 kilowatts capacity each.

The third-rail system is employed on all parts of the line where the right-of-way is enclosed, which means in the country and outlying districts. In cities and villages a trolley system is employed.

The passenger cars have been furnished by one of the best steam

car builders in the country, who has had a large experience in the building of interurban cars. They are of steam railroad pattern and are trussed beneath the windows from end to end over the truss plank. The freight cars and the repair car are being built by the same people. The repair car is equipped with an electric winch, complete equipment of tools, and also with snow plow. It is equipped with four motors and is adapted for use as a locomotive.

The passenger cars are 59 ft. in length, of handsome design and beautifully upholstered in red plush throughout. Each is provided with two 150-hp motors and equipped with Westinghouse air brakes and air sanders. The cars are to have plate glass windows and are to be 8'-9" wide, giving greatest comfort to passengers. The trucks are being furnished by the Baldwin Locomotive Works, of Philadelphia, and are the very latest and best, with steel-tired wheels and inside hung brake gear. Parties are now negotiating for the purchase of large tracts of land on Spring Lake, which will be converted to the purposes of a beautiful summer resort, and a line of steamboats is to be operated between Fruitport, Highland Park, Spring Lake and other resorts. No expense will be spared to make the road and its equipment complete and perfect in all its appointments, and among the special features will be a copper metallic circuit telephone line the length of the road, with arrangements so that the conductor of each interurban can tap a set of telephone instruments on any part of the line.

The Grand Rapids, Holland & Lake Michigan Interurban Railway has been operating one or two passenger cars between Grand Rapids and Jennison for some weeks, but it has secured its power from the lines of the local street railway company. A few weeks ago, however, the power house was formally opened and the current fed to the lines from the company's power house at Jennison, and it is expected that cars will be operating over the entire length of the line by Dec. 1.

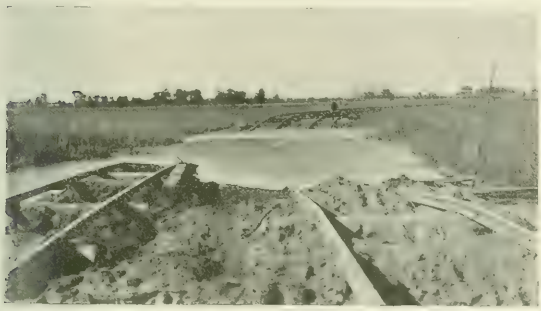


FIG. 3.—A SINK HOLE.

The lines of this company extend in a southwesterly direction from Grand Rapids to Holland and Mackatawa Park, and south to Douglas and Saugatuck. A feature of the road that is duplicated by few interurban roads in the country is its double-track construction. Two tracks extend from one end of the line to the other, and the poles are set centrally between the tracks, carrying tubular iron cross-arms well braced. On most of the line the poles extend above the cross-arms, which also serve as the supports for the trolley insulators, and carry at their top a line of barbed wire, grounded at intervals, for lightning protection.

The completed power plant will consist of two vertical Ball & Wood engines of compound-condensing type, 750 horse-power each, connected direct to two Westinghouse three-phase alternators of 500 kilowatts each. The machine voltage is 400, and it will be stepped up to 20,000 at the central transformer plant and down to the line voltage of 550 at the sub-stations. The central stations and each of the two sub-stations will be provided with two 300-kw rotaries. The sub-stations will be located at Zeeland and Holland, and will be furnished as passenger stations, with ticket offices and waiting rooms. The boiler plant consists of four Cahall Babcock boilers of 300 horse-power each, equipped with Green mechanical stokers. The cars are of handsome design, equipped with air brakes, and the air is carried in tanks under the cars, filled from a reservoir at Jennison. The latter is supplied by an air compressor at the central station.

A number of difficulties were encountered in building the Holland road, and some interesting feats in engineering were accomplished in overcoming them. A short distance from Holland a soft, marshy place was discovered, and for many days teams drew gravel and filled it in to establish the grade, after which the two tracks of the road were built across the fill. This was no sooner done, however, than the whole caved in to an unknown depth, carrying the tracks with it and leaving nothing visible but a large pond. An effort was made to fill this in, and carloads of gravel were dumped into it, but the effort was in vain. After a great deal of study it was planned to drive piles to establish a firm foundation for the roadbed, and this was done. Large pile drivers and engines were secured, and more than 1000 piles were driven into the sinkhole, some of them to a depth of 75 ft., sections being spliced piece by piece to the lengths already driven as the work progressed.

The viaduct at the Lake Shore & Michigan Southern Railway crossing, a few miles south of Grand Rapids, is a fine piece of engineering, constructed to permit the interurban cars to pass over the railway tracks, and it is so well planned that the grade is not very steep on either side of the trestle. Another similar trestle, covering a broad gulch between two hills, is built near Zeeland.

The road has commenced operating through cars between Grand Rapids and Holland on a regular schedule. The cars are run from both ends of the line at intervals of an hour and ten minutes. The distance is a little less than 30 miles, and a fare of 44 cents is charged, which amounts to 1½ cents per mile. A transfer arrangement with the local street railway system is in effect, and transfers are issued by the interurban conductors to any part of the city for an additional 5-cent fare, while the city street railway conductors issue transfers to the interurban cars good to the city limits. The business is excellent, and the Sunday traffic between Grand Rapids and Holland is enormous. In spring the cars will run through not only to Holland, but west to the shore of Lake Michigan and thence south to Saugatuck.

The Grand Rapids, Kalamazoo & South Haven Traction Company expects to operate in conjunction with a Chicago freight and passenger boat line making connections at South Haven, and to make a feature of the Chicago traffic. The line will open up some rich farming and fruit country, and furnish transportation facilities that ought to give a great impetus to the movement of the products in these counties. The road will get its power from the Kalamazoo River at a point near Allegan, and only a few miles from the Allegan long-distance transmission plant that was described in these columns when opened two years ago. The power plant of this interurban company will be located between Allegan and Otsego, and the work upon it will commence in a few weeks. In fact, Engineer M. Van Harlingen, of the company, is now located at Allegan, and has several corps of surveyors out on the branches of the line. He is about ready to give out the contracts for the construction on the road, which will be let in 10-mile sections, or sublet as a whole. The distance from Grand Rapids to Allegan is 33 miles, and from there to Kalamazoo is 22 miles. From Allegan to South Haven is about 30 miles, and from South Haven up to Saugatuck is about 20 miles, so it will be seen that the line projected is a long one. Options are held on two or three sites for a power station, all on the Kalamazoo River near Otsego. The river will be dammed, and a fine plant of three-phase alternators will be installed. The steel is already contracted for, and it is said that the contract has been let for a part of the machinery.

This road was promoted by William Aldrich Tateum, of Grand Rapids, and W. H. Patterson, of Pittsburg, and its franchises, property and interests were transferred a few weeks ago to the Grand Rapids, Kalamazoo & South Haven Traction Company, which was incorporated under the laws of Michigan. The construction company, a New Jersey corporation of which Mr. Van Harlingen is the engineer, has the contract for the construction of the road. In Grand Rapids itself the Grand Rapids Railway Company has agreed upon a transfer arrangement with the two interurban companies whose lines already reach there, and it stands ready to make suitable arrangements with any others. There is not a city in the country that has a better street railway system to-day than Grand Rapids.

A few weeks ago its new power house was opened—a model plant of its kind, equipped with two large power units, either one of which will carry the normal load of the road, and some auxiliary machinery. Each of the two large units consists of an Allis cross-compound condensing engine, with an economic rating of 1250 horse-power and a maximum rating of 2200, direct connected to a General Electric 14-pole direct-current machine of 800 kilowatts capacity, economic rating, which can run up to 3000 amperes on heavy load.

The company has been improving its lines and extending them in all directions in the last year, and the people of the city seem to be

perfectly satisfied with the system. During the year the company has replaced miles of its steel with new 80 and 90-lb. rails, and all are fastened with cast-welded joints. The company has just placed an order for a number of the new magnetic brakes manufactured by the Westinghouse Company, and its cars will be equipped with them. This system will form the center of what promises to be one of the finest systems of interurban railways in any State in the Union.

Electrical Incomes and Outputs per Ton of Coal.

ALTON D. ADAMS.

COAL is the raw material and electrical energy the finished product of generating stations. In every system of electrical supply the problem is to deliver energy from the boiler furnace at the station to the lamps, motors, heaters and chemical vats of consumers. The general conditions are that heat must be changed to motion, motion to electrical energy, and this energy transmitted to the points of use. Notwithstanding the uniformity of these requirements, there are very few lines of manufacture in which such great variations are to be found between the quanties of raw material consumed and the product. Unfortunately these variations are too often overlooked because the data necessary to establish their existence is not readily available. Massachusetts alone among the States causes comprehensive data concerning the operations of electrical systems within its limits to be collected and published. The figures here presented as to the incomes, outputs and coal consumption of electric stations are derived from the report of the Gas and Electric Light Commissioners of this State, for the fiscal year ending June 30, 1900. Data is given for stations in cities only, and each station is designated by the name of the city in which it is located.

No city in the State except Boston contains more than one complete plant for public electrical supply. Figures are given for the two largest electrical systems in Boston. These systems have been consolidated since the issue of the latest report. All of the stations here considered are operated exclusively by steam power. For convenience of comparison, the stations are arranged in an order corresponding to the amount of coal burned during the year by each. The

Tons of coal burned by electric lighting stations, and the income per ton from sales of electrical energy for the year ending June 30, 1900.

Location of Station.	Tons of Coal Burned.	Income per ton.
Boston—Edison	38,783.7	$28.75
Boston—Electric	28,746.0	31.24
Lowell	7,234.0	21.90
Cambridge	6,385.0	24.59
Pittsfield	6,302.0	12.75
Fall River	5,953.0	29.00
Worcester	4,877.0	44.40
Somerville	4,719.9	22.07
Lynn	4,627.0	32.69
Salem	4,403.0	22.19
Brockton	3,754.2	19.61
Chelsea	3,528.0	17.32
Newton	3,520.1	19.39
Waltham	3,392.2	14.64
North Adams	3,348.0	15.12
Woburn	3,084.0	18.62
Malden	2,961.4	44.67
Haverhill	2,277.6	30.61
New Bedford	2,209.0	47.65
Fitchburg	2,004.0	29.81
Northampton	1,974.0	18.46
Quincy	1,352.3	29.24
Gloucester	988.7	40.28
Beverly	773.2	36.50
Marlboro	656.3	36.50
Newburyport	518.0	33.10

income per ton of coal for each station is determined by a division of the total income from the sale of electrical energy by the number representing the tons of coal consumed. Tons of coal here stated are long tons of 2240 lbs. each. Where screenings have been used, 85 per cent of their weight are taken as the equivalent weight of coal. Coke has been used to a small extent, and its weight in the original reports is given in short tons of 2000 lbs. each. These weights for coke have been added to those of coal without allowance for the short ton, on the assumption that coke is usually a more effective fuel than soft coal.

In a comprehensive view of the data for these 26 systems, the most striking fact to be noted is the great variation in incomes per ton of coal burned. Illustration of the extremes of this variation are found at New Bedford and Pittsfield. In New Bedford the electric station earns an income of $47.65 for each ton of coal it burns, while the station at Pittsfield receives an income of only $12.75, or 27 per cent of the former amount, per ton.

Even among stations that consume nearly equal amounts of coal there are wide differences between the incomes per ton. Take for illustration, the stations at Worcester and Somerville, consuming 4877 and 4719.9 tons of coal, respectively. At Worcester the income is $44.40 per ton, or twice the $22.07 received at Somerville. Equally good illustrations of the differnces in incomes for plants that consume nearly equal amounts of coal may be seen in Cambridge and Pittsfield, and in Malden and Woburn. On the other hand, stations of widely different capacities often derive nearly equal incomes per ton of coal. Thus the Newburyport station, that consumed only 518 tons of coal, got an income per ton that was a trifle greater than the like amount received by the station at Boston, that consumed 28,746 tons, or more than 50 times as much. Similar equality of incomes per ton of coal burned by stations of widely different capacities may be observed in the Boston Edison station and that at Quincy, in Fitchburg and Fall River, and in a number of other cities included by the table.

The income per pound of coal burned is obviously a factor of great importance in the determination of net earnings for an electric system. It is, therefore, a matter of no small practical interest to determine whether the very low earnings per ton of coal displayed by many stations are the best that can be had. The suggestion may at once be made that as the incomes of electric systems depend directly on the prices they are able to obtain for energy, the small earnings per ton of coal are simply due to poor markets. If this view of the case is in the main a correct one, there is little more to be said, and the station with a large coal bill and a small income must be left to its fate. On the other hand, if it can be shown that in most cases a low income per ton of coal is the result of inefficient operation, a little good engineering may greatly improve matters.

It is just at this point that the student of operations by American electric stations meets the greatest difficulties. The amount of coal yearly burned is usually secret, the prices at which energy is sold are more secret, and the number of kilowatt-hours delivered is most secret. Happily for the present inquiry, it is possible to determine from the Massachusetts reports not only the total amounts of coal consumed but also, by calculation, the prices at which large parts of the station outputs were sold, and the numbers of kilowatt-hours in these parts.

Street lighting is that part of the services performed by electric systems whose price and amount in kilowatt-hours can be accurately determined from the reports. The importance of this information obviously depends to a large extent on the ratio of street lighting to the total amount of service performed by each electric system. Not only the kilowatt-hours supplied for street lighting and the price in each place has accordingly been calculated, but also the ratio of the income from street lighting to the total.

In order to draw fair conclusions as to the efficiency of electric systems from the prices for street lighting, it is desirable to determine whether such prices are generally higher or lower than those received for commercial service. As street lighting is usually the largest single contract on which an electric system is engaged, and as this service constitutes a more uniform load than any other, it seems at first glance that the rates charged for it should be lower than most others. On the other hand, the amount of street lighting to be done in any one city changes very slowly, while there is opportunity for great expansion in the direction of commercial service. Moreover, after a plant has reached a considerable capacity additional load may be taken on at a comparatively small expense of operation. These considerations, and certain facts as to particular plants that cannot be stated here, lead to the conclusion that average rates for commercial service are not usually far from those charged in street lighting. On this assumption it is easy to determine whether the wide variations in incomes per ton of coal burned are due to low rates for energy, or to poor efficiency. It is obvious that any errors, due to the assumption that average commercial rates equal the rates for street lighting, will be of less importance the larger the ratio of the income

from street lighting to the total energy income. For this reason comparisons should be limited to stations that derive a large share, say, one-third at least, of their energy income from street lighting.

The ratio of income from street lighting to total energy income was at Worcester 34.6, and at Somerville 46.4 per cent. At the Somerville station the income per ton of coal was $22.07, and at Worcester the like income was $44.40. The price per kilowatt-hour for street lighting was 6.09 cents in Worcester, and 9.08 cents, or about 50 per cent greater in Somerville. On the reasonable assumption that average commercial rates corresponded to those paid for street lighting in these two cities, the Somerville station must have earned about $66 per ton of coal burned, if the efficiency of operation had equaled that at Worcester. As the fact is that only one-third of this last amount was earned at Somerville per ton of coal, it follows that the consumption of coal there per unit of output was three times as great as that at Worcester. At Lynn 34.4 per cent and at Northampton 33.2 per cent of the entire energy income was derived from street lighting. The rate at Lynn was 6 cents per kilowatt-hour for energy in street lamps, and at Northampton 15.70 cents. Each ton of coal burned at the Worcester station earned $44.40, so with equal efficiency the station at Northampton would have earned more than $110 per ton, if commercial rates were equal to those for street lighting. As only $18.46 per ton of coal was actually earned by the station at Northampton, its efficiency was only one-sixth of that of the Worcester plant.

Location of station.	Kilowatt-hours to street lamps.	Cents per kilowatt-hour.	Per cent street lighting to total.
Boston—Electric	4,841,625.6	6.66	35.9
Worcester	1,233,021.1	6.09	34.6
Fall River	1,276,508.2	6.53	48.6
Lowell	956,304.9	6.00	36.2
Cambridge	837,348.8	7.81	41.6
Lynn	868,747.3	6.00	34.4
New Bedford	352,949.6	7.07	23.7
Somerville	532,885.3	9.08	46.4
Brockton	323,400.9	7.92	34.8
Haverhill	331,072.4	6.75	32.1
Salem	635,065.4	6.32	41.1
Chelsea	337,175.5	8.07	44.8
Malden	336,742.8	8.61	21.9
Newton	399,868.3	8.18	47.9
Fitchburg	307,975.1	9.71	50.1
Gloucester	100,876.6	12.80	32.4
North Adams	188,224.9	8.00	29.7
Waltham	112,204.0	11.86	26.8
Quincy	99,832.6	14.49	36.6
Pittsfield	132,816.5	10.26	16.9
Northampton	77,118.6	15.70	33.2
Newburyport	73,814.5	15.28	65.8
Woburn	76,007.7	13.91	18.4
Beverly	159,980.7	10.20	57.8
Marlboro	80,739.4	10.27	34.5

It may be thought that quite small plants cannot approach the much larger ones in efficiency, but the facts show that such is not the case. At Beverly the electric plant got 10.2 cents per kilowatt-hour for street lighting and 57.8 per cent of its income was from this source. The Cambridge plant received 7.81 cents per kilowatt-hour for its service to street lamps, and earned 41.6 per cent of its income in this way. At Cambridge the income per ton of coal burned was $24.59. As the price in Beverly was 1.3 times that in Cambridge for street lighting, if this difference in prices extended to the entire outputs, the income at the Beverly station should have been $31.96 per ton of coal, with equal efficiency in both plants. But the Beverly plant actually earned $36.50 per ton of coal, so that its efficiency was 14 per cent greater than that at the Cambridge plant. The Cambridge system, however, supplied 837,348.8 kilowatt-hours to street lamps, or more than five times the 159,980.7 kilowatt-hours furnished for a like purpose by the plant at Beverly. In the matter of coal the Cambridge consumed eight times as much as the Beverly plant.

To bring out more clearly the differences in efficiency that exists among electric systems, it is desirable to get the results of each in pounds of coal consumed per kilowatt-hour of output. With the assumption previously made, that commercial rates are the same as those for street lighting in systems where the income from the latter source is at least one-third of the total amount received for energy, the pounds of coal per kilowatt-hour of total output may be calculated. Where the average price per kilowatt-hour is the same for commercial service as for street lighting, the kilowatt-hours supplied to street lamps must be the same per cent of the total energy output that the income from street lighting is of the total energy income. In each case, therefore, the number of kilowatt-hours supplied to street lamps is divided by the per cent of income from street lighting to the total income, to determine the entire number of kilowatt-hours in the output. The number of tons of coal as previously given for each station is multiplied by 2240 to reduce it to pounds. This last amount is then divided by the number representing the entire output in kilowatt-hours, and the result is the number of pounds of coal burned per kilowatt-hour. All of the stations that derived one-third or more of their income from street lighting have been included in this process. The results are remarkable for the wide range of efficiency which they exhibit. The station at Worcester consumed only 3.1 lbs. of coal per kilowatt-hour of output, while that at Northampton used 19.3 lbs. for an equal result. According to these figures the system at Boston, though having an output more than four times as great as that at Worcester, the next largest, is surpassed in efficiency by the systems of Worcester and Lynn. The most valuable of these results, because the least liable to error are those for systems at Fall River, Somerville, Newton, Fitchburg, Newburyport and Beverly, in which the ratio of income from street lighting to total energy income ranges from 46.4 to 65.8 per cent. At Fall River the consumption of coal was 5.1 lbs., and at Newburyport 10.3 lbs. per kilowatt-hour, a difference of 100 per cent. If the average commercial rate in any case is greater than that for street lighting, the computed number of total kilowatt-hours for the year will be too great, and the pounds of coal per kilowatt-hour in the table too small. To show the probable limits of error in the figures for pounds of coal per kilowatt-hour, assume that in any case the average rates for commercial service is one and one-half times as great as the rate for street lighting, when the street lighting furnishes one-half of the total energy income. Then the true figures for total kilowatt-hours will be $(\frac{1}{2} + \frac{1}{2} \times \frac{3}{2}) = 5\text{-}6$ of that given in the table, and the pounds of coal per kilowatt-hour will be $1 \div 5\text{-}6 = 1\frac{1}{5}$ times the amount given.

Location of system.	Total-kilowatt-hours for all service.	Pounds coal per kilowatt-hour.
Boston—Electric	13,486,422	4.7
Worcester	3,563,644	3.1
Fall River	2,626,560	5.1
Lowell	2,641,726	6.1
Cambridge	2,012,867	7.2
Lynn	2,525,428	4.1
Somerville	1,148,459	9.2
Brockton	929,312	9.1
Salem	1,545,171	6.3
Chelsea	752,624	10.5
Newton	820,182	9.6
Fitchburg	614,706	7.3
Quincy	272,766	11.1
Northampton	232,284	19.0
Beverly	276,783	6.2
Newburyport	112,180	10.3
Marlboro	234,027	6.2

With all possible allowances for error it is plain that the stations considered present variations of efficiency that can only be accounted for by poor engineering in some of them.

To Study American Industry.

A cable dispatch from Paris of Nov. 9 says: A decree of the Minister of Commerce, M. Millerand, will be published in *The Official Journal* to-morrow, appointing a commission to study the organization of the Industrial School which France proposes to establish in the United States for the study of American industrial methods. The commission, which is composed of 14 members, is presided over by Senator Poirrier, and includes M. Bouquet, Director in Chief of the Department of Technical Instruction in the Ministry of Commerce, and the heads of the State and private industrial institutions.

Telegraph Systems, Operating Speeds and Economies.

By Romyn Hitchcock.

RAPID communication of intelligence between distant points, even to the ends of the earth, is a need of this day of hurry and energetic living. Possibly we are living too fast, giving too little thought to the pleasures and comforts of life and the well-being of those around us, in a wild scramble for elusive wealth, which, when we get it, we have no time to enjoy. But apart from commerce and business there is a social side, and the adoption of radical changes in the methods of telegraphic communication, bringing the art well up to electrical possibilities with the most improved methods, will so quicken and cheapen the transmission of dispatches that the telegraph will come into universal use for correspondence. It will also bring about a more perfect and wider distribution of news, since every country paper will receive well-edited correspondence recording the events of the day in all parts of the world.

The man of wealth may now speak over a wire with a friend in Chicago, 1000 miles away, but he must pay the price. That price must always be large. The long-distance telephone may be used by the few—it is not for the many. They must rely upon the telegraph, which is now too slow and expensive. When an electric impulse travels along a wire with lightning speed, how can we say that the telegraph is too slow? Can anything be more speedy?

The electric current is, indeed, capable of meeting all requirements of speed, and it may well seem strange to all who think of it, if no means has yet been discovered whereby a telegraph message can be delivered in a few minutes instead of hours from the time of sending It is the purpose of this article to indicate the present condition of the telegraph business in this regard, the reason why the service is slow and costly, and to point out the direction in which we are to look for improvement.

It is remarkable how firmly practical telegraph men have adhered to old methods and opposed innovations. Scarcely a change in the method of transmission has been made, except in mechanical details, since the historic message: "What hath God wrought?" was sent from Washington to Baltimore by Morse in the spring of 1844. To-day, after the lapse of more than half a century, and in a land famed for invention and progress, the old Morse key, changed and improved in form, but in principle the same, continues to perform almost the entire service of the telegraph, working at a speed of 15 words a minute.

Such a condition of stagnation in the telegraph business may well cause astonishment to the general public, and lead to the question whether the fault lies with the electricians and inventors of the country? That it does not we purpose to show as clearly as necessary. It is true there are a few Wheatstone circuits and a Buckingham printer in use, but these are anomalies, sporadic offshoots of a primitive, antiquated system, indicative of arrested development on lines of progress. Other efforts for improvement have been suppressed entirely.

With the Morse key for sending, the need of more service on wires was early recognized, and this was first met by the invention of the "duplex," whereby two messages could be sent at one time over a wire, one each way, and later the "quadruplex" was introduced, with which two messages in each direction could be sent together. At present, the quadruplex, transmitting 60 words a minute and requiring the services of eight operators, represents practically the highest development of the telegraph service, and even this is limited to distances of 500 miles. It does not utilize one-twentieth part of the carrying capacity of a good telegraph wire.

Nevertheless, the introduction of the quadruplex was of inestimable importance. It was stated by a high authority (a former president of the Western Union Telegraph Company), that the additional circuits of the quadruplex, represented in value to his company $10,000,000. This, then, was the value of an increase in speed from 30 words with the duplex to 60 words a minute.

More than 15 years ago Mr. P. B. Delany invented his well-known synchronous multiplex system, whereby six messages could be sent over a wire at the same time. This system was adopted in England, and has been in constant use, the inventor receiving a good royalty from the British telegraph department during the life of the patent. It has not been used in this country. A different form of multiplex has been brought forward by Mr. T. B. Dixon, which promises to soon reach perfection, and which seems to possess decided advantages over the present methods of quadruplex working. By this also six messages can be transmitted, or 90 words a minute.

All these systems are operated with the Morse key. It should be noted that whether 15, 60 or 90 words a minute are transmitted over a wire, in each case the speed of working per operator is only 7.5 words a minute, since for each sending operator there must be one at the other end of the line to receive the message. Therefore, we may say, that with the prevailing methods a wire which may extend 500 miles is monopolized by eight operators, each representing a transmission of 7.5 words a minute.

Or, we may present the facts in another way. If 10,000 ten-word messages, which would really be 20 words if we include address, signature and other necessary additions, are to be sent from one office during eight hours, this would be 200,000 words, or 416 words a minute to be transmitted. To do this work would require the services of 27 sending operators, the same number to receive, and since only two messages can go in one direction at a time, they must have 13 wires.

Thus we have an explanation of the multiplicity of wires which overload the telegraph poles and which represent a considerable investment of money and large expenditures for maintenance, although they are busy only during part of each day. Obviously, the great need of the telegraph business is better utilization of the conductivity of copper wires, since there is an enormous disproportion between the cost of wires and the service obtained with the Morse key. The aim should be, precisely as in power transmission, to utilize to the fullest extent the conductivity of the line and to reduce the amount of copper to a minimum. Other economies of importance would immediately result from such a policy.

It may interest Morse operators in this connection, to learn that by a recently applied invention, the speed of Morse transmission can be doubled, or increased to the highest speed at which the receiving operator can transcribe by sound on a typewriter. Of course, this does not mean that the speed of key-working by hand can be increased. The key is operated in the ordinary way, but the dots and dashes are reproduced as perforations in paper tape. The perforating may be done at a distant station. The perforated tape is introduced into a special transmitting mechanism which sends the message to line at any speed desired by the receiver, who may either take it down by sound or cause it to perforate another tape for retransmission. Thus the duplex can be made to do the work of the quadruplex, and the efficiency of the quadruplex can be doubled.

The Morse key has given way to some extent abroad to different forms of printing telegraphs, in which messages are received printed with types, on either paper tape or in page form. The old Hughes printer continues to do its work in Europe with a working speed of 40 words a minute, but an average of 25. The Baudot is greatly favored in France, connecting Paris with London, Berlin, Vienna, etc. It is said to transmit 30 words a minute and six messages may be sent together, three each way, or four may be sent in one direction. The Rowland multiplex printer is being tried at Berlin. The operating speed is said to be 40 words a minute for each keyboard, and four messages can be sent together in each direction, eight messages passing over the wire at one time.

The editor of the *Electrotechnische Zeitschrift* has recently made some interesting comments relative to the different printing systems referred to above. The following tabular statement is taken from his article. The first column of figures gives the number of operators required for each system, the second column the number of words sent per minute, the third the number of words per operator and the fourth requires some explanation.

	Op.	*W.*	*Op. W.*	*R.*
Morse	2	15	7.5	1
Hughes simplex	4	25	6.2	1.4
Hughes duplex	6	50	8.3	3.7
Baudot 4-fold	8	120	15	16
Baudot 6-fold	12	180	15	24
Rowland 8-fold	12	320	27	77
Baudot 6-fold	12	180	27	24
Rowland 8-fold	6	160	27	39

The last two lines, beneath the rule, compare the Baudot when sending four messages in one direction with the Rowland sending the same number but working only one way.

The last column of figures is intended to represent some numerical relation between the cost of wire conductors and of personal service. They are obtained by multiplying the words per minute by the words

per operator for each system, taking the product so obtained for Morse as unity. The editor offers them with reservations. The present writer is not sure that they represent anything in particular. But they are a part of the table.

Taking the figures as given, it will be noticed that with the Baudot the speed per operator is only double that of Morse. The utilization of the line conduction is, on the other hand, when all the machines are in use, three times that of the quadruplex.

The Rowland apparatus, sending four messages each way, shows a speed per operator 3.6 times that of Morse, and a saving of four operators. The wire service of 320 words a minute is a notable achievement. Professor Rowland was one of the world's great men. His work in scientific research was always good, always the most well-conceived and perfect in execution. Therefore, me may believe that his printing telegraph will yet prove to be a valuable invention.

There are still to be considered some of the numerous forms of printing telegraph machines, operated with typewriter keyboards, but not multiplex. They send single messages only, although possibly duplex operation may be practicable. Most of these are thus far only known to the inventors and the Patent Office. But assuming a typical machine to operate at 40 words a minute, and that one receiver can attend two machines, as with the Rowland, if two machines are sending there would be three operators engaged, and the number of words would be 27 per operator. This is nearly 3.2 times the speed of Morse, while the line would carry 80 words. This shows a line transmission of 1.3 as compared with the quadruplex and a saving of five operators. Unless economy in the pay of operators rather than in the cost and maintenance expenses of line, is a desideratum, which can only be the case with very short circuits, it does not appear that the simplex printing telegraph machine possesses any notable advantage over older methods, except for local communication.

With reference to the foregoing figures, it should be said, that it is doubtful if a speed of 40 words a minute can be maintained in practice. Comparatively few typewritists can copy from manuscript at that speed, on an ordinary machine, with the accuracy indispensable in the telegraph business. With all telegraph printers, so far as the writer's observation goes, the operator must acquire a certain kind of touch to ensure perfect working over a line, and this interferes with rapid manipulation of the keys. Probably it would be nearer practical results to assume an average of 60 rather than of 80 words.

If such machines can be operated duplex, which is still problematical, the transmission would be 160 words (more likely 120), which would be of sufficient importance to be worthy of consideration.

On the other hand, there never has been a printing telegraph that could be trusted in the hands of operators alone. No reference is here made to such difficulties as are common to all mechanical contraptions, but only to those aberrations peculiar to electrical apparatus generally, and euphoneously designated by electricians as "bugs." They require expert electrical skill for their elucidation, and the figures above given for personal service in connection with printing telegraphs require correction, for which adequate data are not available.

The next step in advance is the printing telegraph with mechanical transmission. The message is first punched in a tape which is then run through a machine which sends the signals to line. At the receiving end the message is printed automatically. The Buckingham apparatus is of this kind. The transmission is from tape, with six perforations for each letter or space, which is run through a Wheatstone machine. The printer is an admirable although exceedingly complex machine. The system works duplex and probably transmits regularly 80 words each way, 160 words a minute between Chicago and New York, possibly more. The claim is made for it that the working speed is 100 words a minute each way. But all claims for speed of telegraph operating should be taken with a large allowance for possible errors. There is no obvious reason why all inventors of printing telegraphs should be led in devious ways, to the dead uniformity of 100 words a minute for every apparatus. Operated by hand they admit a limitation to about 50 words, but always declare that if the machine could be fingered fast enough it would print 100. It should not be publicly mentioned, perhaps, since it is a dead secret among inventors, but something depends upon whether one allows three or five letters to a word. However, the Buckingham apparatus is most excellent, and it is doing good service, under competent supervision.

The Buckingham apparatus seems to compare favorably in efficiency with the Wheatstone automatic, having some advantage over the latter in that the messages are printed by the receiving apparatus. But its installation is costly, and the price of continuous action is eternal vigilance.

The Murray system, which has already been illustrated and described in the pages of Electrical World and Engineer, is the latest development in this direction. If ingenuity, well-directed energy and perserverance reap their just reward, Mr. Murray will succeed. The transmission is from tape perforated on a keyboard machine. Messages are received in the form of perforated tape which may be run through a typewriter apparatus which is thus actuated to print at great speed. Or, it is proposed to use the tape in a similar manner for the setting of types for newspaper use. There would seem to be a wide field of usefulness for this admirably conceived system. Mr. Murray believes that his apparatus will transmit 100 or more words a minute, and this expectation is based upon tests over wires of the Postal Telegraph Company, with machines not yet perfected in all details. He has a special alphabet for transmission which is considerably shorter than the Morse.

Beyond all these, in a field of limitless range and promise, are the automatic or machine systems, which transmit from perforated tapes and receive in dots and dashes at great speed. These are the systems which economize in line and plant. They are the systems which must be relied upon to provide cheap telegraphy for the people.

The great Wheatstone invention has led the way in this direction, but its speed is limited by mechanical and electrical features. It carries regularly between New York and Chicago about 100 words a minute each way. Although this speed is only a little more than 3.3 times that of the hand quadruplex, the latter does not usually operate more than half the distance. Therefore the comparison should be with the duplex and the figures should be doubled. However, admitting that the system is also in other respects a superior one, even the proportion 6.6 is not sufficient for business competition with other methods of much greater speed and economy of operation. The Wheatstone is outclassed by later methods not yet in general use.

Much greater speed than is possible with the Wheatstone is necessary if we are to make a near approach to the electrical carrying capacity of copper wire. It is almost superfluous to add that the nearer we approach that limit in practice the smaller will be the investment required for lines and maintenance, and the cheaper will be the public service. The income to be derived from the full utilization of the conductivity of a telegraph wire, at a charge of one-tenth of a cent a word, would satisfy the most avaricious.

Modern high-speed methods, with the modifications and improvements recently adopted, seem to have attained the practical limit of working speed. There is no reason to believe that they will be superseded in future by others of greater speed or accuracy. Speed is a function of conductor and distance. It is sufficient for the present that 1000 words a minute in one direction can be realized in a commercial way over 1000 miles of wire.

Whether regarded from the standpoint of an investor for gain, or in its purely utilitarian and social aspects, whereby the use of the electric current will become universal for correspondence, the new telegraph offers a subject for thought and imagination. The time is not far distant when ordinary letters will be transmitted by wire. Telegrams of 50 or 100 words will be sent 1000 miles, or even from Maine to California, for less than we can send a 10-word message today from New York to Chicago.

This means a radical change in business as well as in social correspondence, letter telegrams becoming almost as cheap as the letter post, and exchangeable across the continent within a few hours, from which will follow a development along these lines of which the world has not yet dreamed. This is not a chimera—it is a reality within our reach, founded upon the most solid basis of physical science and perfected in every detail of execution and operation.

For the benefit of those whose confidence in pure science requires the reinforcement of more tangible and materialistic evidence, it may be added that a practical demonstration of high-speed telegraphy has been one of the features of the Pan-American Exposition, and this system—the Delany—has been adopted on a 300-mile circuit by one of the principal railway companies.

Data as to Use of Calcium Carbide and Acetylene.

The Treasury Department has just issued a special consular report bulletin devoted to replies received from Germany and Sweden as to the use of acetylene gas in those countries. Some of the details brought out are quite important and interesting.

Consul Kehl writes as follows from Stettin, Germany: Acetylene

gas is emerging from a crisis which almost retired it as an illuminant. About eight years ago, when this gas was in its infancy, numerous devices for its manufacture sprang into existence; but through ignorance and improper constructions, many fatalities resulted. In December, 1896, an awful explosion of acetylene gas occurred in Berlin. The press denounced its use; the police authorities throughout Germany placed almost prohibitive retsrictions upon acetylene generators; the preparing of liquid acetylene was strictly forbidden; insurance companies protected their interests by high rates and special requirements in addition to those prescribed by the police. As a result, only safe and meritorious machinery is now constructed.

For the manufacture of gas-producing contrivances and the various acetylene-burning devices, Germany has about two hundred and thirty-five factories, the most important being the "Allgemeine Carbid und Acetylen Gesellschaft, Berlin." This concern manufactures everything in the line of acetylene-producing machinery and the different gas-consuming articles. The imperial testing station for marine lights, situated close to Stettin, has officially tested the light-house burner and reflector manufactured by the firm above named. The chief of the station, in a personal interview, expresses himself as follows: For light-houses out of reach of electricity, and easily accessible in winter or summer, acetylene would render good services, although it can in no way be compared with electricity in reliability, on account of the many details which must be looked after when burning this gas. I prefer electricity. Most of the French coast lights are electrical, while our lights are all petroleum.

At the Altenbruch light-house, on the Elbe, there have been some experiments with acetylene, giving the following results: By a consumption of 102 liters per hour, 302 candle-power was produced, and by 175 liters per hour, 435 candle-power. An objection to acetylene for "long-range" light-houses, as advanced by an experienced sea captain, is that in a fog or thick weather it "walls" too easily. A petroleum light will penetrate a fog to a greater distance than any other illuminant. For clear weather, acetylene probably gives the best results. In this district (the Oder River down to Ziegenort) there are fifteen navigators' lights, five of which are burning acetylene; one (on an artificial island in the Big Bay) is to be replaced by electricity, due to the difficulty of approach during the period of ice.

The acetylograph is a portable search or signal light, and can be used by day for signaling purposes. This apparatus, carrying its own generator, is mounted on three legs similar to those of a camera. The hand search light for the hospital or medical corps has a small generator attached to a belt and connected with a reflector by a hose about 3 feet long.

Schöusee, a small village in West Prussia, is illuminated with acetylene. Radenz Castle, at Koschmin, is lighted throughout with this gas. Many other instances can be quoted where acetylene is used for illuminating. In general, it is not believed that it will ever become popular or have great commercial value. The constant care required to prevent accident is an impediment.

The following has been received from Consul-General Muir, of Stockholm: Acetylene gas has been used in Sweden for about ten years, although its practical use was not developed until after the exhibition at Stockholm, in 1897. Experiments have been made with the gas in light-houses, beacons, etc., but the results have not yet been reported. It has come into practical employment in several railroad stations, as well as in manufactories, churches and private dwellings. The largest firms manufacturing apparatus for the production of acetylene gas are the following: Acetylene Aktiebolaget "Koh T. Noor;" Sarverket "Suplex Ideal;" Aktiebolaget Acetylene-gasverk; Hera Prometheus A. G.; Svensson & Co., Acetylene-affär; Nordiska Acetylene Aktiebolaget; "Prinus" Acetylene Gasverk; Svenska Carbid och Acetylene A. B.—all situated in Stockholm. The manufacturers of carbide used for the production of acetylene gas are: Alby Calcium Carbid fabrik, Alby; Örebro Elektriska Akt. Bol. Örebro; Trollhättans Elektriska kraftaktiebolag, Trollhättan; Stockholms Superfosfat Aktiebolag, Stockholm. The price of carbide is 200 crowns ($53.60) per ton f. o. b. Stockholm or Gothenburg.

Consult Bergh reports from Gothenburg, Sweden: I am informed that in this consular district acetylene gas has not yet come into use in light-houses, for buoys, or for beacons. It has been decided, however, to try to use it in the small light-house or beacon at the entrance to the city of Marstrand, on the west coast, a few miles from Gothenburg. Acetylene gas is used on several Swedish steamers for the top-light, the side lanterns and for search lights. It has recently come into use at several railroad stations, and favorable reports have been made. The gas is furthermore used in carriage and bicycle lamps and hand lanterns in factories, and for small cooking and laundry stoves. There are in this city two concerns which manufacture the apparatus, but only a few have yet been exported. I have also seen here appliances of foreign manufacture. The largest factory operating in this part of the country is probably the one at Trollhättan, some 50 miles from this city. I am told that calcium carbide is exported chiefly to Hamburg, but also to Japan and adjoining countries. At present, the price of calcium carbide is 20 kroner per 100 kilograms (about $2.43 per 100 lbs.) at the factory.

According to calculations made by the manufacturers of acetylene works, the use of the gas is economical, especially in this country, where petroleum and coal are considerably more expensive than in the United States. It is calculated that a factory using fifty lamps at 16 normal candle-power each, burning 720 hours per year, would have the following yearly expenses for lighting:

Using petroleum, refined, at present price	$149.97
Using coal gas in common burners	291.85
Using electric incandescent lamps	236.88
Using acetylene gas	125.53

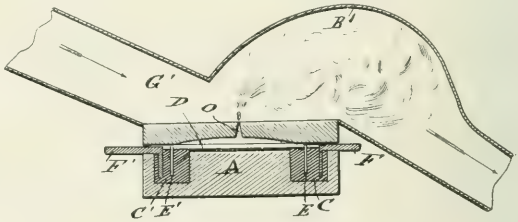
These calculations are based on the average price of gas and electricity and counting calcium carbide at 27 kronor per 100 kilograms.

If certain regulations are complied with and the gas works are of a type approved by the insurance companies, the latter do not make any discriminations against persons or business firms who use acetylene.

Electrical Pigment Furnace.

The illustration herewith represents in vertical section an electric furnace designed for the production of dioxide of tin (stannic acid), and patented Nov. 5 by Charles Paul Bary, of Paris. The operation is based on the familiar resistance principle, metallic tin being interposed between electrodes, vaporized by a heavy current of electricity, and the vapor oxidized by a blast of air.

The furnace body *A*, of conglomerated magnesia, is provided at either end with depressions to contain the main bodies of molten tin *C*, these two bodies constituting the terminals of the circuit and communicating through a narrow and shallow groove *D*, of such cross-section that the metal therein may be readily volatilized by the heat developed by the passage of the current. Electrodes *F*, F^1, make connection with the molten metal at opposite ends of the furnace and are



BARY ELECTRIC FURNACE.

protected from overheating by refractory depending partitions *E*, E^1. The vaporized tin escapes through a contracted orifice *O*, and is burned to oxide in the combustion chamber B^1 by air admitted at G^1, the fumes being collected in bags as usual. The furnace resembles in form and function the construction designed by Westman for the treatment of arsenical ores, heretofore described in these columns (Vol. 37, p. 670).

The method presents a case in which electrically developed heat is employed for a reaction occurring at moderate temperatures and readily effected in an ordinary furnace. In such cases the presumption is always against the economy of the process, and it is necessary to show a distinct advantage due to the mode of application of the current. In the present instance such an advantage seems to be gained, for the construction avoids the direct impingement of the air upon the surface of the molten metal, and there is, therefore, no danger of wasting metal and contaminating the oxide by small particles of incompletely burned tin mechanically carried over by the strong blast.

Electric Lighting for New York Elevated.

The stations on the Manhattan Elevated road of New York have long been among the worst lighted places in the city, except where electric lights have been introduced at a few points or where trial has been made of various forms of hood burners, which seem to go to pieces rapidly under the incessant vibration of the structure. Mr. W. E. Baker, the electrical engineer, who has charge of the electrical equipment of the Manhattan Elevated Railroad, now states that in less than two months the stations and station platforms of the Second Avenue branch of the road will be illuminated by electricity. Each station will have 50 lights of 12 candle-power each, and the lights will be kept burning from sundown until dawn. This illumination will be made possible by the completion of the generating plant at Seventy-fourth Street and the East River. The Second Avenue line, which will be the first branch of the system to be fully equipped with electricity, has been fitted out with the third-rail from the Battery to its terminus, so that all it needs now is the motor cars and the supply of electricity to fully equip it. The cars will be put in operation soon after Jan. 1, 1902. The great distributing station at Seventy-fourth Street and the East River will transmit its current to seven sub-stations at Division and Allen Streets; Thirty-fourth Street, between Second and Third Avenues; Third Avenue and Ninety-ninth Street, Third Avenue, near 161st Street; 110th Street, near Eighth Avenue; Fifty-third Street, near Ninth Avenue; Spring Street, between the Sixth Avenue and Ninth Avenue lines.

For the illumination of all the system 35,000 incandescent and 250 arc lamps will be used on the different stations. The passenger stations have lately been wired with a complete system of iron conduits, through which are drawn lead-covered conductors. The lead-covered cables are drawn through the station hand rails to the parts of the station where the lamp-posts and wall fixtures are set up.

Lighting the St. Louis Exposition.

Mr. Isaac S. Taylor, director of construction and maintenance of the Louisiana Purchase Exposition Company, is keeping well ahead of the practical work in devising the effects which are to make the St. Louis World's Fair not only larger than any of its predecessors, but also as unlike them as may be possible. He said lately, with regard to the important question of illumination:

"The question of lights for the Exposition is requiring a good deal of attention at present. Naturally, we wish to get away from methods that have become stereotyped, or 'midway' effects that are unworthy of the dignity of a big exposition. The grounds and buildings committee has not yet decided upon a plan of action in regard to the light problem. Ultimately a decision will be reached as to whether an electric plant will be erected by the Exposition Company and managed under its control or whether the matter will be disposed of in the form of a concession. In either case a plant will have to be constructed, and there can be little doubt that it will be within the limits of the site.

"The most attractive use of the lights will probably be in connection with the cascades. Here we expect to introduce an entirely novel effect, and one which at the same time will be in conformity to the other features of the Exposition. Back of the cascades we will introduce powerful electric lights, which will illuminate the broad sheets of water and make them visible at night from fully half the points on the grounds. The idea of throwing powerful lights on cascades and fountains from the outside has been carried into effect before with pleasing results, but the visibility of the mechanism destroyed the illusion. In the matter of fountains we shall also introduce the concealed lights, though this is not an original idea.

"The principal lighting effects will be on the Art Building, and on the main avenue leading therefrom to the principal entrance. The Art Building, from its commanding height, will shed a blaze of light upon all its surroundings, and the main avenue will be doubly illuminated. We shall get away from the plan adopted at Buffalo, however, in the matter of festoons of incandescent lights along the cornices of the buildings.

"We shall probably introduce a number of arcs, spanning the avenue making a triumphal way from the entrance to the crest of the highest hill. In addition, there will be two powerful searchlights from the 400-ft. towers on the Liberal Arts and Electricity buildings. All the lights will be white. Colored effects have a cheap appearance, which is proper only in midway locations.

"Apart from the question of illumination, the cascades are receiving attention. The water which is to supply them must be clear. In case the outflow of the artesian wells should not be sufficiently transparent high-pressure filters will be used, which will make the water perfectly limpid. The basins into which they are to empty will furnish another innovation. We have decided not to have the ordinary masonry finishing, which gives an air of artificiality, but will line the basins in some cases with piling, and in others with sod and gravel. The drainage from the roofs will find its way into the cascades, while that from the grounds will be turned into the sewers."

Mr. Luther Stieringer, the well-known consulting engineer, to whom the beautiful effects at Omaha, the Pan-American, etc., were due, has recently been summoned to St. Louis.

New Telephone Patents.

Telephone patents of the issue of Nov. 5 number two only, and both are directed to making the telephone circuit do more work, one relating to the ever-fascinating and never-conquered repeater problem, and the other to a duplex, or rather "contraplex," system. The repeater patent is granted to Clyde J. Coleman, of Chicago, and the invention consists in using a polarized horse receiver mounted so as to oscillate or rock, and carrying on a shaft a drum which is mechanically connected by a cord to the diaphragm of the repeating

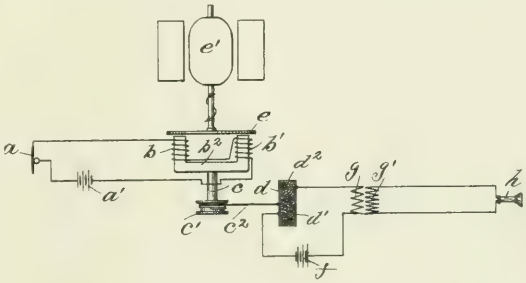


FIG. 1.—TELEPHONE DUPLEX PATENT.

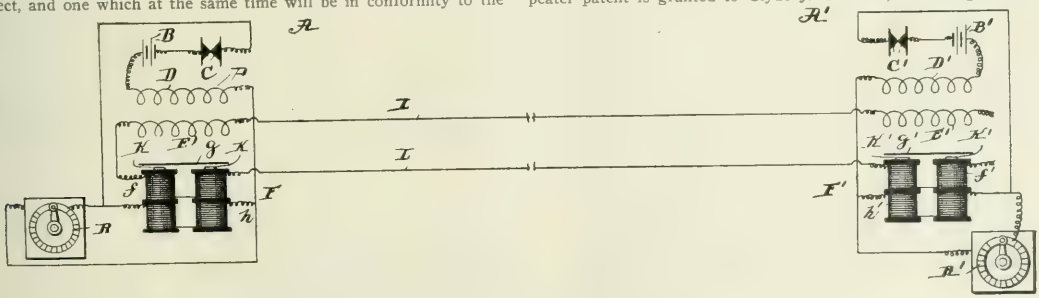


FIG. 2.—DIAGRAM OF TELEPHONE REPEATER CIRCUITS.

transmitter. Opposite the poles of the polarized receiver magnet is an iron disk rotated by a motor at uniform speed.

Referring to the diagram of Fig. 2, b^2 is the polarized receiver and e the disk or keeper, rotated at uniform speed by the motor e^1. The drum c^1, carried on the shaft c attached to b^2, is connected by the cord c^2 to the diaphragm d of the repeating transmitter, connected in circuit in the usual way. The disk is continuously rotated at uniform speed, and the permanent magnetism of b^2 attracts the same with a normally uniform force. When a vibrating current is sent over the line by means of the transmitter a, the strength of the poles of b^2 is varied to cause the same to attract the disk e with varying force, and the shaft c, carrying the magnet, is thus rocked or oscillated back and forth correspondingly. This oscillation imparts a corresponding vibration to the diaphragm d through the agency of the cord c_2 and to drums c^1. A modification of the invention is shown in which the granular carbon microphone of the repeating transmitter is replaced by a solenoid with an armature attached to the diaphragm controlled by the oscillating receiver.

In his specification Mr. Coleman says that in an application filed Oct. 28, 1899, he has described and generically claimed a system wherein a supplemental source of energy is provided, which is controlled by the current produced by the transmitter to produce a vibrating or undulatory current, the variations of which are amplified to any desired degree. In that application he has illustrated and described one embodiment of the generic principle, and the present application relates to another embodiment of the same general principle. While a "generic principle," of course, must be capable of working both ways, it is not so easy to see how this particular embodiment could be made to work in both directions, a vital point which the drawings and specification leave to the imagination.

The invention of Mr. Isidor Kitsee, of Philadelphia, "has for its object to increase the capacity of a telephonic circuit by the simultaneous transmission of speech in opposite directions over one and the same line-wire"; in other words, to produce a duplex, or, as the simultaneous transmission of two messages in opposite directions is sometimes called, a "contraplex" telephonic system. This system is more specially adapted for the purpose of transmitting news from one center to another.

At each station two persons are present. One person transmits the message from station A to station A^1, one person receives the message at station A^1, one person transmits the message at the same time from station A^1 to station A, and one person receives the message at station A. This description, in Mr. Kitsee's own language, shows clearly the limitations of the system, which, like the previous patent, is practically a one-way system, and, therefore, of very limited possibilities in actual telephone working. To put it in another way, there are four persons, a and b at station A, and c and d at station A^1. Now, a can talk to c and d can talk to b at the same time, but c cannot talk back to a nor b to d; a has a transmitter but no receiver, and b has a receiver, but no transmitter, d and c being similarly situated, respectively. Even for call-wire working such a method would be no longer useful, since modern practice in trunk working requires the exchange of messages both ways over a call wire.

Mr. Kitsee's invention is practically the application of the differential telegraph duplex system to the telephone receiver. Referring to the diagram of Fig. 1, F is a differentially wound receiver, the second coil h being connected in series with the primary circuit of the transmitter. A shunt rheostat R is used to adjust the resistance of the differential circuit until no side-tone is heard in the receiver F, when station A is talking to station A^1. Similar adjustment being made at A^1, transmitter C can then talk to receiver F^1 and transmitter C^1 can talk to receiver F simultaneously, as described above. The inventor says that a better arrangement of the differential circuit is made by using a split secondary in the induction coil, using one secondary in series with the receiver coil proper, as usual, and the other in series with the opposing coil h and the rheostat. A closer adjustment can be obtained in this manner.

CURRENT NEWS AND NOTES.

UNDERWRITERS' ELECTRIC MEETING.—The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the New York board rooms, 32 Nassau Street, beginning 10 A. M. Tuesday, Dec. 3.

LI HUNG CHANG, the great Chinese administrator, whose death at the age of nearly 80, has just been announced, must be credited with the introduction of telegraphs into China. The lines were managed first by Danes, who established for him a school for native operators.

WIRELESS TELEGRAPHY ON LIGHTSHIPS.—Among the recommendations of the annual report of the Lighthouse Board, now in the hands of the Secretary of the Treasury, is that an appropriation of $25,000 be made for connecting lightships with the main land by means of wireless telegraphy.

ELECTRIC POWER ON NEW YORK CENTRAL BRANCH.—It is stated that electric power may be introduced on the Putnam Division of the New York Central Railroad if the electric system on the Manhattan Elevated proves satisfactory. The Manhattan trains may then run over the Putnam road to Yonkers. It is further stated that estimates are being made by the electrical manufacturing companies on the cost of equipping the Putnam road with electric motive power. As noted by us some weeks ago, it is understood that Mr. B. G. Arnold is quietly doing some expert work on the question for the New York Central.

NATIONAL STANDARDIZATION BUREAU.—Eight acres of ground for the site of the National Standardization Bureau have been purchased in the District of Columbia about a quarter of a mile west of Connecticut Avenue on Pierce Mill road. Among the considerations that led to the selection of this site is that it is free from mechanical and electrical disturbances of all kinds, and has an elevation satisfactory with respect to atmospheric conditions. Plans for the buildings have been prepared, and their execution will be commenced upon the approval of the plans by the Board of Visitors, which convenes in December. The buildings provided for are a laboratory and a power house, the entire cost of which will be about $250,000.

COPPER RAIL BONDS.—Mr. Charles M. Hobbs, inspector of the electrical department of the Baltimore & Ohio Railroad, has issued an illustrated circular giving an account of the strange behavior of flexible bonds used on the belt line of the Baltimore & Ohio Railroad in Baltimore. The bonds were covered by the angle bars at the rail points, there being sufficient clearance to prevent crowding the bond. Under the severe conditions of service the metal of the bond at a very large number of the joints squeezed out over the top of the angle bar and below the head of the rail. The metal is forced out in irregular sheets about .005 of an inch and over in thickness. In some cases these ribbons are 8 or 10 inches long, and in others four or five strips are forced out. The metal ribbons are formed on both sides of the rail and occur mostly on tracks of the heaviest train service, although the same action has taken place on the other tracks. Several excellent half-tone illustrations are given, showing the results of this peculiar action, to account for which Mr. Hobbs does not offer any explanation. His experience, however, enables him to point out the weak points of protected flexible bonds used on steam railway tracks, and make several valuable suggestions as to the exacting requirements for such service.

X-RAYS ELUCIDATED.—A Dr. H. P. Pratt gives in a Chicago journal called the *Pan-Path*, the following exposition of X-rays: "The force from the X-ray tube is electrostatic in character, and of very high potential. It acts on matter in the same way as any e. m. f.; that is to say, it dissociates or electrolyses molecules along its lines of force. It may be used for cataphoresis. The X-ray is a germicide, through the production of ozone. The X-ray hastens physiological action, causing a temporary rise of temperature and increased elimination of waste through the lungs, skin and kidneys. The X-ray stimulates heart action. By equalizing the circulation the X-ray is a nerve sedative. The X-ray is a direct nerve tonic. A soft tube and a heavy current produce the greatest effect on the tissues. With reasonable care the X-ray burn can be avoided." Another writer in the same journal quotes Dr. Pratt as the discoverer of the fact that in some cases pieces of metal behind a sensitive plate produces the same effect as they would if placed in front, and adds: "Dr. Pratt considers that the X-rays radiate from the tube at first in straight lines, and later bend around and return, after the manner of an electric circuit. The fact that some metals affect the sensitive plate when behind it, he regards as a confirmation of his hypothesis that the 'X-ray circuit' is similar to an electric circuit."

TROLLEY PARLOR CARS.—The parlor car service of the Brooklyn Rapid Transit Company during the summer brought in gross earnings of $4,812, and the matter of a theatre service of parlor cars during the winter is under consideration.

CANAL LIGHTED BY ELECTRICITY.—The Cornwall Canal, Canada, is now lighted from end to end by the St. Lawrence Electric Power Company. There are some 250 lights in use on the canal, placed 300 ft. apart, with from 6 to 13 at each lock. The lamps are the enclosed arc, of 2000 candle-power.

PERILS OF ALPINE TRAVEL.—The wire ropes fastened to some of the most dangerous places on Swiss mountains have been found to constitute a new danger as well as a safeguard. They act as lightning conductors, and several tourists were stunned during the past summer, though none of the casualties proved fatal.

THE ROENTGEN RAY PENSION.—A large increase of pension has just been allowed to a civil war veteran 83 years old, who, with the aid of the Roentgen ray, was able to prove various injuries that had long disabled him, but for which he had not heretofore been able to secure an allowance. The case is said to be the first of the kind in the United States Pension Office.

NORTH SEA TELEPHONE CABLE.—Consul Roosevelt, at Brussels, reports to the State Department: "In a few days a new submarine telephonic cable will be laid, connecting Brussels with London. The circuit will be so disposed as to serve large commercial cities of Belgium and England, such as Antwerp, Liege, Birmingham, Manchester and Liverpool."

CHAMBER OF COMMERCE.—The corner-stone of the new building of the New York Chamber of Commerce was laid last week with appropriate ceremonies. Prominent among the documents, etc., relating to the history of the Chamber during the 123 years of its existence, were reports, papers, medals, etc., in regard to the laying of the submarine cable, and a copy of Dr. H. M. Field's "Story of the Atlantic Telegraph."

YERKES EVIDENCE IN LONDON.—A special cable dispatch from London of Oct. 30, says: Mr. Charles T. Yerkes to-day testified before the arbitrator appointed to decide on the electrical system for underground railroads. He reiterated that he would not be connected with any but the direct-current system, practically universally used in the United States. Mr. Yerkes said he had installed electricity on from 500 to 600 miles of street car lines in Chicago, which, equipped with this system, had never had a single death as the result of electricity. Mr. E. W. Rice, Jr., of the General Electric Company, testified technically in support of Mr. Yerkes' contention.

TROLLEY AND STEAM FARES.—Passenger travel on the Chicago-Joliet trains has been cut down about 50 per cent within the past month by the opening of the Joliet Electric Railway, which connects Chicago with the suburbs of the Southwest for a distance of 35 miles. Electric lines sell a round-trip ticket for 74 cents, while the train fare is $1.04. It takes an hour to make the run one way by rail and two to three hours by the electric lines. The inroads made into the passenger traffic have caused railway officials to consider the reduction of their rates to compete with the trolley lines. Roads running out of Chicago in other directions are also feeling the loss of traffic somewhat, but not to the extent the Joliet lines have.

ELECTRIC POWER DEVELOPMENT IN CANADA.—Mr. Louis Simpson, a Canadian manufacturer, has purchased from the Dominion Government and others the larger part of the property on which the Chats Falls are situated, on the Ottawa River, and will organize a company to develop the power of the falls. The Chats Lake is about 30 miles long, and through it the waters of the Ottawa River flow at the rate of 32,000 cubic feet per second at low water. At the east end of the lake the discharge widens into a bay, from which the water passes through natural flumes in the rock. There are 13 of these flumes, and it is proposed to build power houses thereon to develop the water power. It is calculated that at low water 80,000 horse-power can be developed at a cost of $15 per hydraulic horse-power.

SAFETY OF OCEAN TRAVEL.—Commenting on the arrangement of Lloyds in England for the adoption of a very elaborate Marconi reporting system, the *New York Evening Post* says: With this system in vogue, it seems as if there should be a decided improvement in the security of ocean voyages. Vessels equipped with the wireless instruments may almost always be in touch with other ships on transatlantic voyages, and any trouble can at once be flashed through the air, communication being possible for at least 100 miles. Under these circumstances, any steamship that floats around disabled and lost to the world would do so simply because the owners of the vessel have neglected to equip her with the wireless system, and thus failed to take one of the most ordinary precautions against trouble and worry. Overdue vessels will be able to tell where they are and what has delayed them, so that anxiety may be allayed, and a call for help at sea from 100 miles away should rarely or never fail to be answered. Those who go down to sea in ships in the future are more than likely to ask questions in regard to the Marconi equipment, and it is by no means impossible that the system will be as important and necessary a part of an Atlantic liner as the propeller.

SERIES MOTOR CONTROLLER.—Two patents issued Nov. 5 to C. J. Reed relate to a method of series-motor control whereby variable speed may be obtained without unnecessary waste of energy. This is accomplished by having independent armature and field currents, and means controlled by variations in the armature current, to produce desired variations in the field current. The source of auxiliary current may be either a storage battery, a motor-generator or a combination of the two. In the field circuit is a rheostat, which is operated by a magnetic device, through the coils of which the armature current passes. As the armature current varies a movement imparted by the magnetic device varies the current in the field by acting upon the rheostat in the field circuit. Thus the amount of current flowing through the field magnet winding is automatically regulated in accordance with the load, by the amount of current flowing through the armature. Another point of the invention consists in introducing a counter e. m. f. in the armature immediately before opening the armature circuits for change of circuit from series to parallel, this being accomplished by establishing a circuit which includes the storage battery and the motor armature, the armature and field magnet being in parallel. The patent describes in detail the controller for performing the various operations, and the application of the system to two or more motors working on the same load.

ROENTGEN RAY WORK.—The surgeon-radiographer to the Imperial Yeomanry Hospital, Mr. J. Hall-Edwards, described some of his experiences as to the value of Roentgen rays in warfare at the recent meeting of the British Medical Association. He found that the plan of obtaining the current for charging the accumulators from a dynamo connected with a belt to a foot motor of the bicycle type was altogether impracticable, as no one could work the bicycle arrangement long enough to be of much use. A small oil engine was used instead of the foot power, and worked very satisfactorily. As to the results of the introduction of Roentgen rays into military surgery, Mr. Hall-Edwards remarks: "With the friendly aid of these rays we are enabled to record the effects of small-bore projectiles under the various conditions which occur in actual warfare. We are enabled to localize the position of a bullet or other foreign body with absolute scientific accuracy; and, if our present knowledge be used to its fullest extent, we can see the condition of the parts as plainly as we could do were the soft tissues composed only of transparent gelatin. These facts being recognized, it is easy to see that the application of the rays to military surgery must produce results of the greatest possible value for future guidance, and that their complete application in a great war must prove of inestimable service in increasing our knowledge upon this most important subject. Many of the time-worn, useless and dangerous methods of finding the whereabouts of hidden bullets may now be forgotten; for with these rays we have at our disposal an aseptic, scientific and absolutely accurate method of localization, which may be improved, but which even now is as near perfection as our present knowledge can make it. There can be little doubt that, in the fact of the new facts brought to light by means of these rays, military surgery will have to be rewritten, and the advance made will mark an epoch in its progress.

STUDYING WIRELESS TELEGRAPH SYSTEM.—All the German naval officers are receiving instruction in wireless telegraphy, and all ships of the German navy will be equipped with wireless apparatus. Our Navy Department appears still to be "investigating."

THE GLASGOW EXHIBITION appears to have been more successful financially than the Pan-American. It closed on Nov 9, after being open 163 days. There were over 11,000,000 visitors. The daily attendance was 68,625, and the daily receipts £1,000. It is expected that there will be a surplus of $400,000.

SUPERPOSED-CURRENT DISTRIBUTION.—A patent granted Nov. 5 to Dr. Frederick Bedell describes a system of electrical distribution employing currents of different character, and particularly a constant potential system employing both alternating and direct currents. The inventor has discovered that if an alternating current be superposed on a direct current, the line loss will no longer be the square of the sum of the two currents, but the sum of their squares multiplied by the resistance. This involves a large copper economy in distribution systems, or, conversely, a higher efficiency of transmission. For example, if on a direct-current system an alternating-current system is superposed, by doubling the copper four times as many lamps as before can be supplied; or in supplying current over a common conductor to devices such as two incandescent lamps, with one ampere of direct and one ampere of alternating current, respectively, the energy received by the respective receiving devices is the same, while the energy lost in the conductor is only one-half the corresponding amounts of energy in case both devices received like currents. Several applications of the system are shown. In the simplest form, an alternator is connected at one side to one leg of a direct-current circuit, and from the other collector ring a conductor is run to form a third conductor in the combined system. Lamps are connected between the two direct-current conductors, and also between one of the direct-current and the alternating-current conductor. In a more symmetrical application, there are two direct-current generators and two alternating-current generators in opposite sides of a closed circuit. If we assume the form of the circuit to be rectangular, then there will be a main of the working circuit leading from each angle of the closed circuit. In order to secure a maximum of economy, any one translating device in the circuit should be supplied with current of one character—that is, either direct or alternating current. This implies a balance of line losses, and means are described whereby this condition of balance may be maintained.

TESLA WIRELESS TELEGRAPH PATENTS.—Among the patents issued Nov. 5 are five granted to Nikola Tesla relating to wireless telegraphy. In each case the invention applies to the Tesla system employing an aerial conductor extending into the rarified atmosphere and terminated by a plate—the other end of the aerial conductor being, of course, grounded. The main feature of all the patents consists in the use of a condenser wherein a charge is accumulated and then released to operate the receiving apparatus. One system described is based upon the ordinary use of alternating or pulsating transmitting currents. In the circuit of the aerial conductor is placed a commutator and condenser, the former of which has a motion synchronous with the generating apparatus at the transmitting station. By this means received alternating currents are rectified and the condenser always charged by current of the same sign. In the circuit of the condenser is a mechanical discharging device by means of which the condenser is discharged at regular intervals of time, a definite number of which intervals corresponds to the interval of a dot, and a larger number to the interval of a dash. Thus the feeble charge received on the aerial wire will, during a certain period, be accumulated in the condenser, and the entire quantity accumulated during the period then discharged into the receiving circuit, and there operate, directly or indirectly, the receiving device. Two other patents relate also to the accumulation of a charge in a condenser, but instead of employing the usual method of wireless telegraphy, the sensitive device at the receiving end is a selenium cell. Moreover, in this case the condenser is charged through a local battery in the circuit of the condenser and selenium cell. From the transmitting station radiations identical with or resembling those of ordinary light are sent out, and upon striking the selenium cell at the receiving station decrease its resistance. Upon such decrease of resistance a change from the local battery passes into the condenser, and after a definite period the condenser is discharged into the receiving circuit by means similar to those described in the first-mentioned patents. In one arrangement shown a coherer replaces the selenium cell. A number of different forms of receiving circuits are shown, in one of which a coherer is employed. The fifth patent relates to a system in which radiations such as ultra-violet light, cathode or Röntgen rays, are employed. As is well known, ultra-violet rays possess the property of dissipating a negative charge; consequently, if one side of a condenser is connected to a plate subjected to the influence of ultra-violet rays the condenser will become positively charged. In the Tesla patent the upper plate of the aerial conductor is of large surface, clean and highly polished or amalgamated. This conductor is connected to one side of a condenser, and when through the influence of radiations of small wave length, a definite charge has been accumulated in the condenser, it is discharged into the receiving circuit. This patent, in addition to the mechanical form of discharger described in the preceding patents, gives a description of another form consisting of two very thin conducting plates placed in close proximity and very mobile, enclosed in a receptacle from which the air has been exhausted. This device may be compared to the ordinary gold-leaf electroscope, and is connected across the condenser. When the potential of the condenser due to accumulated discharge arrives at a certain value, the two plates by attraction come in contact and the condenser is discharged through the receiving circuit. Besides ultra-violet rays, the patent states that radiations from Lenard and Röntgen tubes may be employed. As in other Tesla patents referring to elevated aerial plates, no information is given as to the tenuity of the atmosphere corresponding to the condition when it becomes conductive, nor of the approximate elevation of the terminal plate.

LETTER TO THE EDITORS.

The English Electrical Industry.

To the Editors of Electrical World and Engineer:

Sirs.—Your issue dated Sept. 7, 1901, contains an article by Mr. E. Kilburn Scott, headed "A Note on English Methods," which is unique in its mass of inaccuracies and extremely poor style. Perhaps the great excuse for the publication of this so-called note is that it was written by a man whose nationality presumably is English, yet it may not be generally known that he is engaged in the exploitation of the manufactures of a Belgium electrical firm, viz., the International Electric Company, of Liege. The editorial which is written on this letter, and which commends to the notice of American manufacturers the extremely candid criticisms which are given by an Englishman on his fellow countrymen, is certainly not appreciated in the spirit given in this country. While open to every candid opinion which might be expressed, the Englishman is not and never will be willing to accept such crude expressions as fill Mr. Scott's article from end to end.

It is curious to note that in spite of the fact that "our telegraphists are partly trained," we have the finest system of telegraphs existing. That the "purely English manufacturer must knock off dynamo making" (Anglicized, we presume, "discontinue") seems very sad, yet the ray of hope is that somebody else must do it for him—Mr. E. Kilburn Scott? There is no doubt that the Continental firms are not only "thinking to rush plants," but are already doing it at prices which cannot be reached by home manufacturers, but Mr. Scott conveniently does not touch upon the point of quality. There are firms to-day in England who are building electric motors and generators of as good a type as can be found either on the Continent of Europe or America, and at prices which more than favorably compare, and if quality and efficiency are taken into consideration, certainly English manufacturers have nothing to learn. One might mention scores of concerns in England, such as Bruce Peebles, Electro Motors, Limited, Newton Electrical Works and the Electric Construction Company, whose workshops and the material manufactured are as up to date both in design, efficiency and price.

We have no huge concerns in England such as the General Electric Company, of New York, or the A. E. G., of Germany, and even those that are the largest and longest established among the English electrical firms, are the most conservative and out of date.

There is certain material (for instance, railway motors) which but few firms have successfully made in this country, but it must always be taken into consideration that the electrical industry, as a whole, is severely handicapped by absurd rules and regulations, made not by the manufacturer, but by the Board of Trade and a number of so-called experts.

Mr. Scott's statement that the trade unions of this country are not the real cause of a great amount of the backwardness in manufactures, shows a great want of appreciation of the true state of affairs on his part. One cannot expect, however, a man whose experience has probably only extended as far as a "royalty monger" or as a "dynamo designer" who "hardly knows a pump from a mangle," or perhaps one of his so-called "one-horse template pattern consulting engineer" to be conversant with the grim facts known only too well to every English manufacturer.

That the real business man in England is always open to any suggestion which might be made for the betterment of his business is beyond dispute, but it is only fair to say that he is bound almost hand and foot by restrictions and circumstances which his Continental and American brethren do not realize.

The whole of the so-called facts of his note are, to be candid, absurd, and while allowing and only too well appreciating the fact that the electrical industries of this country leave much to be wished for, I cannot help but remark that the issue for which every one is looking will not be obtained through the writing of articles of this description or the sales which Mr. Scott may make of his Belgian apparatus.

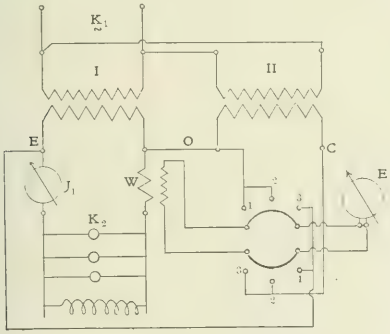
Mr. Scott's closing remark is more than refreshing, coming as it does from a man whose sole object in life, at least at present, is not to educate the English manufacturer but simply to prove to him that nothing can be manufactured in this country appertaining to matters electric of a first-class nature, hence the Continent must be resorted to, but preferably Liege.

London, England. Henderson W. Knott.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers.

Voltage Drop in Transformers.—Bragstad.—An article, illustrated by diagrams, on the determination of the voltage drop in transformers. He first gives a graphical method for determining it, and then describes an experimental method for directly measuring it. When in a transformer, having equal numbers of primary and secondary turns, one terminal of the primary winding is directly connected with the corresponding terminal of the secondary winding, and when a voltmeter is connected between the other two terminals, it measures directly the voltage drop in this transformer. Theory shows that this voltage drop must depend only on the current, and must be independent of the e. m. f. and the phase difference. If the voltage coil of a wattmeter is connected between the two terminals just mentioned, the current coil being in the primary circuit, one can determine the two components of the voltage drop. The following method can be used for a transformer in which the ratio of the numbers of the primary and of the secondary turns has any value, but one must



VOLTAGE DROP IN TRANSFORMERS.

have at his disposition for this purpose two transformers which have exactly the same ratio of the primary and secondary turns. The connections are shown in the adjoining diagram. The transformer *I* is loaded; *II* is not loaded. *J* is an ammeter, *W* a wattmeter, *E* a voltmeter, 1—2—3 is a switch. By means of connection 1 one obtains the secondary voltage at the terminals and the secondary power, by means of connection 2 the primary voltage reduced to the secondary, by means of connection 3 the voltage drop and the effective loss of power. These measurements are made with constant secondary voltage and secondary current; the secondary phase difference varying. The current supply is connected in this case to the terminals K_1, the load to the terminals K_2. To measure the voltage drop at constant primary voltage for varying phase difference, the terminals K_1 and K_2 are exchanged. The results of his measurements are in agreement with the theory.—*Elek. Zeit.*, Oct. 3.

Standardization of Electrical Apparatus.—Broderick.—An article in which he discusses how standardization affects the interest of the consumer. Increasing standardization in recent years, has lowered the price, has assured the prompt fulfillment of promises of delivery and has also made satisfactory operation certain. On account of interchangeability of parts, renewals and repairs have become easier and cheaper. He refers to the work done by the A. I. E. E. and A. S. Mech. E., for promoting standardization. He advocates hearty co-operation between buyer and manufacturer. Where existing installations appear to require obsolete or special apparatus, consultation with the manufacturer is likely to prove of value. It may be found possible in some cases to use standard apparatus without any temporary sacrifice and, of course, with immediate and future advantage; and in other cases some temporary sacrifice, involved in the adaptation of standard apparatus to requirements may be shown to be much more than offset by the advantages accruing therefrom.—*Eng. Mag.*, Nov.

Breakdowns of Electrical Machinery.—Hill.—A very brief article in which he quotes from a statistical report of Longridge that the mechanical breakages amount to the large figures of 32 per cent of the total breakdowns in the case of dynamos and 17 per cent in the case of motors.—Lond. *Elec. Rev.*, Oct. 18.

References.

Polyphase Working.—Eborall.—The beginning of an illustrated reprint of his Cantor lectures on polyphase electric working, abstracts of which have been noticed in the Digest before.—Lond. *Elec.*, Oct. 25.

Large Alternators.—Ball.—A brief article on the introduction of large alternators into practice, as a result of concentration in power stations.—*Cassier's Mag.*, Nov.

Speed Control of Motors.—Hoit.—A paper read before the Civil Eng. Club, of Cleveland. He first discusses "belt transmission with mechanical speed control," and "direct-connected transmission with rheostatic control." He finds that both methods are unsatisfactory. He speaks in favor of multiple voltage control, the speed being varied by supplying the armature of the motor with different voltages, while the fields are constantly excited from any one specific voltage.—*Jour. Ass'n Eng. Soc.*, Sept.

Lights and Lighting.

Lighting and Extinguishing a Certain Number of Street Lamps After Midnight.—Loewy.—An illustrated description of a system devised by Czeczowiczka for burning during the first part of the night twice as many lamps as for the second part. All the lamps are connected in parallel and fed by the same mains, but while the lamps which have to burn only the first part of the night are each (or a group of them) in series with a choking coil of low resistance and high reactance, the other lamps which have to burn the whole night are not provided with such coils. In the first part of the night direct current is supplied to the lamps, and all lamps burn as the choking coils have then little influence. At midnight the supply is changed to alternating current, and the lamps which are in series with choking coils obtain too small a current to be lighted; they are, therefore, extinguished. He gives a calculation of the choking coils required and shows that the loss in them is very small.—*Zeit. f. Elek.*, Oct. 20.

Osmium Lamp.—A note stating that the Austrian Gas Incandescent Light & Elec. Co. of Vienna, protects its filaments by supports made of a "sintered or fritted refractory oxide," preferably a mixture of 10 thoria to 1 of magnesia, non-adherent and chemically indifferent to osmium, formed into threads and sealed into a hollow glass stem, and so mounted within the lamp bulb that they engage and sustain the metallic filament against sagging or vibration.—*Lightning,* Oct. 17.

Power.

Russian Water Power Transmission Project.—Dobrotvorsky.—An article on a scheme of developing extensive water powers near St. Petersburg with electrical transmission to that city. The project comprises hydraulic works on three rivers, three turbine generating stations of 28,000 to 38,000 horse-power each and high-voltage transmission over lines of 68 to 106 miles length. It is estimated that 48,600 kilowatts will be consumed shortly after completion for lighting, traction and power purposes. At present St. Petersburg is supplied with electric light from ten central stations, and there are besides some 250 isolated plants, the combined capacity of all plants being estimated at 51,000 horse-power.—*Eng. News,* Oct. 24.

Modern Turbine Installations.—An article on modern turbine construction in Switzerland, especially by Escher Wyss & Co. The type generally adopted for low and medium heads is based on the American design of Francis, with circumferential inlet and axial discharge. This type has almost entirely replaced the Jonval turbine, and in many instances is also displacing the Girard turbine, the latter being used only for very large units. For units of moderate discharge outlet working under high pressure, a direct pressure turbine of the Pelton type with spoon-shaped buckets is used, these three types forming practically all in general use in new installations. Several new installations are described.—*Zeit. Ver. Deut. Ing;* abstracted at some length in *Eng. Mag.,* Nov.

Power for Turntables.—A report of a committee of the Ass'n of R'y Superintendents. Tables driven by electric power, steam power and gasoline engines are briefly described. The kind of power and apparatus desirable depends upon the location of the turntable with reference to electric or other power plants. If electric power can readily be obtained from the railroad company's plant or from outside parties, electricity should be used, as it requires least machinery, and is economically maintained. Attention should be given as to whether a suitable current is available at all times, including nights and Sundays. Some data are given on the first cost of plant and on the power required.—*West. Elec.,* Oct. 26.

Electric Power and Industrial Prosperity.—Dunlop.—After a discussion of the reasons why the introduction of electric power in British workshops has been delayed, he says that victory in the inevitable twentieth century struggle for commercial and industrial supremacy will surely fall to that nation which is able to make the best use of electric power, and which displays the greatest ingenuity in bringing about by its means economy in labor and increase in output. He discusses the advantages of electric power, saving in power, labor, fuel and repairs; in the cost of buildings, equipment, and clear head room; freedom in the arrangement of machinery and shops, in the growth of premises and distribution of power; a more satisfactory control of speed; great increase in output and cleanliness, and less serious shutdowns for repairs. The substitution of electric power for nearly all laborious handling reduces the labor cost and at the same time eliminates only the lower class of labor.—*Iron and Coal Trades Rev.;* abstracted in *Eng. Mag.,* Oct.

References.

Electric Power in Coal Mines.—Habermann.—The conclusion of his paper, the first part of which was recently abstracted in the Digest. He discusses the electric driving of the main hauling machines. On account of the widely varying load he believes that economical operation can be obtained only with a storage battery. This requires direct current to be used. The arrangements are discussed in detail. In an appendix to this paper he says that he has changed his opinion, just noticed, on the necessity of direct current for driving the main hauling machines. He now believes that the three-phase induction motor may prove to be of great advantage for this purpose in future. —*Zeit. f. Elek.,* Sept. 29.

Increased Voltage on Transmission Lines.—Boernecke.—An article in which he discusses the three reasons to which an increase of voltage on transmission lines may be due. The first reason is over-excitation of synchronous motors, but the increase of voltage due to this cause is never dangerous. The second reason is resonance phenomena, which may become quite dangerous. He gives a review of the theoretical investigations of these subjects by various authors and describes the apparatus which have been devised for protection of the line against resonance phenomena. The third reason is a charge of the line, due to the static electricity in the atmosphere. This subject is still too unexploited to be treated mathematically. He begins a review of investigations of this subject. A large number of different types of lightning arresters are described.—*Zeit. f. Elek.,* Oct. 6, 13.

German Three-Phase Plant.—Winawer.—A profusely illustrated description of the generating station of Karlsruhe. There are three 400-kw, 4000-volt three-phase generators. The current is used for lighting and power purposes.—*Elek. Zeit.,* Oct. 10.

Niagara.—Dunlap.—An illustrated article on progress at the new power house at Niagara.—*West. Elec.,* Oct. 12.

Two-Phase Workshop Installation.—An illustrated description of the installation of the Union Switch & Signal Co., of Swissvale, Pa. There are three gas engines directly connected to 75-kw generators giving two-phase currents at 220 volts. The motors in use are two-phase induction motors, the aggregate capacity of the motors installed being 500 horse-power.—*West. Elec.,* Oct. 19.

Cotton Mill Installation.—An illustrated description of the power plant of the Olympic cotton mill at Columbia, S. C. The machinery in the works is operated from line shafting, driven by induction motors. —*The Eng.,* Oct. 15.

Canal Lift.—In a continuation of the illustrated serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany, an illustrated description is given of the electrically operated lift on the Dortmund-Ems Canal for raising or lowering canal steamers and barges of 600 or 800 tons burden a height of 14 to 16 meters.—Lond. *Elec.,* Oct. 25.

Engines Driving Large Dynamos.—Day.—An illustrated paper read before the Manchester Ass'n of Eng. on special features of steam engine building when engines are applied to the direct driving of large dynamos, and on the methods which have been adopted in the Ferranti engine with a view to meeting these requirements.—Lond. *Elec.,* Oct. 25.

Gas Engines.—Simon.—The first parts of an illustrated article on gas engines in electric installations. The method of making Dawson gas is described, and the superiority of gas engines over steam engines is shown. Several types of gas engines are briefly described and illustrated.—*Elek. Anz.,* Oct. 6, 10.

Traction.

Havana.—Greenwood.—An illustrated description of the system of the Havana Elec. R'y Co. The trolley system is used with the unusual plan of having two trolley wires over each track, "as the method that would least affect vested rights, and at the same time assist operation during the periods of dry weather, during which time the rails would be more or less covered with fine limedust. This dust would prevent good metallic contact between the car wheels and rails and interrupt the electrical circuit if the single trolley method had been adopted." The power house contains three steam-driven, 550-volt, 850-kw generators. The system comprises 31 miles of track, of which 20 miles is double.—*St. R'y Rev.,* Oct. 15.

References.

Electric Railways.—Cardew.—A reprint in full of his Cantor lectures, abstracts of which have been noticed before in the Digest. First Lecture: Historical summary, advantages of electric traction, motors, field magnets, Ward Leonard system.—Lond. *Elec.,* Aug. 30. Continuation of first lecture, series-parallel control, unspringborne weight. Second Lecture: Polyphase system, induction motor, differences between direct current and polyphase motors, cascade connection, controlling arrangements, line equipment, and contact devices, bonding, safety device.—Lond. *Elec.,* Oct. 11. Continuation of second lecture, return conductor, Ganz's trolley pole. Third Lecture: Generation and transmission, equipment of sub-stations, relative advantages of direct and polyphase current, equipment of a full scale railway.—Lond. *Elec.,* Oct. 18.

Tramways.—More.—A very long and profusely illustrated paper, read before the Glasgow Eng. Congress, on "Recent tramway practice." He discusses in detail the construction of the road, the equipment of the power house and the rolling stock.—Lond. *Elec. Eng.,*

Sept. 20, 27; Oct. 4, 11. Several points of the paper are discussed in an anonymous article in Lond. *Elec. Rev.*, Oct. 18.

London.—The first part of a well illustrated article on the "Electric tramways of the London United Tramways." The central station contains two steam-driven compound-wound direct-current generators for supplying current to the lines in the vicinity of the power station, and, in addition there is now one 500 kilowatts to be increased afterwards to two 1000-kw, 5000-volt, 25-period, three-phase sets for the transmission of power to the sub-stations.—Lond. *Elec.*, Oct. 18.

Interurban Electric Railroad.—An illustrated article on the Toledo, Fremont & Norwalk Railroad, with high-tension alternating-current transmission and converter sub-stations.—*St. R'y Rev.*, Oct. 15.

Boat Propeller.—An illustrated description of a new submerged electric motor and propeller. The motor and propeller occupy the place of the rudder and the boat is steered by turning the sternpost. The motor itself is under water and is enclosed in a water-tight globe. The storage batteries are placed in the boat. The motor is a series-wound, two-pole machine of slow-speed type.—*Sc. Amer.*, Oct. 19.

Installations, Systems and Appliances.

REFERENCES.

British Lighting Station.—An illustrated description of the St. Annes-on-the-Sea electric station. The three-wire system with the neutral earthed at the station, is used, with 480 volts between the outers. There are two 70-kw dynamos and a storage battery of 260 cells.—Lond. *Elec. Eng.*, Oct. 4.

British Lighting Station.—An illustrated description of the Battersea electric plant. The three-wire direct-current system is used with 460 volts across the outers. The present plant amounts to a total of about 1500 horse-power in boilers, engines and dynamos.—Lond. *Elec. Rev.*, Oct. 4.

Wires, Wiring and Conduits.

Disruptive Strength of Insulating Materials.—Baur.—A reply to O'Gorman's criticism of his formula, recently noticed in the Digest. He agrees that more evidence is wanted for his formula. Regarding the arguments made by O'Gorman that for thicknesses of the dielectric above 1 cm. the curve must become an approximately straight line, he says that his curve, beyond 1 cm., is approximately a straight line, and that his experiments are in agreement with this view. While O'Gorman calls attention to the great importance of the shape of the electrodes, he refers briefly to former experiments made by him which appear to show that the shape is of no importance.—Lond. *Elec.*, Oct. 18.

REFERENCE.

Duplicate Feeders.—Andrews.—An illustrated communication on a system of duplicate mains devised by him for the purpose of preventing an interruption to the supply in the event of a short circuit occurring on any feeder. The system is in use in Hastings, and has proved satisfactory. When a bad short circuit occurred on one of the duplicate high-tension feeders to a sub-station the faulty section was immediately automatically disconnected and the supply maintained.—Lond. *Elec.*, Oct. 25.

Electro-Physics and Magnetism.

Spectra of Hydrogen.—Trowbridge.—An account of an investigation of "the spectra of hydrogen, and some of its compounds." He arrives at the following interesting results. Hydrogen is an insulator. The passage of electricity through hydrogen, nitrogen, oxygen and their gaseous compounds is conditioned by the water-vapor present. The dissociation of the water-vapor in the case of tubes filled apparently with pure hydrogen under the effect of a strong, steady current of electricity, shows an electrolytic action closely analogous to that of the voltatic cell. In the case of electrolytic copper terminals in an atmosphere of hydrogen pure copper is deposited from the negative terminals and a suboxide of copper at the positive terminal. Under the effect of powerful condenser discharges, oxygen is set free from commercial aluminum and magnesium. Certain carbide bands are always present in glass tubes filled with hydrogen, nitrogen, oxygen and ammonia gas, notwithstanding the greatest care which may have been taken in submitting them to a high temperature during the process of exhausting, when powerful discharges are used. The brilliancy of the light of tubes filled with hydrogen diminishes as the process of the dissociation of water-vapor goes on and the resistance of the tube increases. It is possible to raise such a tube to the X-Ray stage from a pressure of ½ mm. merely by the application of a strong steady current. The X-rays excited by the application of a steady current are due to the radiations set up by the dissociation of highly rarefied water-vapor.—*Phil. Mag.*, Oct.

Curves Traced by Point Discharges.—Weber.—De Heen has made an experiment in which a plate of resin was charged and then held over a number of Bunsen flames. Each flame discharged a portion of the plate, and the various portions were sharply marked off from each other along lines which could be made visible by dusting with sulphur, lycopodium and carmine. The present author has found that the same phenomena are produced when point electrodes are used instead of flames. The tracings show lines resembling honeycombs. The plates remain charged along these lines. He explains this as follows: A single point opposite a metallic surface produces a discharge which proceeds along a paraboloidal path. Two such paraboloids side by side behave like elastic bodies and flatten each other where they touch.—*Ann. der Physik*, No. 9; abstracted in Lond. *Elec.*, Oct. 18.

Luminous Effects on Wires.—Borgmann.—Bare wires appear surrounded by a luminous halo when they are connected with the secondary of an induction coil, and the circuits either open or closed by means of a Crookes tube. Besides the halo bright stars appear on the wires at nearly equal intervals. He has studied the behavior of such wires in tubes containing gas at various pressures. An essential difference was produced in the phenomena observed by inserting a spark-gap of less than 3 mm. in parallel with the induction coil.—*Phys. Zeit.*, Aug. 17; abstracted in Lond. *Elec.*, Oct. 4.

Photo-Electric Effects.—Kreusler.—Two papers, the first dealing with the fact that the lowering of the spark potential by ultra-violet light discovered by Hertz, and the dissipation of an electric charge under the same influence discovered by Hallwachs, show a marked difference in the extent to which they are influenced by the material of the electrodes. He finds that the photo-electric effect shows a great increase of intensity in the neighborhood of the sparking potential. In the second paper he makes use of this result for the photometry of ultra-violet light. He determined the absorption of various bodies for ultra-violet light.—*Ann. der Phys.*, No. 10; abstracted in Lond. *Elec.*, Oct. 18.

Influence of Light Upon the Superficial Electric Properties.—Buisson.—An article in which he discusses the speed of discharge of negative electricity, the potential difference between two metallic condenser plates, and other superficial electric properties which are influenced by light. He reaches the following conclusions: The surface of a lighted metal is different from the condition when it is in the dark, and varies with the nature of the light. The effect of the light is independent of the gas which surrounds the metal. It is probable that the gas takes in the very thin layer of gas which is contained in any metallic surface, and which exists in spite of a change of the surrounding gas or of a vacuum.—*L'Eclairage Elec.*, Oct. 5.

Cathode Rays.—Seitz.—An account of experiments referring to the reflection and absorption of cathode rays. An important result is that the coefficient of absorption increases with the thickness of the absorbing film, and Lenard's law, according to which films possess equal absorbing power if they have equal masses per unit of area, is, therefore, only true as a first approximation.—*Ann. der Physik*, No. 9; abstracted in Lond. *Elec.*, Oct. 18.

REFERENCES.

Vector Analysis.—Punga.—The first part of an article illustrated by diagrams in which he gives a summary of Grassmann's "Ausdehnungslehre" (1844), and its application to the analytical and graphical investigation of alternating-current phenomena. This is a kind of vector analysis and is somewhat similar to Steinmetz's symbolic method.—*Zeit. f. Elek.*, Oct. 20.

Brush Discharge Through Diaphragms.—Toepler.—An account of experiments in which he studied some modifications of the "brush arc" in the open air between a metallic point and a semi-conducting plate, such as slate or basalt, these modifications being produced by introducing a small block of metal or a metallic diaphragm into the path of the discharge.—*Ann. der Physik*, No. 10; abstracted in Lond. *Elec.*, Oct. 18.

Electro-Chemistry and Batteries.

Increase of Capacity of Storage Batteries by Heating.—Heim.—A paper in which he gives an account of tests of a storage battery at different temperatures. He found that both the ampere-hour and the watt-hour capacity increased with increasing temperatures. The

voltage of the cell, discharged at 20 amperes, decreased from 1.99 to 1.825 in 3½ hours at a temperature of 14 degs. C., and from 2.025 to 1.825 in 6¼ hours at a temperature of 45 degs. In a discharge with 32 amperes the voltage decreased to 1.825 in 1¾ hours at 14 degs., in 2½ hours at 30 degs., and in 3 3-5 hours at 45 degs. The ampere-hour efficiency decreases with increasing temperature. It was 0.86 at 45 degs., against 0.95 at 14 degs. The decrease of the watt-hour efficiency with increasing temperature, however, is not so great. This efficiency was 0.72 at 45 degs. against 0.75 at 14 degs. He thinks that the good effect of the heat upon the capacity is due to the increased circulation of the acid in the pores of the plates. He then discusses practical applications of his scheme, but it seems that there is no great hope for success, as according to the information, obtained by him from a large German storage battery manufacturing concern, artificial heating of the battery diminishes the life of the plates.—*Elek. Zeit.*, Sept. 26.

Electro-Chemistry in Great Britain.—J. B. C. KERSHAW.—A continuation of his serial on electro-chemical and electro-metallurgical industry, dealing with the progress in the United Kingdom. He discusses first copper refining; copper smelted from the American pyritic ores is richest in gold and silver contents, and is, therefore, best adapted for the electrolytic refining process. Since the growth of the electrolytic refining industry in America the shipments of raw copper of this character to Europe have ceased and the American refineries are now drawing supplies from Europe. As a result of this situation, all the European refineries have plant in excess of their present output. For aluminum production in Great Britain the Heroult process is used, 5000-hp electric plant being installed for this purpose. For electrolytic alkali and chlorine production the Castner mercury process and the Hargreaves-Bird diaphragm process are used, while in a third plant a gravity process has proved a failure. Some brief remarks are added on the manufacture of calcium carbide, sodium and sodium peroxide, zinc plating and electrolytic methods for the extraction of zinc from the ores.—*Elec. Rev.*, Oct. 26.

Nomenclature of Ions.—WALKER.—An abstract of a Brit. Ass'n paper in which he proposes definite affixes for distinguishing the electrolytic ions as derived from various compounds. Cations would be marked by the simple ending ion, as sodion, barion, etc., dots over the symbol indicating the number of electric charges carried (valency). The ending anion with dashes, would indicate that the ion is derived from an oxide salt; a sulphate would give sulphanion. Osions would be derived from sulphites, idions from sulphides. Complex ions would be hydrocarbanion, dihydrophosphanion, etc.—Lond. *Eng'ing*, Oct. 18.

Electric Heating in Organic Chemistry.—LOEB.—A long illustrated account of experiments in which the electric current is used to produce the heat required for certain chemical reactions, especially in organic chemistry. The heating effect of resistance wires of carbon or metal is better adapted for this purpose than the heating effect of the electric arc, because the former method enables one to regulate more effectively the temperature required in each special case.—*Zeit f. Elektrochemie*, Oct. 3.

REFERENCES.

Acker Process for the Production of Alkalies and Chlorine.—J. B. C. KERSHAW.—An illustrated article on the Acker process for the electrolytic production of alkalies and chlorine, in use at Niagara. As no exact information was available, the description is based upon "Acker's patents of 1899." As is well known, Acker uses fused salt as electrolyte and molten lead as cathode material.—Lond. *Elec.*, Oct. 25.

Potential Differences of Allotropic Silver.—CRAW.—A brief abstract of a Brit. Ass'n paper giving a preliminary account of experiments in which he put plates of silver, differently treated, in a solution of potassium nitrate containing a little silver nitrate, and determines the differences of potential. Rolled silver becomes anodic to electrolytic silver.—Lond. *Eng'ing*, Oct. 4.

Max Accumulator.—The first part of an illustrated English translation in abstract of the French article of Gasnier recently noticed in the Digest.—Lond. *Elec.*, Oct. 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Instrument.—HEYCK.—An illustrated description of a modification of an instrument of Thiermann for measuring e. m. f.'s, currents and resistances by means of compensation against a standard cell. The principle is shown in Fig. 1. There are two loops, one containing the standard cell *N. E.*, the other the e. m. f. *K* to be measured. The first loop has a total resistance W_1, the second the total resistance W_2. When two points *E* and *F* of the first loop and two points *C* and *D* of the second loop are so chosen that the potential difference between *E* and *F* is equal to that between *C* and *D*, and when *E* and *C* are then connected together and also *F* and *D*, no current will flow in *EC* and *FD*; w_1 and w_2 are the resistances of those parts of the first and second loop, respectively, which do not contain the

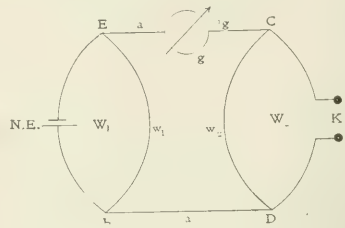


FIG. 1.—DIAGRAM OF CIRCUITS.

standard cell and the e. m. f. *K*. When the galvanometer *g* indicates no current, the e. m. f. *K* to be measured multiplied with the ratio of w_2 to W_2 is equal to the e. m. f. of the standard cell multiplied with the ratio of w_1 to W_1, so that *K* can easily be found. The new form of this instrument is shown in Fig. 2. A fixed resistance of 89,050 ohms is connected in series with four sliding contact rheostats 10 × 1000 ohms, 9 × 100 ohms, 9 × 10 ohms, 9 × 1 ohm. It will be seen from the diagram that the 10 × 1000 ohms and 9 × 100 ohms are always in the total resistance W_1, while the 9 × 10 and 9 × 1 ohms can be disconnected. The maximum of W_1 is 100,049 ohms and the minimum 99,950 ohms, so that the maximum difference between W_1 and 100,000 ohms is 5 per 10,000. The resistance w_1 may have any value between 1 and 10,999 ohms. In practice, however, only values above 1000 ohms are used in order to measure easily with an exactness of 0.1 per cent. As standard a Weston cell is used with an e. m. f. = 1.0187 volts at 18 degs. C. The internal resistance is 34 ohms, and is supplemented by a manganin resistance of 1836 ohms in series, so that the joint resistance is 1870 and the voltage at the terminals of the standard cell (of which the series resistance is considered to be a part) is 1 volt when closed through an external resis-

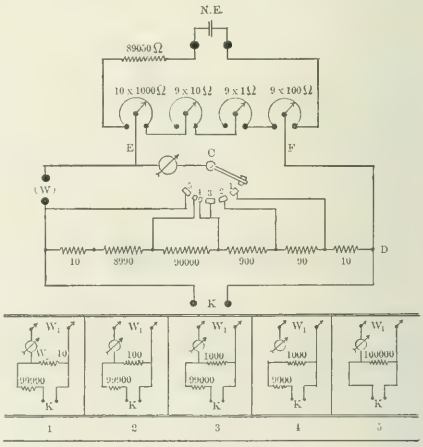


FIG. 2.—DIAGRAM OF CONNECTIONS.

tance of 100,000 ohms. It must be remarked that during the measurements the cell gives current, but this flows only through the loop W_1, and is only 0.00001 ampere, i. e., the tenth part of the current permissible for a Weston cell. This represents the arrangement of the loop W_1. For the loop W_2 six resistances of 10, 8990, 90,000, 900, 90 and 10 ohms (together 100,000 ohms) are connected in series in such a way that for the positions 1, 2, 3, 4, 5 of the rheostat *C*, the resis-

tance W_1 is 100,000, 100,000, 100,000, 10,000, 100,000 ohms, respectively, and w_1 = 10, 100, 1000, 1000, 100,000, respectively. The e. m. f. K to be measured (in volts) is then for position 1 of rheostat C equal to one-tenth of w_1 (in ohms), for position 2, one-hundredth of w_1, etc., for position 5 one hundred-thousandth of w_1. A Deprez d'Arsonval galvanometer is suitable for the measurements. The instrument may also be used easily as a Wheatstone bridge, and the resistance to be measured is then found directly from the resistance w_1.—*Elek. Zeit.*, Oct. 17.

Tachometry.—J. A. Fleming.—After a brief description of revolution counters he describes several types of tachometers. The governor tachometer is not very accurate. A far better form is a hydraulic speed indicator, consisting of a small, circular, centrifugal pump, which may be constructed by enclosing in a brass box a brass four-bladed fan, the blades having their planes parallel to the fan shaft. The fan blades very nearly touch the inner side of the cylindrical box. Two pipes lead to this box, one entering near the shaft axis and one on the outer wall of the containing box. The former is connected to a reservoir of fluid which may be water, and the latter pipe is connected to a tall, vertical glass pressure pipe. The shaft is driven by the motor or dynamo, of which the angular velocity is to be recorded. The fan then pumps the water from the reservoir to the stand pipe and the height of the water in the stand pipe is proportional to the square of the angular velocity of the shaft. The smallest variation in the speed shows itself in a change of height of the liquid. The greater the speed, the greater will be the actual variation in height in the column of liquid corresponding to a given percentage variation of speed. One great advantage of this arrangement is that the glass gauge tube need not be near the pump. The pressure can be transmitted any distance through a metal pipe, and several gauge glasses may be served off one pipe. He recommends this method for electric stations. It is quite possible to attach the hydraulic pump to the shaft of each dynamo and to have the pressure gauges, or indicating columns, side by side on the switchboard at any distance so that the attendant can see at a glance the exact speed of each machine. For the detection of inequality in the angular velocity of a wheel or shaft during each revolution, the stroboscopic disk method which has been described repeatedly in the Digest, is very delicate. A method of measuring the non-uniformity of angular velocity is to use an electrically driven tuning fork with a pencil fixed to its prong which describes a wavy line on a paper tape arranged in a groove of a disk revolving on the axle of the dynamo.—*Cassier's Mag.*, Nov.

Telegraphy, Telephony and Signals.

Marine Wireless Telegraphy.—A long editorial on the agreement between the Marconi Internat. Marine Communication Co. and Lloyd's, which places the Marconi system of wireless telegraphy upon a secure and enduring footing for mercantile marine signaling. According to the agreement, "Lloyd's will employ no other system of wireless telegraphy than that of the Marconi Co. for a period of 14 years. They will receive commercial messages at their signal stations from any vessel equipped with the Marconi apparatus, and will also send messages to any such vessel; but they will receive or transmit no wireless telegraph communication whatever where a vessel is equipped with apparatus not supplied by the Marconi Co." Presumably only at special and widely distant signal stations, apparatus for sending messages over 100 miles will be installed. Where signal stations are dotted along the coast at no greater distance than 20 miles apart, a transmitting power not exceeding 20 miles will be used, as otherwise there would be overlapping and confusion of signals.—Lond. *Elec.*, Oct. 25. (See Current News and Notes, this issue.)

Wireless Telegraphy.—An anonymous communication referring to the fact that according to the reports of the naval manœuvres, the one squadron was easily able to read the message transmitted by the vessels belonging to the enemy. To intercept messages sent in a special code, is useless. It would be much more practical to break up the signals sent by the enemy, so as to make them quite unintelligible. This could be done by means of the ordinary transmitter, with an automatic adjustable spark-gap capable of varying the wave-length two or three times a second, and an automatic key sending along, say, 150 signals per minute.—Lond. *Elec.*, Oct. 18.

Miscellaneous.

References.

British National Physical Laboratory.—Glazebrook.—An abstract of a Brit. Ass'n paper in which he gives an account of the progress being made by this institution. The building is described. Among the work first to be attacked will be that of the Alloys Research Committee, photo-micrographic examination of steel rails, determination of the elastic properties of alloys with the aid of a Buckton testing machine of special design. The engineering laboratory is to be opened before the end of this year.—Lond. *Eng'ing*, Oct. 4.

Glasgow Exhibition.—A continuation of the illustrated serial, describing the exhibits in the pavilion of the Brit. Westinghouse Elec. & Mfg. Co. A three-cylinder vertical gas engine of 125 horse-power drives a compound-wound standard railway generator, which supplies power to all the plant at work in the pavilion. There is a 325-kw motor-generator, a 50-kw synchronous converter, induction motors, and a complete tram car, equipped with the Newell electromagnetic brake.—Lond. *Elec. Rev.*, Oct. 18.

A continuation of the illustrated serial, giving descriptions of paper insulated cables, and underground junction boxes, etc., of the Brit. Ins. Wire Co., and some direct-current generating sets of other companies.—Lond. *Elec.*, Oct. 18.

Small Screw Gauge.—A report of a committee of the Brit. Ass'n on suggested modifications of the shape of the thread of the Brit. Ass'n screw gauge for the use of instrument makers.—Lond. *Elec.*, Oct. 18.

Electric Igniters.—Meyer.—A long paper, read before the German Miners' Ass'n on the prevention of failures of electric igniters for firing explosives for blasting purposes in mines.—*Glueckauf.*, Sept. 28.

New Books.

Elektromotoren fur Wechselstrom und Drehstrom. By Professor G. Roessler. Berlin: Julius Springer. 230 pages, 89 figures. Price, 7 marks.

The author of this work is professor of the Technical High School, of Berlin, and the book is based on lectures on alternating-current engineering and power transmission. At the same time it is a continuation of his earlier book on direct-current motors. Like the latter, the present book has been written for the use of the engineer who employs electric motors in his plant or workshop, and these will find in the book the general information he needs, the characteristic features of the different types of motors being described and explained in a simple, but strictly scientific manner.

The book deals with the general principles underlying the construction of alternating-current machinery, and gives the characteristic features of those single-phase and polyphase alternating-current motors which are of commercial importance. The contents of the book is even richer than is indicated by the title, for besides motors the generation of alternating and polyphase currents is also discussed. The book may thus be considered as an introduction to the subject of alternating-current engineering in general. The author has endeavored to use as little mathematics as possible, and whenever he gives formulas he explains their physical meaning very clearly. Graphical illustrations are often made use of.

The book is divided into nine chapters, which deal with the following subjects: General principles of the rotary field and of induction motors; the production of a rotary field by combination of several alternating fields; field windings of alternating-current motors and generators; measurement of alternating currents, e. m. f.'s and power; the polyphase induction motor; the single-phase induction motor; the synchronous motor; operation in parallel of single-phase and polyphase machines.

The book has evidently been prepared with gerat care and may be expected to fulfill the purpose for which it is intended. It may be recommended especially to those engineers who have studied the author's older book on direct-current motors and have found his method of treatment to their liking.

The Telephone System of the British Post Office. A Practical Handbook. By T. E. Herbert. New York: Whittaker & Co. Second Edition, revised and enlarged. 218 pages, 146 illustrations. Price, 3 shillings sixpence.

In England the toll and long-distance lines are owned by the government and are comprised under the collective name "trunk lines." The National Telephone Company owns the local exchanges with the exception of a few cities, where lately the municipalities have built or are building exchanges of their own, as at Tunbridge Wells and Glasgow. In London the government itself is making preparations to enter into competition with the National Telephone Company.

The lines connecting the government's lines with those of the National Telephone Company are called "junction lines."

The author in writing this book had in mind to provide the employees of the post office entrusted with the handling of the government trunk lines and the government's end of the junction lines, with a guide in their daily duties and at the same time to put a textbook in the hands of the novices entering the business. Before entering the subject proper the author gives an historical sketch of the development of telephonic apparatus and explains shortly the principles upon which their operation is based. Coming to the description of the working of the different systems in use, the tendency to keep up with the time can be noticed, though the status of English telephoning is not up to the standard of American practice. However, British practice is advancing, which circumstance the author impresses upon the mind of the reader by adding a chapter on recent advances in switchboard design in which the Western Electric Co.'s relay board is described. The Kellogg system is also mentioned, but only as to the four-division system as installed years ago in St. Louis, which is out of date now and has been changed to conform to more modern practice. In commenting on this system the author speaks of a 40,000-line multiple, adding, "were such a thing possible." Of this he may rest assured, for at the present time he can place an order in this country for a four-division board for as many as 90,000 lines, using automatic lamp signals, common battery for talking and all the features of the very latest relay system.

Though the book will be mostly of value to the English telephone man, there are many points that will repay any one interested in telephony to read it. The explanations of the various subjects are clear and precise, and it is made quite evident that European methods contain many features that are new to us and which deserve credit.

BOOKS RECEIVED.

ELEKTRISCHE KRAFTUBERTRAGUNG UND KRAFTVERTEILUNG. By C. Arldt, Chief Engineer Allgemeine Elektricitats-Gesellschaft. Berlin: Julius Springer. 387 pages, 257 illustrations. Price, 4 marks.

ELECTRICAL ENGINEERS' POCKET BOOK. A Handbook of Useful Data for Electricians and Electrical Engineers. By Horatio A. Foster, with the collaboration of eminent specialists. New York: D. Van Nostrand Company. 987 pages, illustrated. Price, $5.

THE INDICATOR HANDBOOK. A Practical Manual for Engineers. By Charles N. Pickworth. New York: D. Van Nostrand Company. 132 pages, 148 illustrations. Price, $1.50.

A HANDBOOK FOR THE ELECTRICAL LABORATORY AND TESTING ROOM. By J. A. Fleming, M. A., D. Sc., F. R. S., M. R. I. Vol. I. New York: D. Van Nostrand Company. 538 pages, illustrated. Price, $5.

COURS D'ELECTRICITE. By H. Pellat. Tome I. Paris: Gauthier-Villars. 329 pages, 145 illustrations. Price, 10 francs.

ELECTRICAL CATECHISM. An Introductory Treatise on Electricity and Its Uses. By George D. Shepardson, M. E. New York: American Electrician Company. 403 pages, 1516 illustrations. Price, $2.

LESSONS IN PRACTICAL ELECTRICITY. Principles, Experiments and Arithmetical Problems. An Elementary Text Book. By C. Walton Swoope. New York: D. Van Nostrand Company. 462 pages, 385 illustrations. Price, $2.

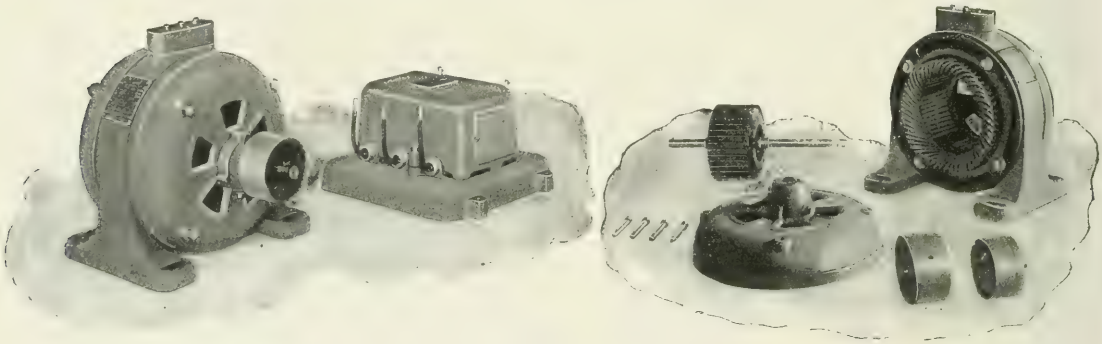
McKinley National Memorial.

Col. A. C. Bakewell, 479 Fifth Avenue, New York, announces to the electrical interests of New York State that he is authorized by the New York State organization to receive subscriptions for the McKinley National Memorial Association, and he appeals to them to assist him in raising funds necessary for the erection and maintenance, at Canton, Ohio, of a suitable memorial to our late beloved President. Checks should be made payable to the order of James G. Cannon, treasurer. No moneys should be paid to any one purporting to represent Colonel Bakewell, unless they are provided with satisfactory credentials from him.

Small Alternating-Current Single-Phase Motors.

There has long been a strong demand for a really satisfactory single-phase motor, as there are numerous uses to which such a motor could be applied. For lighting, with incidental power in small motors, single-phase alternating current offers a great advantage by its superior simplicity, so that even when a polyphase system is used, for small powers it is generally more convenient to use single-phase motors.

Single-phase alternating-current motors have suffered from the absence of starting torque, thus requiring complicated starting devices, either external appliances or a commutator, and also from the disadvantage of very low power factor. For example, on 125 cycles single-phase, an ordinary 1-hp motor, as a rule, even when doing no work whatever, consumes more than 1 horse-power in current. While this current represents only apparent energy its effect on lights operated on the same system is disastrous, and even very small single-phase motors when running, and still more when starting, pull down the lights operated on the same circuit to such an extent as to seriously interfere with their satisfactory operation.



FIGS. 1 AND 2.—SINGLE-PHASE CONDENSER MOTOR.

A single-phase condenser motor as built by the General Electric Company to obviate the above defects, is illustrated herewith. It has a complete three-phase winding, one phase of which is connected to the supply while another phase is shunted by a condenser. This arrangement produces an electrical and magnetic displacement of the phases corresponding to that which exists when the motor is operated on a three-phase circuit. By this means a self-starting motor is obtained which starts up under full load, and since the condenser is so proportioned as to supply the entire magnetizing current, the motor operates at a power factor of 100 per cent. Such a motor evidently possesses all the good characteristics of the standard three-phase motor, while it is superior thereto in power factor.

Since the output of a given condenser varies with the square of the voltage at which it is operated, it is found most economical in connection with motors wound for low voltages to employ a small transformer or compensator which steps up the voltage applied to the condenser, the latter being actually operated at 500 volts. The condenser and compensator are combined in one unit known as the "Condenser-Compensator," and permanently connected to the motor as shown in Figs. 1 and 3.

The motor is started in the same way and with the same ease as any polyphase induction motor. Fig. 1 shows a ½-hp, 125-cycle motor with its condenser-compensator, and Fig. 2 shows the various

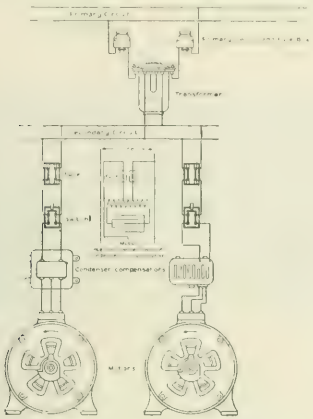


FIG. 3.—DIAGRAM OF CIRCUITS.

parts of the motor. The power factor, efficiency, current and speed curves of this motor are shown in Fig. 4.

One-quarter-hp and ½-hp single-phase motors are provided with centrifugal clutch pulleys, which enable the armatures to reach speed before the load is applied. This clutch consists of a split ring, which is expanded by means of a centrifugal weight so as to engage the inner surface of the pulley when the proper speed has been reached. The larger single-phase motors are provided with a starting switch and electrical connections, which limit the current at starting, and at the same time allow the motor to develop strong starting torque, in the same way as customary with polyphase motors.

The bearings are lubricated automatically and the reservoir requires only occasional examination to see that the oil is kept at the proper level. The motors may be adapted to wall or ceiling suspension by simply turning the bearings 90 degs. or 180 degs., in order to keep the oil parts in an upright position. The bearings may be turned without removing the armature. Slots are provided in the feet of the motor to provide for adjusting the belt.

These small single-phase motors are built for both 60 and 125 cycles and have found extensive application in connection with all classes

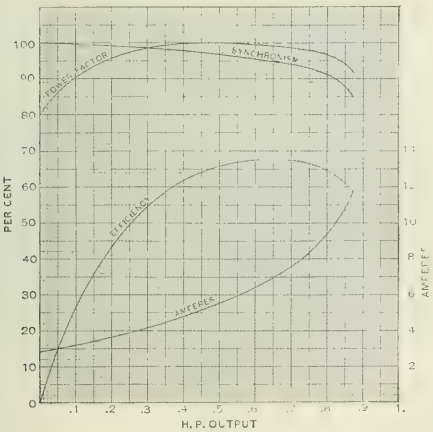


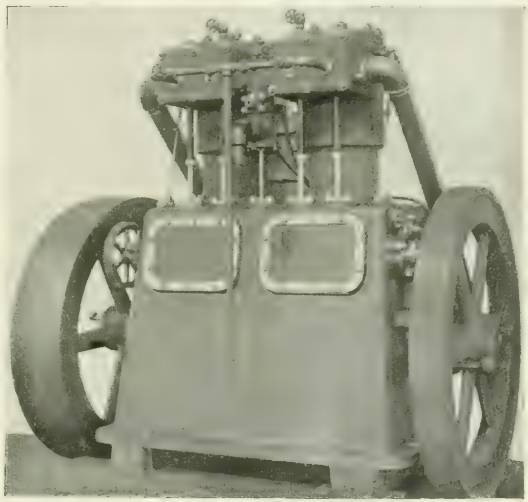
FIG. 4.—MOTOR CURVES.

of small machinery, such as printing, bookbinding and typesetting machinery, coffee grinders, dentists' drills, fans and blowers, refrigerators, window exhibits, sewing machines and other applications of the most varied character.

Maywood Gas Engine.

The gas engine shown herewith, made by the Maywood Foundry & Machine Company, Maywood, Ill., is of the vertical multiple cylinder type, with the crank shaft, cam shaft, rocker shaft, connecting rods and all main bearings and working parts enclosed in an oil-tight base and running in an oil bath which furnishes perfect lubrication to all parts, including cylinders and pistons. The cams, cam and rocker shafts, igniter cams and rods are all easily accessible by removing the two front doors on the engine. The two rear doors give easy access to the main bearings and connecting rods.

The pistons are heavy and substantial, and have five spring rings of superior material and design. The tops of the pistons are removable for adjustment of the wrist pin bearings without the necessity of taking out the pistons. The cylinders are very heavy, and have water jackets of ample size to secure proper circulation to keep them cool. The valve chests are water-jacketted, and so made that when the valve seats are worn they can be bored out and bushed. The valves are of the direct-acting poppet type. The igniters are operated by hardened steel cams on the cam shaft, and have points of platinum-iridium. The igniters can be removed for repair in a few moments in case of accident. Current for ignition is obtained from an Edison-Lalande battery and spark coil, or direct from the dynamo, and may



VERTICAL TYPE GAS ENGINE.

be connected up with both battery and dynamo by means of a double-throw switch, using the battery to start with and then switching to the dynamo as soon as in operation. This saves the battery and furnishes a ready means of knowing whether the igniters are working properly by the breaking of the circuit on the three or four incandescent lamps through which the current passes.

The gears which transmit power from the crank shaft to the main shaft are very heavy, and are cut from solid steel castings. A neat cover is placed over them to protect them from dust and dirt, and the possibility of anything falling into them.

The Maywood being a multiple cylinder engine and operated on the four-cycle principle with a throttling governor, takes a charge every revolution on the double cylinder, and a charge every two-thirds of a revolution on the three-cylinder engine. The amount of fuel admitted to the cylinders and the force of the impulse are exactly proportioned by the governor to the requirements of the load, thereby securing a great uniformity of speed and power. The governor is of the fly-ball type, and acts directly by means of a lever and rod on the mixing chamber valve, through which both the air and gas are admitted in definite and proper proportions to form a perfect explosive mixture. The motion of the lever and rod opens or closes this mixing valve as the load may require, and thus the exact amount of explosive mixture necessary to carry the load is at all times admitted to the cylinders, and so sensitive is this mechan-

ism that it instantly responds to the widest fluctuations of load in plants operating arc and incandescent lights, elevators, blowers, air compressors, wood-working machinery, machine tools, etc. Not only is great steadiness secured in this way, but the impulses being regularly given with every revolution and of much less intensity than in the "hit-and-miss" engine, there is avoided the severe shock and strain incident to the slowing down and sudden raising of speed. This greatly prolongs the life of the engine and minimizes repairs. The proportion of gas or gasoline to air is regulated by a valve on the outside of the mixing valve, and may be instantly changed and set anywhere so as to give from one portion of gas to eight of air to one portion of gas to twenty of air, as the quality of the gas being used may require. A dial, over which a pointer attached to the lever operating the gas valve moves, indicates the exact proportion.

Another feature in the governing of the Maywood engine is the ability to regulate the speed while running. This is done by turning a little thumb-screw on the governor rod, which increases or decreases the tension on the governor spring, and causes the governor to open a greater or less distance as desired. By this means the speed may be varied as much as 50 r. p. m. without affecting the steadiness of the power. This, in case of a temporary overload, becomes very valuable, as the power of the engine is considerably increased by speeding it up. This should only be done in case of necessity, as the higher speed increases the wear on the engine. All these engines will develop at normal speed at least 10 per cent more than their rated capacity in actual bread horse-power.

The Maywood engines are so built that either gas or gasoline may be used, and if desired are furnished with both gas and gasoline inlets, so that a change can be instantly made from one to the other while the engine is running, the only thing necessary to do being to shut off one valve and open the other. This feature is useful where the engine is being operated with gasoline in case anything goes wrong with the supply pipes or gasoline is unexpectedly exhausted.

Meeting of Automobile Manufacturers.

The National Association of Automobile Manufacturers held a meeting last week during the continuance of the automobile show, and gave a supper on Nov. 7 at the Hoffman House, at which General Nelson A. Miles was among the speakers. The association appears to be growing rapidly, and now has about 85 members.

During the meeting some of the manufacturers took occasion to state very plainly their disapproval of several leading members of the Automobile Club of America in importing French vehicles, and then taking such pains to boom them with speed runs. While the manufacturers did not deny the right of any American automobilist to use whatever machine he saw fit, they thought that too much prominence had been given to the achievements of the foreign makers. A resolution was offered that the members of the club should co-operate more with American manufacturers in encouraging the home makes, but this was afterward tabled. Aspersions were also cast upon the appraisal of several imported machines as being far below the actual cost, and it was decided to appoint a committee of three to lay the matter before Secretary Gage of the Treasury Department. One member said that he knew of an automobile that had recently been brought in which cost $15,000 abroad, and was valued at $5,000 when going through the Custom House.

Another member said that from January to September he knew of eleven machines which had entered from abroad and their total valuation had been placed at only $11,000, which he characterized as ridiculous. The committee to lay the facts before Secretary Gage will consist of a member from this city, one from Boston, and one from Philadelphia. Samuel T. Davis presided at the meeting, and the Executive Committee of the Manufacturers' Association was appointed to consist of Mr. Davis, D. E. Reinhart, C. E. Duryea, A. W. Packard and Charles Clifton.

The conduct of the Automobile Club in managing the show also came in for considerable criticism. It was claimed that the manufacturers would be the best judges of their own show, and a determination to take matters into their hands for show purposes was indicated when it was announced that the Manufacturers' Association had secured the Garden for the automobile show in 1903. The reason it could not begin proceedings next year was because the Automobile Club has already rented the Garden for the show in 1902. The manufacturers decided to give two shows a year, one in this city and the other in Chicago.

Electrical Illuminations in Australia.

We showed recently some of the electrical illuminations that were displayed in Canada during the visit of the Duke and Duchess of York and Cornwall. Two illustrations on this page give an idea of the effects of a like nature, for a like purpose, in Australia. The cuts are made from photographs sent by Messrs. Noyes Brothers, of

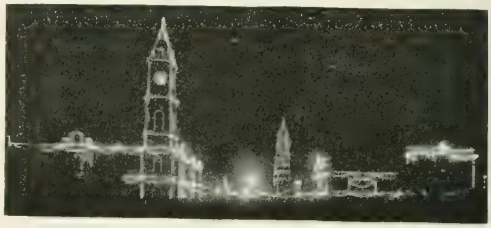


FIG. 1.—ELECTRICAL ILLUMINATIONS IN AUSTRALIA.

Sydney, showing illuminations in the city of Adelaide, South Australia. This work was carried out by the above firm under contract to the Government of South Australia. There were in all 11,000 lamps run from two stations. The entire work was carried out in 30 days, the machinery being shipped from Sydney. The work was entirely satisfactory, and ran without a hitch, eliciting the formal thanks of the Government of South Australia for the manner in

FIG. 2.—ELECTRICAL ILLUMINATIONS.

which the contract was carried through. The whole of the machinery comprising the generating plant, consisted of Westinghouse apparatus. One of the views shows the post office, town hall and treasury building at Adelaide, while the other represents the ducal arms upon the Parliament House.

New Telephone Exchange at Jackson, Mich.

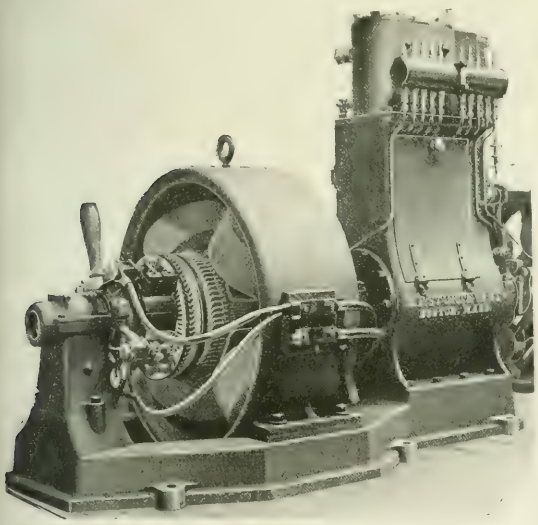
The People's Telephone Company, of Jackson, Mich., has been exhibiting some of the Kellogg apparatus it will use, and it has elicited much favorable comment. The board which the Kellogg Switchboard & Supply Company are building for the Jackson exchange is a 3000-line "Major" multiple board. It will have an equipment of 1640 lines. Included in this contract is a toll board with equipment of 30 lines, a chief operator's desk, 1400 wall telephone sets and 100 desk sets complete. The woodwork of this board is to be mahogany. The framework is heavy angle iron construction, which makes a very rigid structure and insures permanent alignment for the apparatus contained therein. The power plant will consist of two sets of 11 cells of Chloride storage battery each, to be charged by a Holtzer-Cabot direct-connected charging set, the generator side of which is a special telephone machine built for a range of from 20 to 30 volts. The primary side to run on a voltage to be 110 or 220 volts direct current. A second machine of this description is provided for reserve. For ringing a Holtzer-Cabot dynamotor will be provided, having a primary to run on 110 or 220 volts, and a secondary to give pulsating and alternating currents of 110 volts (at no load), and a

reserve machine of the same description, but with a primary of 24 volts. The power switchboard will be of marble, supported by an iron framework.

A New Direct-Connected Generating Set.

A recent type of Sturtevant engine, consisting of a 5 by 4 enclosed double upright engine, direct connected to a standard 12-kw, four-pole generator, is illustrated herewith. The engine is of the type originally designed for the severe work of forced-draft fan propulsion on the vessels of the United States Navy. The cylinders are placed side by side in the same casting. The cranks are set opposite, i. e., at an angle of 180 degs. Steam being admitted simultaneously to the top of one cylinder and the bottom of the other, the reciprocating parts are balanced in their movement and high speed is made possible. The cylinders are of large diameter as compared with the stroke, so that great power may be developed at high rotative but moderate piston speed, making the engine particularly suitable for direct connected dynamo driving. The steam admission to both cylinders is regulated by a single piston valve, under the control of a shaft governor of the same design as that used upon the single upright engines. All moving parts subject to friction are of steel and the bearings of ample size. Automatic relief valves are provided to prevent any danger of damage by water in the cylinder. Complete sight-feed oiling arrangements from a single oil tank connect with all of the bearings, and the frame is so constructed as to readily and entirely enclose all running parts, while still leaving them perfectly accessible by the mere opening of the door.

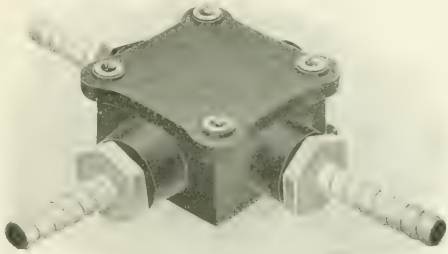
The magnet frame of the generator is of cast steel, and the shaping of the pole pieces and proportioning of magnetic field and armature is such as to insure sparkless operation under all changes of load. The temperature rise after a full-load run of ten hours is not in excess of 40 degs. C. The bearings, which are ring oiling, are built upon the ball-and-socket principle. The armature is of the barrel-wound type. The cast iron flange, bolted to the armature spider at each end of the core, forms a support as well as a cylindrical receptacle for the projecting ends of the coils. The flange extension also protects the windings from any oil that may be thrown from the bearings. The surface of the interior of the armature is perfectly smooth, offering no opportunity for the collection of oil or dust. Ventilation is effected by the use of specially constructed vanes, forming air ducts between the laminæ of the core. These convert the armature into a blower and create a strong draft through the windings. The commutator is supported upon cast-iron spiders, and the radiating surface of the commutator is thus very large, with the result that it runs exceptionally cool. Carbon brushes are used mounted in holders of the sliding socket type.



DIRECT-CONNECTED GENERATING SET.

Interior Marine Cable Box.

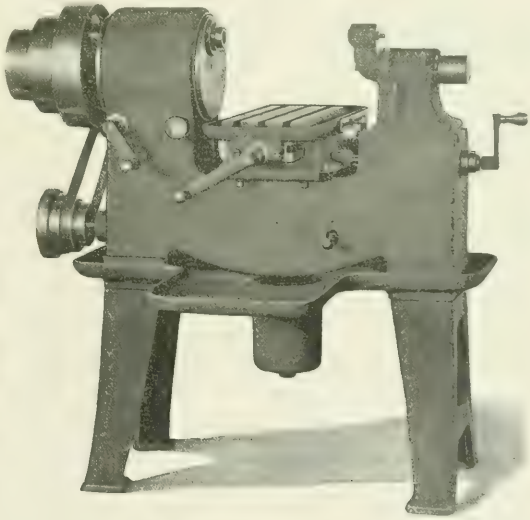
We show in the accompanying illustration a new marine box with stuffing box attachments for use with the Sprague Electric Company's flexible steel armored cables. It is designed for use in marine, submarine, and all other classes of work where the nature of the installation requires freedom from moisture. It is absolutely watertight.



MARINE CONDUIT BOX.

Grant Milling Machine.

The milling machine illustrated herewith has a working surface 7 inches by 19½ inches, the table being 10½ inches wide by 27 inches long. The table works in either direction, and has an automatic stop motion. Three changes of feed to each step of the cone are generally made, from .016 inch to .054 inch, and the greatest distance from the center of the spindle to the top of the table is 6⅞ inches, the least distance being ⅞ inch. The saddle has an adjustment giving a lateral movement of the table of 2½ inches, graduated to read .001 inch. The spindle runs in a phosphor bronze sleeve, which is easily adjusted for wear. The tail stock is adjustable longitudinally, as is also the arm supporting arbor, with means of securely fastening when in proper position. Both can be quickly removed for the various operations.



MILLING MACHINE.

The machine, which is manufactured by the Grant Tool Company, Franklin, Pa., is provided with a pan, as shown, to catch all the oil or lubricant used in milling, no matter in what position the table may be. The weight of the machine is 1050 lbs., and the floor space required is 4 ft. by 4 ft.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money, at the close of the week, was quoted at 3½ per cent. nominal; time money closed at 4½@5 per cent, with a liberal mixture of industrials. In the stock market renewed activity was stimulated by easy money, and the expected Northern Pacific deal, and there was a general advancing tendency in railway shares. United States Steel stocks shared in the general improvement, as likewise did traction stocks. Among the latter Metropolitan Street Railway heads the list with a net gain of 7⅞ points, followed by Brooklyn Rapid Transit with 4⅛ points. Metropolitan was actively dealt in, the sales of the week aggregating 90,775 shares, quotations ranging between 152½ and 164, the closing price being 162⅞. At the beginning of the week there was some pressure on the idea that the result of the election in the city would have an adverse influence on this stock. Brooklyn Rapid Transit closed at 67⅜, which figure was ½ below the highest quotation of the week, the minimum price being 62¾. General Electric was the exception in the electric list and was knocked down to a point 1⅞ lower than that at the close of the week previous. Quotations ranged between 256½ and 260, the closing price being the former figure. Western Union made a gain of ⅝ point, on sales of 3500 shares, the closing quotation being 92¼. One hundred and ten shares of American Telegraph & Cable were sold at 99. Following are the closing quotations of Tuesday, Nov. 12:

NEW YORK.

	Nov. 4.	Nov. 12.		Nov. 4.	Nov. 12.
American Tel. & Cable..	98	[illegible]	General Electric.........	256	259
American Dist. Tel.....	37	—	General Carriage........	[illegible]	[illegible]
Brooklyn Rapid Transit.	62[illegible]	68[illegible]	Hudson River Tel.......	114	110
Ches. & Pot. Telephone..	—	67½	Illinois Elec. Veh. Trans.	[illegible]	-
Commercial Cable.......	180	—	Metropolitan Street Ry..	154[illegible]	166¼
Electric Boat..........	[illegible]	18	N. E. Elec. Veh. Tran...	[illegible]	—
Electric Boat pfd........	45	40	N. Y. Elec. Veh. Tran...	[illegible]	[illegible]
Electric Lead Reduc'n...	2[illegible]	[illegible]	N. Y. & N. J. Tel......	[illegible]	[illegible]
Electric Vehicle.........	1[illegible]	[illegible]	Tel. & Tel. Co. of Am...	[illegible]	--
[illegible] Vehicle pfd.	[illegible]	[illegible]	Western Union Tel.....	91[illegible]	[illegible]

BOSTON.

	Nov. 4.	Nov. 12		Nov. 4.	Nov. 12.
Am. Tel. & Tel.	[illegible]	157	Mexican Telephone......		2[illegible]
Cumberland Telephone...	—	-	New England Telephone.	-	
Boston Electric Light....	—	—	Westinghouse Elec......		—
Erie Telephone..........	2[illegible]	22	Westinghouse Elec. pfd.	-	-
[illegible]	[illegible]	-			

PHILADELPHIA.

	Nov. 4.	Nov. 12.		Nov. 4.	Nov. 12.
[illegible]	30[illegible]	42	Phila. Traction	[illegible]	[illegible]
Electric Storage Battery.	65	55	Philadelphia Electric	[illegible]	5[illegible]
Elec. Storage Batt'y pfd.	75	55	Pa. Electric Vehicle	[illegible]	[illegible]
Elec. Co. of America....	6[illegible]	6[illegible]	Pa. Elec. Veh. pfd	[illegible]	1

CHICAGO.

	Nov. 4.	Nov. 12.		Nov. 4.	Nov. 12.
[illegible] Telephone	[illegible]	-	National Carbon pfd.....	84	82[illegible]
[illegible]	[illegible]	158	Northwest Elev. com....	39	40
[illegible] Ry.	[illegible]	195	Union Traction.........	13¾	12[illegible]
[illegible]	[illegible]	225	Union Traction pfd.....	53	5[illegible]
[illegible] Carbon	[illegible]	20[illegible]			

ANOTHER LIQUID AIR COMPANY.—The Consolidated Liquid Air Company, with principal offices in New York City, was incorporated last week with a capital of $1,000,000, divided into shares of the par value of $5 each. The company proposes to manufacture liquid air for refrigeration, power, light, navigation, medical application, the manufacture of steels and acids, and for other mechanical and scientific purposes. The company will also manufacture ships, locomotives, automobiles, stationary engines, elevators and other moving vehicles and plants to which liquid air may be applied. The company will operate in America and Europe. The directors are ex-United States Senators R. F. Pettigrew, of Sioux Falls, S. D., and Marion Butler, of Raleigh, N. C.; Charles E. Tripler, George W. Ballow, St. Charles B. Gwynn, and A. M. Miller, of New York City; J. Bouvier Patterson, of Philadelphia, and H. William Moeller, of Newark, N. J. The company is evidently intended to push the Tripler process.

POWER TRANSMISSION SCHEMES.—George J. Baldwin has bought for himself and associates control of the Chattahoochie Falls Company, which owns the Clapp's factory property, two miles above Columbus, Ga. They will develop the property, building one of the largest power plants in the country. It is expected that manufacturers will take advantage of the cheap power, and it is thought the deal will mean the investment in Columbus during the next two or three years of at least a million dollars. J. R. Williston & Co., Boston, Mass., issue a circular offering for sale $90,000 first mortgage 30-year 5 per cent gold bonds of the Lehigh Power Company, of Easton, Pa., at 103½ and accrued interest. The company is organized under the laws of Pennsylvania to utilize the water power of the Lehigh River between the cities of Easton and Raubsville. The bonds offered are the remainder of an issue of $240,000. A sinking fund of $5,000 per annum is provided for retirement. Bonds may be retired at 105 after 10 years from date.

BRITISH WESTINGHOUSE STOCK.—President George Westinghouse, in a circular to stockholders of the Westinghouse Electric & Manufacturing Company, says the British Westinghouse Electric & Manufacturing Company is shortly to issue £250,000 sterling of preferred shares to provide additional funds to be used in completion of the company's new buildings and the purchase of machinery. The stockholders of the Westinghouse Electric Company are given the opportunity to subscribe for the new stock on or before Nov. 25, accompanied by a check to the order of T. W. Siemon for $5 per share subscribed for. The net earnings of the British Company for the year amounted to £49,070 sterling. The authorized capital is £1,000,000 sterling 6 per cent preference shares, of which £750,000 sterling have been issued at par for cash and £750,000 sterling ordinary shares, all of which have been issued for patents and property. The company is quite Anglicized as to management, is now running well, and is doing a large and expanding business.

SALE OF FRISCO TROLLEYS.—Negotiations for sale of the Market Street Railway Company to a Baltimore syndicate are understood to have been closed by H. E. Huntington and I. W. Hellman, for the Market Street Company, and George R. Webb, of Baltimore; R. G. Hanford and Attorney-General T. L. Ford, of San Francisco, representing the Baltimore syndicate. The terms of the sale are not definitely known. If the syndicate takes all of the 186,170 shares at $95, which is believed to be the actual agreed price, they will have to pay $17,686,150. Mr. Webb, the representative of the syndicate, recently purchased the San Francisco & San Mateo electric line and the Sutter Street cable line. He is president of the United Railroad & Electric Company, of Baltimore.

TO BUY CHICAGO STREET RAILWAYS.—A Chicago daily newspaper states that $30,000,000 are to be offered, through the City Council, to the street railway companies of Chicago, for all tangible property owned by them in connection with the trunk lines for which franchises will expire in 1903. Buffalo capitalists are prepared to pay this sum if the City Council will grant them a franchise to operate on the trunk lines of the old companies and to place parallel tracks on all subsidiary and extension lines. The proposition of the Buffalo capitalists is new, because the city is to get all profits after allowing 10 per cent of the gross receipts to the proposed company, and providing a sinking fund of 4 per cent, so that the plant can be purchased by the city after 20 years.

NEW YORK TELEPHONE BONDS.—The Mercantile Trust Company, of New York, trustee under a certain mortgage dated May 24, 1888, and an agreement dated Nov. 1, 1888, both executed by the Metropolitan Telephone & Telegraph Company, which the New York Telephone Company has assumed and agreed to pay, invites proposals for the sale to it, on Jan. 1, 1902, of bonds secured by said mortgage at a price satisfactory to the New York Telephone Company, at a rate not exceeding par and 10 per centum premium, to such an amount as shall not exceed the sum of $23,420.16.

PACIFIC COMMERCIAL CABLE.—The Commercial Pacific Cable Company recently incorporated to operate a cable line between this country and the Philippine Islands, has filed with the New York Secretary of State a certificate of increase of capital from $100,000 to $3,000,000. The stockholders who consent to the increase are John W. Mackay, George G. Ward, Clarence H. Mackay, Edward C. Platt, Albert B. Chandler, Albert Beck and William W. Cook.

DIVIDENDS.—The Consolidated Traction, of Pittsburg, has declared a dividend of 3 per cent on preferred as registered Nov. 5. Pratt & Whitney Company have declared a dividend of 1½ per cent on the preferred, payable Nov. 15. Niles-Bement-Pond Company has declared a dividend of 1½ per cent on the preferred, payable Nov. 15. The National Carbon Company has declared a dividend of 1¾ per cent on its preferred stock, payable Nov. 13.

SHAWINIGAN POWER SECURITIES.—The securities of the Shawinigan Water & Power Company, of Shawinigan Falls in the province of Quebec, have recently been sought by American capitalists to a considerable extent. The bonds of this company, to the amount of $1,500,000 have recently been disposed of in New York at a very satisfactory figure.

EVERETT-MOORE MORTGAGES.—The Everett-Moore syndicate will abandon its $50,000,000 mortgage plan for Michigan lines, and will execute one for $26,000,000, taking care of prior liens. Four million dollars will be devoted to purchase of the Detroit, Ypsilanti, Ann Arbor & Jackson.

THE ATLANTIC COAST ELECTRIC RAILWAY, which runs from Pleasure Bay on the Shrewsbury down the Jersey coast to Belmar, has defaulted on the six months' interest due on Nov. 1 on its 5 per cent first mortgage bonds, which amount to $800,000. According to the company's statement for the year ending Dec. 31, 1900, the gross income from passengers was $188,956, and from other traffic $79,847, making a total of $268,803. All expenses were $152,327, leaving a net income of $113,475. The company has 23.58 miles of track.

Commercial Intelligence.

THE WEEK IN TRADE.—Among the good reports from the various sections of the country may be noted improvements in collections and increase in bank deposits in the smaller cities, especially those in the corn belt. Country merchants are reported in good financial condition, which is reflected in part by better supply and easier tone in money. On the whole, the trade situation presents many points of strength and few of weakness. Nearly all the industries were active, but special strength and activity prevailed in iron and steel. The consumption still seems to be running ahead of the production. The shortage of railroad cars continues to be an obstructive feature, seriously hampering trade movement. One effect of this shortage was the shutting down of twenty blast furnaces in the Pittsburg district, owing to the scarcity of coke. Railroad material was very active at Chicago, and at Pittsburg there was a heavy demand for Bessemer iron, sales of 15,000 tons being reported, with good premiums for prompt delivery. Activity prevails in structural material also, sales at Pittsburg having aggregated 12,000 tons for the week. The railroads are ordering new cars very liberally. Railway earnings for October confirm the best reports as to the large business offered. The indications point to an increase of fully 10 per cent over the earnings in October last year. "Manufacturers," *Bradstreet's* says, "are busy the country over, and running full time in nearly every instance." According to the same authority, there were 191 business failures last week, as compared with 172 the week previous, and 161 the corresponding week last year. There was better inquiry for copper from Europe, and some orders were placed in this country. Transactions here were few, however, and the ruling quotations remain unchanged. Lake is quoted at 16⅝@16¾c.; electrolytic in cakes, wire bars and ingots, 16¼c.; cathodes, 16c., and casting stock, 15¾@15⅞c.

HANDLING COPPER.—A draft of the proposed new copper rates of the New York Metal Exchange has been submitted to the members. It provides that the regular call, or calls, shall be in standard copper, but any other grade of copper may be called at the request of any member. Standard copper shall consist of either domestic or foreign, and shall be of 96 per cent fine copper or over. For each full 1 per cent above 96 per cent fine copper 1 per cent may be added to the amount of invoice when delivered. Copper testing below 96 per cent fine shall not constitute a good delivery, according to the new rules. The minimum fluctuation is to be .025 of a cent. We note also the following announcement in the Salt Lake, Utah, *Tribune:* Notice has just been served on local ore buyers by the management of the United Metals Selling Company, with general offices in New York, that in future customers, who are now forwarding their copper under contracts, will be required to accept settlement at the market price of copper 90 days after the consignment is billed out. In brief, the Metals Selling Company, which is now marketing the product for nearly all the producers of the country, does not propose that the man who ships his copper at intervals shall sidetrack the regular customer, and under the new rule the former is required to wait 90 days for his money—the settlement then to be on the ruling price of the metal in the open market. As practically the entire output of Utah copper is forwarded under contract, no embarrassment is apprehended under the rule.

METER TELEPHONY IN CHICAGO.—The president of the Illinois Telephone & Telegraph Company (independent) says: "We will give Chicago a new idea in telephone service within a year. The telephone user will pay for what he gets as he pays for gas and the maximum cost per year will be less than half present rates. We shall be ready to install 20,000 telephones in the downtown district by July 1, 1902. The gas company's meter system is the basis of our plan of dealing with the telephone user. We shall put in a telephone for anybody who wants it—and as many as he wants. He will sign no contract and pay no rental. He will make a deposit of, say, $5 to cover cost of the instrument, as he makes a deposit for his gas meter. Every time he uses the telephone the automatic meter will charge 5 cents against him. If he does not use it once in a year he will have nothing to pay. When the charges of 5 cents for each call amount to $85 within a year on a business telephone, additional calls will cost nothing. Fifty dollars a year will be, in the same way, the maximum charge on residence telephones. We can afford to make these rates because we shall use the Strowger automatic switchboard, which does away with the costly force of manual switchboard operators at 'central.'"

NEW POWER PLANT AT CHAUDIERE FALLS.—The machinery in the new power house of the Ottawa Electric Company at the Chaudiere Falls was set in motion on Oct. 24. The structure is a model one, and its equipment is the finest in North America for its size. It replaces the distributing centers destroyed in the great fire of April, 1900, and the temporary ones that have been used since. The machinery and equipment, which was installed by the Westinghouse Electric Company, consists of three large generators and a number of other smaller machines. The plant comprises three sets of turbines. Each set includes three turbine wheels of 39 inches diameter. There are also two sets, each containing two 15-inch diameter wheels. The larger wheels drive the main generators, three in number, which are direct connected. Provision is also made for the installation of additional machinery. The capacity of the present plant is 4000 horse-power. The plant in the steam station is to be overhauled and kept in reserve. The Stilwell-Bierce & Smith-Vaile Company did the concrete work on the new building.

NEW OTTAWA POWER PLANT.—Over 125 men are now employed on the site of the Consumers' Electric Company's new power house at the Chaudiere Falls in Ottawa. From present indications, the building will be completed and plant installed, ready for the development of electric power, in about nine months. The house will be built entirely of fireproof material. There will be two machines at first, each of 2000 horse-power, and two exciters, each 250 horse-power. When this plant is in operation, work will be carried forward at night. Only part of the total permanent plant is to be installed within the next year. It will consist of eight waterwheels, each of 500 horse-power capacity. They will be arranged in two units of four wheels each, and each unit will be attached to a 2000-hp dynamo. As the demand increases, the plant will be enlarged, and accommodation is being provided for 12 more wheels to be arranged in three units of four each and attached to three dynamos.

POWER ENTERPRISE IN WYOMING.—W. F. Cody and Nate Salisbury with other Eastern capitalists will expend $700,000 on a canal 45 miles long that will reclaim about 100,000 acres of land at Cody City, Wyo. The canal will be built from the Shoshone River, and a dam will be built of solid masonry across the river at the headgate. At this point a large power plant will be built which will supply Cody and the surrounding country with light and power. F. C. Kelsey has come on to New York to submit to the Eastern capitalists the surveys and estimates. He will have full charge of the work, with headquarters at Cheyenne, Wyo.

THE CLARK AUTOMOBILE TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., has just completed the installation of a handsome and novel intercommunicating telephone system in the Commercial National Bank of its home city. The installation is a 12-point Clark automatic system of the battery call type. The bank occupies exclusively a new building on Westminster Street, and this installation completes a model banking house equipment. "A turn of the dial and the pressing of a button" connects any desk in the establishment with any department of the business, from the president's office to the janitor's quarters.

THE ELECTRIC PORCELAIN COMPANY, manufacturer of high-grade vitreous porcelain for electrical and other work is located at East Liverpool, Ohio. Mr. William Erlanger is president; Harry W. Peach, secretary and treasurer; Samuel C. Dyke, superintendent. Its plant began operation on Nov. 4, making porcelain tube, which for the present is its main product. It is working at present with one kiln, but has already contracted for an additional one, which it is expected will be completed about the first of the year. As soon as this additional kiln is made it will manufacture cleats and rosettes and other porcelain insulators.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, made an export shipment of milling machines on Oct. 26 which was rather unique in the number of points of destination to which goods were sent. In this single shipment machines were included for the following foreign points: Manchester, Liverpool and London, England; Brussels, Berlin, Vienna, St. Petersburg, Paris and Japan. The above would seem to indicate that the foreign demand in some lines of machine tools is considerably alive.

THE ATHENS (GA.) ELECTRIC RAILWAY COMPANY has ordered from the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, two pair of 24-inch cylinder gate Victor turbines to operate under 45-ft. working head, and to be used in driving electric generators.

THE STANDARD TRACTION BRAKE COMPANY, of 120 Liberty Street, New York City, has recently received a large order for axle and motor-driven brake equipments for the Massachusetts Construction Company, 60 State Street, Boston, Mass.

ROBBINS & MYERS' EXPORT TRADE.—Mr. James A. Myers, president of the Robbins & Myers Company, of Springfield, Ohio, is now in Europe looking after the export business of this company. The company is a large exporter of fans, and has also been exporting a great many dynamos and motors. The foreign demand for its product is increasing so rapidly that it was found necessary for a representative to go abroad and close contracts for the coming season. This company has been engaged in the manufacture of dynamos and motors, and its well-known ceiling, desk and bracket fans since 1897. It confines itself to small units, the dynamos ranging in sizes from ¼ kilowatt to 10 kilowatts, and motors from 1-16 horse-power to 12½ horse-power, its entire electrical line being for direct-current circuits. Soon after starting the manufacture of fans it added its line of dynamos and motors. For three years it manufactured these goods on the third floor of its foundry machine shop, this floor having 3400 sq. ft. This business assumed such proportions that it was found necessary to seek larger quarters. It was then that it added a three-story brick building of 31,000 sq. ft. of floor space, used exclusively for the manufacture of fans and dynamos and motors. This factory is excellent in equipment for the manufacture of fans and motors, being provided with the latest tools and machinery obtainable, many of the special tools and winding machines having been constructed by experts in the employ of the company, these special tools and machines enabling the company to turn out its goods on an unusually economically basis. The plant has first-class railroad facilities and is one of the best lighted and heated factories in the world, the heating being effected by the hot air system. The first floor is used for machine room, tool room, engine room, plating room and offices, the second floor for the building of the fans and motors, and the third floor for storage and packing. This firm started in a small way 23 years ago in the gray iron foundry business. To-day it has one of the best equipped light gray iron jobbing foundries in Ohio, having a daily capacity of 35 tons. The foundries have 37,000 sq. ft. of molding floor space, and accommodate 130 molders. The four-story foundry machine shop used for repairs and setting up work has 13,600 sq. ft. of floor space. The cleaning rooms are equipped with friction rattlers and dust exhausters of the company's own make. The entire plant covers three acres of ground.

COPPER WIRE GOSSIP.—The Boston News Bureau is responsible for the following: A local manufacturer of copper wire says: "The distinction which is made by some finicky buyers of copper as between the Lake and the electrolytic article is imaginary rather than real. The American Telephone people, for instance, will only use Lake copper, but it has been demonstrated that under the recently improved methods of manufacture, electrolytic wire is the equal of Lake wire in conductivity and tensile strength. I do not see any indication in the trade of a lower price for copper. 'Charlie' Brooker, as the trade knows him, who is at the head of the Coe Brass Manufacturing Company, recently implored the United Metals Selling Company to deliver him a certain number of carloads of copper within a specified time, adding that if they did not, he would be obliged to shut down his plant. This demonstrates to what extent the actual consumers of copper have reduced their supplies, as the Coe Brass Company ordinarily carries a supply of copper of between 8,000,000 and 10,000,000 lbs. Amusing incidents come to the knowledge of the trade which seldom leak out in financial quarters; for instance, one of the largest wire manufacturers in Worcester recently booked a foreign contract for the delivery of copper wire extending over a period of several months. This contract was taken at an actual loss, based on a 17-cent market for copper. If, however, the unexpected should happen, and copper should drop to 12 cents, the Worcester concern stands to make a profit of between $40,000 and $50,000 and the possibility of this large profit was considered as worth a cost of several thousand dollars. I expect to see an improving demand for our copper from abroad, as their stocks on hand are at the lowest point for many years. The European manufacturer is obliged to get his electrical copper supplies from America, as the copper which is produced in Spain, Australia and South America is suitable for casting purposes only."

THE C & C ELECTRIC COMPANY, of Garwood, N. J., whose New York offices are at 143 Liberty Street, state that the New York demand for motors on the Edison circuits, especially in the clothing manufacturing districts, is particularly heavy. Last month's sales of the company are said to have exceeded those of any two months for the last two years. Among the contracts recently secured is one for two 25-kw direct-connected generator, six 7½-kw back-geared for two 25-kw direct-connected generators, six 7½-kw back-geared tended to operate the big gantry crane which is utilized for carrying the heavy guns from the railway to the United States Government proving grounds, a distance of 300 ft., at Sandy Hook. Other orders lately obtained comprise two 75-kw direct-connected generators, and one 50-kw machine for the Park Realty Hotel, which is to be constructed at Sixty-third Street and Madison Avenue. Six motors varying from 5 to 20 horse-power are to be installed for driving the ventilating apparatus at the new Christian Science Church, New York City. One 75-kw direct-connected generator and one 50-kw machine of the same description have been ordered for installation in the new Corn Building, 96 Wall Street.

THE BADT-GOLTZ ENGINEERING COMPANY, Monadnock Block, Chicago, announces that F. B. Badt has sold his interest in the company to William Goltz, and that the name of the company will be changed to the Goltz Engineering Company, which will be controlled by William Goltz. The following agencies will remain with the Goltz Enigneering Company; Zimdars & Hunt, Reuterdahl Electric Company; Charles J. Bogue; A. & W. Electric Sign Company; A. L. Ide & Sons (for Wisconsin); New Britain Machine Company. Mr. Badt will continue business under the name of F. B. Badt & Co., and will retain the following agencies: Weston Electrical Instrument Company; Ward Leonard Electric Company and Harold P. Brown. The offices of both will remain at 1504 Monadnock Block, Chicago.

J. G. WHITE & CO., of London and New York, were awarded recently, as noted, a contract for an electric road for the municipal authorities of Bournemouth, the beautiful South of England seaside resort. The contract amounted to about $500,000 for the overhead section and $300,000 for the conduit section. Mr. Connett, the engineer of the firm, who made a great success of his conduit work in Paris, will have charge of the contract. The firm have within the last few days, it is learned from their office in New York, been awarded another conduit contract by the London County Council for a municipal road at Tooting, representing about 16 miles of single track all told, and at a contract price of about $900,000.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., is building two 300-hp tandem compound engines direct connected to alternating generators, which will run in parallel, for the Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio. The Janesville Electric Company, Janesville, Wis., is installing a 135-hp engine, built by the Ball Engine Company, which is also furnishing an additional engine to the plant of the Baltimore Hotel, Kansas City, Mo. James S. Kirk & Co., Chicago, are adding to their electric plant, and the Ball Engine Company will furnish an 80-hp engine.

PUGET SOUND NAVY YARD.—Proposals will be received until Nov. 26, to furnish at the Navy Yard, Puget Sound, Wash., boiler, pump, condenser, generating sets, motors, machine tools, electrotyping outfit, ammeters, voltmeters, tachometers, photometers, testing set, gauges, indicators, instruments, tools, shafting and iron pipe. Blank proposals will be furnished upon application to the Navy Yard, Puget Sound, Wash., or to the Bureau. A. S. Kenny, paymaster general, United States Navy.

SWITCHBOARD CONTRACT.—The Home Telephone Company, of Jamestown, N. Y., has awarded a contract to the Stromberg-Carlson Company, of Chicago, for its new switchboard. The board will be of the most modern construction, with central energy electric lamp equipment. The first installation will be of 1100-drop capacity. The total capacity will ultimately reach 3900. The board is to be delivered by March 15, and ready for use by May 15.

TELEPHONY IN CHINA.—Oriental advices received by the steamer "Victoria" say that Baron Masahide, of Tokio, has obtained from Director Sheng, of the Chinese Railway, a concession for the erection of telephone lines which will connect the largest cities throughout China. The preliminary arrangements contemplate that China shall furnish the funds and the Japanese the experts and material.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has under construction several batteries for the United States Government, two of them being for Fort Washington, Md., and one for Fort Hunt at Sheridan Point, Va. These are to be operated in connection with the lighting and power stations now being erected at these points.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, has purchased two large building sites adjoining its present factory, and will shortly have plans prepared for a factory building, which will about double the present capacity. The demand for the A-B lamps is heavier than can be taken care of with present facilities.

MINING PLANT IN BELGIUM.—Note was made in our issue of Oct. 19 of the installing of a large electric mining plant at Charleroi, Belgium, for the supply of three mines. We are now informed by the Compagnie International D'Electricité, of Liege, Belgium, a large and well-known concern, that they are carrying out the work.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, are building a $50,000 erecting shop at their plant in Norwood. The steady growth of the business necessitates this and other extensions.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—It is stated that the Southern Bell Telephone Company will construct a long distance line from Huntsville to Chattanooga, Tenn.

O'FALLON, ILL.—Work has begun on the O'Fallon telephone system, for which a franchise was granted some time ago.

SPRINGFIELD, ILL.—The Central Union Telephone Company will place its wires underground in the business district in this city.

HARRISBURG, ILL.—The Harrisburg & Eddyville Telephone Company, capital stock $1,500, has been incorporated by J. H. Robertson, J. R. Baker and J. N. Hart.

PEKIN, ILL.—The Citizens' Telephone Company, of Pekin, Ill., is putting in an independent plant in Pekin in opposition to the Central Union, and has materially reduced the rates.

ALTON, ILL.—The Central Union Telephone Company has commenced installing long distance telephones in the private offices. The fight between the Kinloch and Bell companies is in progress. Rates have not been cut.

CHICAGO, ILL.—At the end of the month of October the Central Union Telephone Company had 91,276 exchange stations connected and 4,000 orders on hand. This is compared with 76,000 exchange stations in May last, when Mr. Sabin took the management of the company.

WENONA, ILL.—The Wenona Telephone Exchange, established and for some years operated by Mark Gants, has been sold to Frank Ames, of Rutland. The new owner will entirely overhaul the system and put in new cables. The sale also includes control of the exchange at Magnolia.

CHICAGO, ILL.—The Chicago Telephone Company wants an extension of its franchise for twenty years, dating from 1909, the date of its expiration. Officials of the corporation have already communicated their wishes to several members of the City Council, and it is expected that an ordinance for the extension will be soon introduced. The reason for the company's desire to secure the long extension eight years before the end of its grant is due to the fact that it wishes to issue several million dollars' worth of bonds and extend its service.

EVANSVILLE, IND.—The Evansville Home Telephone Company, capital stock $23,000, has been incorporated.

JEFFERSONVILLE, IND.—The Cumberland Telephone Company is preparing to erect a handsome exchange building in Jeffersonville.

INDIANAPOLIS, IND.—The Audobon Society of this city wants telephone, telegraph and trolley wires placed underground in all parts of the city.

SOUTH BEND, IND.—A franchise has been granted to the St. Joseph County Telephone Company. This is an independent company and is composed of Fort Wayne men.

CONNERSVILLE, IND.—The Connersville Telephone Company has increased its capital from $25,000 to $50,000. Modern improvements will be made and the lines extended.

TERRE HAUTE, IND.—The farmers of Riley Township are forming a mutual telephone company, and have asked the County Commissioners for a franchise over the county roads.

BLANCHARD, IA.—A Mutual Telephone Company has been formed here with a capital stock of $1,500.

OSKALOOSA, IA.—The Home Telephone Company is building a new line to the north and west of the city.

VILLISCA, IA.—The old telephone line between here and Milford has been reorganized and extensions built.

HARCOURT, IA.—The Farmers' telephone line, which has been much talked about for the past two months, will be built.

COMANCHE, I. T.—A telephone line is being built from Comanche to Lawton, and local exchanges established.

HODGEVILLE, KY.—The Cumberland Telephone Company is ready to begin work on a telephone line from Hodgeville to Lebanon via Athertonville and New Haven.

HAGERSTOWN, MD.—The Town Council of Sheperdstown has granted a franchise to the Chesapeake & Potomac Telephone Company to extend a line through that place from Sharpsburg, to cover the valley of Virginia.

BALTIMORE, MD.—The Peninsula Telephone & Telegraph Company has purchased or leased the pole line of the Tidewater Telephone Company from Yorktown to Newport News, and will string wires connecting with the independent companies on the Peninsula.

MOLINE, MICH.—The Citizens' Telephone Company of this city is preparing to establish an exchange at Moline, Ottawa County. The circuit between Moline and Grand Rapids is made by the way of Green Lake and the wires have been strung.

DODGE CENTER, MINN.—J. B. Springsted has secured a franchise and intends to establish a local telephone exchange.

CARLTON, MINN.—The Zenith Telephone Company is extending its lines. It will connect with Thomson and Wrenshall.

WINONA, MINN.—The Northwestern telephone exchange is making some extensive improvements in its long distance service.

HUTCHINSON, MINN.—The Hutchinson Telephone Company has commenced work on an extension to its lines to Brookfield, Renville County.

ST. PAUL, MINN.—The Minnesota Telephone Company, North Branch, has filed amended articles of incorporation with the Secretary of State, fixing the amount of its capital stock at $50,000.

GALT, MO.—The Galt Telephone Company increased its capital stock from $2,400 to $4,200.

SHELBINA, MO.—The Kirby Telephone Company is building a line from Kirby to Shelbina.

LIBERTY, MO.—The Kearney Telephone Company will extend its lines to Mosby in the near future.

PORTLAND, MO.—A new telephone line will be constructed in the near future from Steedman to Portland.

WILMINGTON, N. C.—The Interstate Telephone Company is erecting a line to Old Brunswick, twenty miles down the Cape Fear River.

REIDSVILLE, N. C.—Dr. L. L. Sapp. a representative of the Bell Company, has been refused a franchise in Reidsville. An official of the Bell Company, however, says that that company had no connection with the application.

ANDOVER, N. H.—The selectmen have granted a franchise to the New England Telephone Company to construct a telephone line through the town.

BASSETT, NEB.—The Bassett-Springview Telephone Company has completed a line between this place and Newport.

TRENTON, N. J.—The Interstate Independent Telegraph & Telephone Company, capital $3,000,000, has been incorporated by W. Monds Greene, Nelson R. Vanderhoof, and Charles N. King.

ALBANY, N. Y.—The Otsego County Telephone Toll Line Company has been incorporated; capital, $10,000. Directors: John Geer, L. Barker, and John A. Losee, Richfield Springs.

BELFAST, OHIO.—The telephone lines will soon be extended from Boston to Williams' Corner; thence to Newtonsville and Milford.

EAST LIVERPOOL, OHIO.—The Central District & Printing Telegraph Company has commenced laying an underground system in East Liverpool.

COLUMBUS, OHIO.—A telephone pole owned by the Columbus Citizens' Telephone Company caught fire the other day. The pole was burned, throwing 200 telephones out of service.

CANTON, OHIO.—The Central Union Telephone Company has been enjoined from stringing wires along the highway in Plain Township on account of alleged damage to shade trees along the road.

BOWLING GREEN, OHIO.—The Central Union Telephone Company is about to make important improvements at its Bowling Green exchange. New instruments are to be put in and everything brought up to date.

LANCASTER, OHIO.—The report of the Lancaster Telephone Company for the month of September shows: Gross earnings, $701.52; operating expenses, $351.03; net earnings, $350.49; fixed charges, $180.22; surplus, $170.27.

MASSILLON, OHIO.—The report of the Massillon Telephone Company for the month of September shows: Gross earnings, $1,255; operating expenses, $597.54; net earnings, $675.46; fixed charges, $221.80; surplus, $453.66.

COLUMBUS, OHIO.—The gross earnings of the Columbus Citizens' Telephone Company for the month of September were $13,642.80; operating expenses, $6,653.76; net earnings, $6,989.04; fixed charges, $2,916.19; surplus, $4,072.35.

YOUNGSTOWN, OHIO.—The statement for the month of September of the Youngstown Telephone Company shows gross earnings, $2,702.43; operating expenses, $1,443.16; net earnings, $1,259.27; fixed charges, $1,163.83; surplus, $93.44.

CLEVELAND, OHIO.—The United States Telephone Company handled the election returns from all parts of Ohio and points outside the State where there were close contests. The returns were announced from all exchanges touched by the long distance system.

CLEVELAND, OHIO.—The statement of the Cuyahoga Telephone Company for September shows: Gross earnings, $26,790.80; operating expenses, $15,358.73; net earnings, $11,432.07; ground rent and taxes, $1,608.34; interest on bonds, $8,750; surplus, $1,073.73.

MARYSVILLE, OHIO.—Fire in the exchange building of the Marysville Citizens' Telephone Company a few days ago, burned out nearly all of the cables and terminals. The system, including the long distance lines, will probably be out of service for ten days.

WILLIAMSPORT, OHIO.—The Williamsport Citizens' Telephone Company has opened its exchange with 25 subscribers connected. About 30 farmers' lines are to be connected at once, and it is expected that many more will come in soon. Several lines are being built.

SPRINGFIELD, OHIO.—Construction work on the system of the Springfield Home Telephone Company has been stopped by the city authorities, because the company neglected to carry out the terms of its franchise by submitting to the city engineers complete plans of the proposed system.

PORTSMOUTH, OHIO.—The Portsmouth Independent Telephone Company, is building lines to Marysville, Ky., which will give connection through the United States Company's Ohio line, with 37 exchanges in Kentucky. It is also building new lines to Harrisonville, Wallace Mills, South Webster, Rarden and other towns in the vicinity.

CLEVELAND, OHIO.—The September statement of the United States Telephone Company (long distance) follows: Gross earnings, $17,550.83; operating expenses, $9,637.67; net earnings, $7,913.16; interest on bonds, $6,750.00; taxes, $409.63; rent, $155.83; surplus, $597.70. The September statement of last year showed a deficit of $2,781.52.

FOSTORIA, OHIO.—The Fostoria Telephone Company paid a dividend of 5 per cent, on Nov. 5. The company is showing one of the best percentages of increase of any of the independent companies in Ohio. Over 100 telephones have been installed within the last thirty days and about forty contracts are on the waiting list. At present the company has 625 instruments connected. Four new toll lines are to be built at once.

CINCINNATI, OHIO.—The United States Court of Appeals has rendered a decision holding that the injunction granted the Cumberland Company in Louisville stopping the Home Telephone Company of the same city from operating its lines, alleging interference, was wrongly granted. The decision is of im-

portance to Louisville telephone interests. The two concerns named have been for some time fighting for the control of the telephone business of Louisville.

CLEVELAND, OHIO.—The Stark County Telephone Company, one of the most important properties of the Federal Telephone Company, is to be reorganized and bonds are to be issued covering the new exchanges at Canton, Alliance and Massillon. The Alliance exchange, with 300 subscribers connected up, has just been opened. The Canton exchange will be opened about [illegible]

CINCINNATI, OHIO.—A new order, taking effect on Nov. 1, reduces the price of messages from stations in Norwood from ten cents to five cents, the same price which prevails in the city. The telephone company is placing switchboards in Harrison, Delhi and Glendale, Ohio, and contemplates placing them also in College Hill, Loveland, Milford and other suburban villages and connecting with headquarters.

CLEVELAND, OHIO.—The report of the Federal Telephone Company during the month of October, for the properties outside of Cleveland and Columbus will show over 1200 contracts taken, aggregating about $33,000 of revenue. The Cuyahoga Company is securing on an average 22 contracts of all classes daily, representing a daily increase in revenue of about $500. The United States Telephone Company (long distance) is showing a strong gain in business each month. The gain for the month of October over that of September was 30 per cent.

MT. GILEAD, OHIO.—The Morrow County Telephone Company, of Mt. Gilead, is becoming recognized as one of the most successful companies in the Ohio independent field. It has been in operation about three years and has regularly earned more than 10 per cent, and has paid several stock dividends. At present the company has about 150 miles of toll lines and in the neighborhood of 800 subscribers. The Bell Company, which formerly controlled the situation, has been practically forced out of the field, having only a few toll lines at the present time. Charles Dumbaugh, formerly manager of the Bell exchange, is now manager of the independent company. A. A. Whitney is president; V. W. Peck, vice-president; H. V. McMillen, secretary; C. W. Schaff, treasurer.

GUTHRIE, OKLA.—A telephone company, which is expected to compete with the Missouri & Kansas Telephone Company in Oklahoma, Indian Territory and the new country has been organized by Kansas citizens. The company has headquarters in Wichita, where it has been granted a franchise in the name of Frank L. Brown.

RIDLEY PARK, PA.—Council has granted permission to the United Telegraph & Telephone Company to extend its system in the borough.

PITTSBURG, PA.—The Consolidated Telephone Company, of Pennsylvania, has consolidated the following independent lines: The Lackawanna Telephone Company, of Scranton; the People's Telephone Company, of Wilkesbarre; the Anthracite Telephone Company, of Hazleton; the Danielsville Telephone Company, of Danielsville, Pa.; Slate Belt Telephone Company, of Slatington, Pa.; Lehigh Telephone Company, of Allentown; Interstate Telephone & Telegraph Company, operating lines in Lackawanna, Luzerne, Carbon, Lehigh, Northampton, Montgomery, Berks and other counties in the State of Pennsylvania.

KIMBALL, S. D.—The Brule Telephone Company, with a capital stock of $50,000, has been incorporated by M. A. Willy, H. W. Heinrichs, H. S. Stuver, E. P. Ochsenreiter and C. S. Blodgett.

COLTON, S. D.—Articles of incorporation for the Colton Co-operative Telephone Company were filed. The incorporators are J. E. Colton, A. P. Amundson, Martin Larson, A. T. Austin, and others.

NASHVILLE, TENN.—The charter of the Tennessee Telephone & Telegraph Company was recorded. The capital stock is $10,000. Incorporators: Messrs. Sanford Duncan, Geo. J. Waddy, Charles H. Brandon, C. R. Handley and John Bell Keeble.

TAYLOR, TEX.—The Williamson County Telephone Company, capital stock $100,000, has been incorporated by James A. Brailly, H. M. Daugherty, W. H. Harper, Jr., J. E. Boynton and J. B. Ford.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will build an addition to the present building, to cost $40,000. A new switchboard will be erected at a cost of $75,000. The company will use about 75,000 pounds of copper next year.

SALT LAKE CITY, UTAH.—The Bell Telephone Company has laid out the new southern extension of its lines from Beaver to Adamsville, Minersville, Frisco, and thence to the Cactus and Imperial mines; and from thence will connect with the Ophir and Majestic properties. Baggs, in Routt County, Colo., has been connected with Rawlins. The Coeur d'Alene-Spokane line has been completed, doubling the local telephone facilities. A line will be built to St. Johns, west of Stockton, and the Grand Encampment, Wyo., exchange is now open for business. The Wabash, Little Bell, Hawkey-McHenery and Bonanza Flat mines at Park City have just put in telephones.

RICHMOND, VA.—The Southern Bell Telephone Company has filed its formal acceptance of the franchise recently granted by the city. The company also deposited with the city treasurer $10,000 in bonds as required by the ordinance, to guarantee the faithful performance by the company of the work of plant reconstruction and rehabilitation within the time and in the manner provided for in the ordinance.

McMECHEN, W. VA.—The National Telephone Company of Wheeling has been granted a franchise.

AMHERST, WIS.—The Almond and Blaine telephone line will undoubtedly be built to this place this fall.

ARCADIA, WIS.—It is announced that a new telephone exchange will be installed at Arcadia, by the Arcadia Independent Telephone Company.

MILWAUKEE, WIS.—Charles Webster, of Minneapolis, representing capitalists of Kansas City, Cedar Rapids, Iowa and Minneapolis, is in the city for the purpose of securing a telephone franchise, if possible, from the Common Council of Milwaukee.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Ontario Power Company has been incorporated, with Los Angeles as the principal place of business. Directors: R. M. Weed, I. N. Moore, E. A. Beck, E. R. Davis and L. D. C. Gray. Capital stock, $500,000; subscribed, $5,000.

BRAZIL, IND.—The City Council has awarded the city electric lighting contract to the Brazil Brewing Company for a period of ten years.

INDIANAPOLIS, IND.—A mortgage in favor of the Metropolitan Trust Company, of New York, against the Michigan City Electric Light Company for a large sum has been foreclosed and a sale decreed by order of the United States Court.

ST. LOUIS, MO.—The Beck Electric Company has transferred to Leopold Wallerstein, trustee for the Backus Water Motor Company and other creditors, its entire plant. The amount of the company's liabilities is $4,144.35.

ST. CHARLES, MO.—The St. Charles Light & Power Company, recently incorporated with a capital of $30,000, has closed a deal with Mr. D. Williams, whereby the incandescent electric light plant becomes its property. The new management will combine the lighting plant with a power plant for the St. Charles city car line and operate them jointly. The meter system will be adopted and a day and night service be given patrons.

SHELBY, OHIO.—There is a movement on foot among prominent citizens of Shelby to buy up the municipal lighting plant. The prospective buyers think there is money in the enterprise, despite the fact that the plant has been operated at a loss of $12,000 in the past few years.

OTTAWA, ONT.—The Consumers' Electric Company, of Ottawa, has been incorporated by Russell Blackburn, J. W. McRea, H. K. Egan, Hiram Robinson, Alex. Fraser, J. B. Fraser, W. C. Edwards, all of Ottawa. The proposed capital stock is $300,000.

TORONTO, ONT.—At a recent meeting of the Toronto City Council, it was decided to enter suit against the Toronto Electric Light Company and the Toronto Incandescent Light Company, and to ask for the cancellation of their contracts with the city, on the ground that the companies have violated their agreements with the city by amalgamating.

PORTLAND, ORE.—The Southern Pacific Railway Company is preparing to install electric motors for operating the machinery in its car and machine shops in this city.

LITTLESTOWN, PA.—The Electric Light, Heat & Power Company's plant at Littlestown has been sold at Sheriff's sale to Kate Reilly for $151, subject to a $5,000 mortgage.

JOHNSTOWN, PA.—The Johnstown Light, Heat & Power Company, Johnstown, capital $1,000, has been incorporated by J. G. Ellis, John H. Watters, Scott Dibert, Charles F. Kress, James Quinn, Joseph Friedhoff, Fred. W. Stammler, Johnstown.

QUEBEC, QUE.—It is the intention of the Jacques Cartier Power Company, of Quebec, to at once install an auxiliary steam plant in a building to be erected in Quebec city.

MONTREAL, QUE.—The new dam at the Chambly Power Works, which furnishes electric energy for the Montreal Light, Heat & Power Company, is being put into place and will be completed in a few days. The company is having the necessary machinery installed to utilize this additional water power for the generation of electric energy, and will be ready for operation in February next. This new plant will give the Chambly works an additional 15,000 electric horse power.

WALHALLA, S. C.—The Blue Ridge Water Company has been commissioned, proposing to furnish water and lights to the town. Capital, $20,000. J. W. Shelor, R. T. Jaynes and others are interested.

KNOXVILLE, TENN.—The Knoxville Electric Light & Power Company is completing improvements representing about $100,000. The power plant is being duplicated.

WICHITA FALLS, TEX.—The electric light plant here has changed hands, E. A. Clousnitzer having sold the same to W. L. Berger, of Genessee, Ill., for $8,500.

DALLAS, TEX.—The Rosebud Light & Power Company, of Rosebud, Falls County, has been incorporated; capital stock, $10,000. Incorporators, M. M. Kemp, T. S. Henderson, J. K. Freeman and John W. Thomas.

SALT LAKE CITY, UTAH.—The Norris Light & Power Company, of Norris, Mont., will construct a large power plant on the Madison River, which will furnish 30,000 horse-power. The cost will be $3,000,000. The power will be transmitted to Butte, Mont.

SALT LAKE CITY, UTAH.—R. S. Campbell, manager of the Utah Light & Power Company, has just returned from the East, and states that $350,000 has been raised to build a dam in Webber County which will impound 75,000,000 gallons of water. Work will commence in the early spring.

SEATTLE, WASH.—In accordance with the requirements of the new city charter an ordinance has been introduced in the City Council of Seattle, providing for the construction of a municipal electric lighting and power plant, should the same be ratified by a vote of the citizens. The City Engineer is requested to prepare plans and estimates.

LA CROSSE, WIS.—The Central Electric Company, of La Crosse, has been incorporated, with a capital stock of $25,000. The new incorporation is an association of La Crosse business men, and in the event of securing a franchise from the city Council will engage in the manufacture of electricity for city lighting purposes.

CHEYENNE, WYO.—It is reported that it is intended to consolidate all of the big paying mines in the Southern Carbon County country and connect them with the smelter at Grand Encampment by an electric railway system. The deal has been pending for some time. It is estimated that it will cost $3,000,000 to construct the trolley system.

THE ELECTRIC RAILWAY.

PENDLETON, IND. A traction company, headed by F. U. Hardy and C. S. Hernley, has been organized here and will be incorporated at once. The company will build an electric line from this place to New Castle.

INDIANAPOLIS, IND. By agreement a mortgage was foreclosed in the Federal Court here against Lake Cities Electric Railway Company, of Michigan City, Ind. The suit was instituted by the Metropolitan Trust Company, of New York, and the amount involved is $91,988.

SOUTH BEND, IND.—John Ferrick, who had a $1,000 claim against the South Bend & Elkhart Electric Railway Company blocked the whole system for half a day by levying on one of the company's cars and chaining it to the track The company got out an injunction against him and opened up the line.

ANDERSON, IND.—The Big Four Railway Company has taken off the last of its extra trains and given up the fight with the Union Traction Company. The managers admit that some other and more economical method must be adopted to compete with parallel interurban lines, and it is thought the third rail system will be tried soon.

PORTLAND, IND.—The proposed Fort Wayne, Dayton & Cincinnati Traction line will run through Butler, Hamilton, Darke and Mercer counties, in Ohio, and Allen, Jay and Randolph counties, in Indiana, covering in all 320 miles. It will require $7,000,000 to finance it. It is said that there are at least three different Eastern parties anxious to take all the bonds.

DETROIT, MICH.—J. D. Hawks and S. F. Angus, who already own the Detroit, Ypsilanti & Ann Arbor Electric Railway, and are now extending the same to Jackson, have purchased the Lansing Street Railway system. The price is said to be in the neighborhood of $200,000. It is the intention of the company to extend the line from Jackson to Lansing in the near future.

ST. CHARLES, MO.—J. D. Houseman, manager of the St. Louis, St. Charles & Western Railway Company, has purchased the incandescent electric light plant of this city from A. D. Williams, and will operate it in connection with the power house of the electric railway in this city.

ST. LOUIS, MO.—Articles of incorporation have been filed for the Carbondale & Murphysboro Electric Railway Company. The company is capitalized at $50,000. The directors are: William Jans, St. Louis; Thomas M. Logan and Charles L. Ritter, Murphysboro; E. F. Harper, Judge D. M. Browning and Hon. William S. Forman, East St. Louis.

DESHLER, OHIO.—The Toledo & Lima Traction Company has secured a twenty-five year franchise in Deshler.

MARIETTA, OHIO.—The Washington County Traction Company, of Marietta, has been incorporated; capital stock, $250,000.

CLEVELAND, OHIO.—The Everett-Moore syndicate will establish an office in New York in order to be in closer touch with that financial center.

CLEVELAND, OHIO.—On Nov. 4 the Pomeroy-Mandelbaum syndicate secured the final transfer of the property of the Ohio Central Traction Company.

CLEVELAND, OHIO.—The statement of the Cleveland, Elyria & Western Railway for the month of October and for ten months of the year shows $10,124.30 net earnings for October, and $95,329.88 net earnings for the 10 months.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company on Nov. 5 filed a trust mortgage for $6,000,000 covering the properties of the four lines recently purchased by it. The mortgage was given to the Western Reserve Trust Company.

SPRINGFIELD, OHIO.—There is an opening here for another electric railway line in a good territory in this vicinity not yet covered. Mr. E. S. Kelly, president of the Home Lighting, Power & Heating Company, can probably give some information on this subject.

MANSFIELD, OHIO.—The officials of the Mansfield, Savannah & Wellington Railway Company have just forwarded to the North American Trust Company of New York City, an issue of $1,500,000 in bonds on the property of the road which is now under construction from Mansfield to Wellington.

COLUMBUS, OHIO.—It is now stated that when the Everett-Moore syndicate, of Cleveland, secured the Canton & Akron electric line by purchase from Boston bankers, they made the connecting link which gives them control of an electric system from Cleveland to Cincinnati by way of Columbus, about 235 miles in length.

CLEVELAND, OHIO.—The Cleveland Traction Company was incorporated at Columbus Nov. 4, with temporary capital stock of $1,000, by Frank Dehass Robinson, M. S. Robinson, L. A. Russell, Frank F. Gentsch, and F. Burton Gott, for the purpose of constructing, acquiring and operating electric railways in Cleveland. This is the long talked about company fathered by Mr. Robinson.

TOLEDO, OHIO.—The Toledo & Indiana Railway, which is promoted by the Detwiler-Griffin syndicate of Toledo, has closed contracts with the American Bridge Company for the construction of six steel bridges between Toledo and Delta. Large forces of graders are at work along the line between Toledo and Swanton, and it is the intention of the company to complete this division of the road before winter sets in.

CLEVELAND, OHIO.—The Windsor (Ont.) Street Railway Company and the Windsor, Sandwich & Amherstburg Railway have formally been turned over to the Everett-Moore syndicate. When the road was purchased on Sept. 1, there was posted a forfeit of $21,000 with an agreement that the balance of $369,000 be paid on or before Oct. 31, and this was paid Oct. 29. Since securing control the syndicate has spent $12,000 in improvements and much more is to be done. The Sandwich line is to be extended to Amherstburg and the Windsor lines are to be double tracked.

OTTAWA, ONT.—Contracts are about to be let for the enlargement and improvement of the power-house of the Niagara, St. Catharines & Toronto Railway Company at Merritton, Ont.

PHILADELPHIA, PA.—A charter has been granted to the Huntingdon Valley Street Railway Company, headed by I. A. Sweigard, which purposes building a line five miles long in Montgomery County.

CONNELLSVILLE, PA.—The Pittsburg, McKeesport & Connellsville Railway Company has purchased a tract of five acres in New Haven, and will there locate the power plant that will supply most of the power for the new trolley system that is to cross the coke region. The plant will cost $500,000.

PITTSBURG, PA.—It may now be accepted for a fact that the gigantic trolley deal that has been pending here for some time, and by which the Philadelphia Company of this city, will absorb all the other traction properties of Pittsburg and Allegheny City, is practically consummated. The stockholders representing $20,000,000 out of the total capitalization of $27,000,000, have voted affirmatively on the proposition and a general meeting has been called for December 4, 1901, when this action will be finally ratified. This combination will take in the Consolidated Traction Company, the United Traction Company, the Monongahela Traction Company, and the Southern Traction Company.

HOUSTON, TEX.—The Houston Electric Company, of Houston, has been incorporated to build an electric railway; capital stock, $2,075,000. Incorporators: G. C. Baldwin, C. H. Tyler and T. W. House.

PIEDMONT, W. VA.—Stockholders of the Piedmont & Keyser Electric Railway Company elected the following directors: Thomas W. Goeke, Howard S. Richardson, John Mackie, Howard B. Carroll, H. Clay Shaw and Wilson M. Foulk, of Piedmont; J. H. Markwood and William MacDonald, of Keyser, and Dr. H. M. Kemp, of Bloomington. The directors elected Prof. Wilson M. Foulk president, Thomas W. Goeke secretary, and John Mackie treasurer. It is the intention of the company to build at once an electric line from West Virginia Junction through Luke and Piedmont to Keyser.

KENOSHA, WIS.—The Common Council has granted B. J. Arnold a franchise to build an electric line on West Main Street. This completes the link missing to perfect the Chicago-Milwaukee line.

NEW INDUSTRIAL COMPANIES.

THE BUCKEYE ARC LAMP MANUFACTURING COMPANY, of Columbus, Ohio, has been incorporated in the State of Delaware, with a capital of $15,000.

THE AMERICAN TELEPHONE MUTUAL FIRE ASSOCIATION has been organized at Toledo, Ohio to insure telephone property against loss from fire, lightning, cyclones, windstorms, etc.

THE INTERNATIONAL TROLLEY CONTROLLER COMPANY, of Syracuse, N. Y., has been incorporated, with a capital of $3,000. Directors: J. P. Devine, W. S. Farmer and H. S. Fulmer, Syracuse, N. Y.

THE ELECTRIC-MAGNETIC BRAKE COMPANY, of Pittsburg, will apply for a charter of incorporation. The incorporators will be H. H. Westinghouse, W. W. Card, E. M. Kerr and John Caldwell, all of the Westinghouse interests.

THE NATIONAL TROLLEY HARP COMPANY will organize at Pittsfield, Mass., by Geo. H. Russell, of that city, R. A. Manoch and others, with a capital of $10,000, for the manufacture of a trolley harp, invented by Henry C. Heno.

THE STANDARD ROTARY MOTOR COMPANY has been incorporated, with headquarters in Jersey City, N. J. Capital, $1,000,000. Incorporators: William C. Roberts, John N. McLean, Mark J. Strauss and Benjamin Tuska.

THE MAGNETIC SEPARATING COMPANY, Joplin, Mo., has been incorporated with a capital stock of $100,000 for the purpose of placing on the market the Cleveland-Knowles magnetic separator. W. P. Cleveland is manager.

AMPERE ELECTRIC MANUFACTURING COMPANY.—Messrs. R. E. Pringle, F. H. Leonard, E. E. Cary and others, of Montreal, have been incorporated as the Ampere Electric Manufacturing Company, to manufacture electric apparatus and to engage in the development of electric power.

THE STIRLING COMPANY, organized to manufacture water tube boilers, has been incorporated in Jersey City. The capital stock is $1,875,000. The incorporators are Augustus S. Meeker, Clifford W. Perkins and Kenneth K. McLaren, all of Jersey City, the registered office of the company.

THE TAFT-PIERCE MANUFACTURING COMPANY, of New York City, has been incorporated with a capital stock of $300,000, to manufacture machines. The directors are G. J. Pierce, Woonsocket, R. I.; H. B. Thayer, A. L. Salt, S. G. Metcalf, D. A. Carpenter, H. C. Jordan and W. W. Shaw, of New York.

THE CANADIAN ELECTROLYTIC COMPANY, with a proposed capital of $300,000, is seeking incorporation from the Dominion Government. The chief place of business is to be in Montreal. The promoters are Messrs. Harry Bates, Henry Melville, Swift Holbrooke, Josiah Quincy and William Poole, all of Boston, Mass.; William Mitchell, John McLean and Beaumont Shepherd are the Canadian incorporators.

THE AMERICAN DISTRICT TELEGRAPH COMPANY has filed articles of incorporation in Jersey City. The capital stock is $1,000,000. The incorporators are Herbert D. Bennett and Gansey R. Johnston, both of Chicago, and Kenneth K. McLaren, of Jersey City. The certificate declares that the company will operate lines of telegraph for private use and do a signal, police, fire alarm and messenger service business.

THE UNITED STATES ALUMINUM COMPANY and the Aluminum Cooking Utensil Company have been incorporated by interests of the Pittsburg Reduction Company. The companies are to operate in connection with the works at Niagara Falls and New Kensington. Various aluminum specialties are to be produced. The first company has named as its capital $25,000, the other $10,000. The incorporators are R. B. Mellon, A. K. Lawrie and Arthur V. Davis, of Pittsburg; R. E. Withers, Jr., Parnassus, and C. M. Hall, of Niagara Falls.

THE ELECTROGRAPH COMPANY OF AMERICA, capital $1,000,000, has been incorporated in Delaware to manufacture and sell appliances and instruments for the transmission by electricity of fac-similes of writings, pictures, drawings, maps, and other designs. Its main office will be at Cleveland, Ohio.

The directors are W. E. Bemis, New York; E. H. Bourne, Cleveland; John F. Taylor, Chicago; F. B. Squire, Cleveland; Charles R. Huntley, Buffalo; Frank Martin, New York; Addison C. Thomas, Chicago; H. R. Palmer, Cleveland; C. M. Palmer, New York; W. H. K. Rose, Cleveland; Irving W. Durfee, Detroit.

LEGAL.

A CELEBRATED RAILWAY CASE CLOSED.—The famous case of Mr. John N. Stewart, who built a street railway at Ashtabula, Ohio, which was afterwards destroyed by the town authorities on account of alleged violation of the franchise provisions, has been closed in the United States Supreme Court. He brought suit for $150,000 damages and lost the case, which was appealed to the higher courts, with the same result. He finally got the matter before the Supreme Court on a petition for a rehearing. The Supreme Court affirmed the decision of the United States Circuit Court of Appeals.

OBITUARY.

The Late James W. Godfrey

MR. J. W. GODFREY.—It is with deep regret that we record the sudden death of Mr. James W. Godfrey, manager of the sales department of the India Rubber & Gutta Percha Insulating Company of New York. He was mortally wounded in St. Nicholas Avenue on Saturday, Nov. 9, while driving his Speedway trotter, Fake. He died that evening in the J. Hood Wright Hospital, without having regained consciousness. Accompanied by his friend, George Morgan, a broker, Mr. Godfrey drove up the Speedway and on through Inwood and Kingsbridge. Returning, Fake trotted along briskly and in good form during the homeward drive, and all went well until they reached St. Nicholas Avenue and 153d Street. The avenue is poorly lighted, and at that point the city has been repairing the roadway. Some distance from the curb, a pile of gravel was heaped up in the street, and, it is alleged, no lantern had been placed above it to warn drivers of danger. In approaching the 153d Street crossing Mr. Godfrey, who was driving, guided his horse to one side of the avenue to pass a heavy wagon, which was directly in his path. As he did so his light, two-seated runabout struck the mound of gravel and was overturned, throwing both its occupants out heavily upon the roadway. Mr. Godfrey struck violently upon his head. Mr. Morgan, who received only slight scalp wounds, jumped to the assistance of his friend, but found him unconscious from a deep wound in the head. An ambulance call brought Dr. Hanscomb from the J. Hood Wright Hospital and Mr. Godfrey was taken to that institution a few minutes after the accident occurred. He sank, and died at eight o'clock. His wife, his daughter Pearl and a married daughter, Mrs. Archibald, were with him at the time. He had sustained a fractured skull and internal injuries. A sad feature of the affair was that the members of his family were waiting for him at home to join a theatre party, for which he had the tickets in his pocket. Mr. Godfrey was born in New York Sept. 15, 1855, and after graduating from college began a very active and successful business career. For some time he was interested in the manufacture and sale of fire arms, and to the last he was a fine judge of weapons as well as a keen sportsman. With the growth of the electrical industries came the demand for insulated wire, and he threw himself into that new branch of trade with characteristic enthusiasm. He was connected for many years with the New York Insulated Wire Company, and then formed the association with Dr. W. M. Habirshaw, which lasted until his untimely death. No representative of the industry was better known throughout the country, and it is within the bounds of propriety to say that Mr. Godfrey had a strong professional pride in all matters pertaining to the art and his position in it. He was an active participant in all the electric light conventions, aided the various electrical exhibitions with his personal and financial support, and was a member of the New York Electrical Society. He was secretary of the Dale Company, manufacturers of electric light supplies, and took an active part in building up electrical export trade, especially with the Far East. He was also a leading member of the Electrical Contractors' Association of New York. In addition to his prominent share in Masonic affairs, Mr. Godfrey was a member of the New York Athletic Club and of several of the riding and driving clubs of the city, his love of horses amounting to a passion. He leaves a widow and two daughters, one of whom is married. His nephew, Mr. Rowland Simes, son of the auditor of the *New York Herald*, has been in the electrical field for some years and has of late been associated with him in the Dale Company. The funeral exercises took place on Tuesday, and the interment was private. The Episcopal funeral services at Mr. Godfrey's apartments on upper Seventh Avenue were largely attended, and many beautiful floral mementoes testified to the universal esteem. A Masonic service was also conducted by Rome Lodge, to which Mr. Godfrey belonged. This sudden death of so amiable and popular a man has thrown quite a gloom over the electrical trade in New York during the past week.

MR. HENRY HART.—Henry Hart, former president of the Third Avenue Railway Company, of New York City, died last week. He was ninety years old and a native of this city. For a few years he was engaged in the pawnbrokerage business, and in 1853 he established the Third Avenue Railway, in conjunction with M. Van Schaick, Philip Reynolds, Horace M. Dewey and several members of the Remsen family. The road grew and its owners prospered greatly. When Albert J. Elias became president of the company Mr. Hart was in his eighty-first year. At this advanced age he was unable to assist actively in the management of the railway, and was made vice-president. In the last six years, especially, Mr. Hart, realizing that he was growing old, and having implicit confidence and trust in the then existing management of the road, deferred largely to their counsel and direction. The troubles of the Third Avenue Road were the result of old-fashioned management, but they were not precipitated until the re-equipment of the road was undertaken. The situation of the road became very grave, and its stock, which had sold as high as 242 in the spring of 1899, tumbled until it reached 47. On the last and swiftest part of the decline the Metropolitan Street Railway syndicate suddenly appeared in control, and the announcement of a receivership was followed by a rise in the price of the stock. The Metropolitan proceeded to the reorganization and lease of the line.

PERSONAL.

MR. CUTHBERT HALL, representing the Marconi system, has arrived from England and has been staying at the Waldorf.

PROF. SYDNEY SHORT, who has been on a western trip, has returned to New York and is staying at the Waldorf until he is ready to sail for England.

MR. LUTHER STIERINGER was a recent visitor to Chicago en route to St. Louis on business connected with the illumination of the Louisiana Purchase Exposition.

MR. S. L. COLES has an excellent illustrated article in *Collier's Weekly* on the work Mr. G. F. Porter has been doing in the effort to lay and operate an Alaskan cable.

PROF. A. S. LANGSDORF, of the electrical engineering department at Washington University, St. Louis, Mo., addressed the Engineers' Club Nov. 6 upon "Iron in Alternating Circuits."

MR. GEORGE H. WALBRIDGE, member of the electrical engineering firm of J. G. White & Company, has recently returned from Puerto Rico, which island he visited on business, the concern having built an electric road there.

PROF. ELIHU THOMSON.—The November Journal of the Franklin Institute prints the report of its committee awarding the John Scott medal and premium to Prof. Elihu Thomson for his constant current alternating arc light transformer.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, of Norwood, Ohio, was in New York last week, and with Mrs. Bullock was quite an interested visitor at the Madison Square show of the Automobile Club of America.

MR. GEORGE FOSTER PEABODY, of New York, who is well known in electrical circles, has paid $14,000 for the Baldwin property, an old Southern mansion in Montgomery, Ala., and will spend $2,000 in adapting it to the Young Men's Christian Association purposes, and give it free to the Association for three years.

MR. L. J. HIRT, formerly assistant chief engineer of the Metropolitan Street Railway Company, New York, and afterwards connected with the New England Gas & Coke Company, sailed on the steamer "Buffoon" on Nov. 4 for Brazil. He will make an inspection of the works of the Sao Paulo Tramway, Light & Power Company.

MR. ANDREW CARNEGIE has been enthusiastically and unanimously elected Lord Rector of the University of St. Andrews, Scotland. The honor is worthily bestowed of a Scotsman who has done so much for literature and education. Mr. Carnegie is undoubtedly the first telegraph messenger and operator to attain this high distinction.

MR. R. C. BROWN, general manager of the Sao Paulo Tramway, Light & Power Company, Limited, Sao Paulo, Brazil, has returned to the United States, the company's large works having been completed and put into operation. Mr. Brown had charge of all of the company's work, both constructing and operating. His address is Room 840, Cable Building, New York.

MR. F. W. CH. JANISCH, chief engineer, Siemens & Halske Company, Berlin, Germany, after spending some four months in this country, is returning home by the "Hohenzollern," sailing to-day, going via Genoa to Vienna on his way home. Mr. Janisch has greatly enjoyed his stay in America and has been indefatigable as an observer and in pursuit of information. He says, however, that he has heard and noted so much that if he did not go home he would suffer seriously from "mental indigestion."

MR. R. F. ROSS, formerly New England representative of the Electrical World, has accepted the position of general manager of *Insurance Engineering*, a monthly publication devoted to the science of diminishing hazards to property and life. Though but just entering on its second volume, this journal has already established itself as a recognized exponent of the engineering branch of fire-hazard protection, which branch has in recent years advanced to a position of great technical importance, both in its practice and as a factor in the fire hazard business. The addition of Mr. Ross to the staff of the journal assures that its business department will be conducted along dignified lines, and that its advertising department will be administered with a skill that has earned Mr. Ross a high reputation in the field of technical journalism.

MR. T. H. SYMINGTON, who was until recently superintendent of motive power of the Atlantic Coast Line Railroad, and later president of T. H. Symington & Company, Baltimore, has accepted a position as representative of the Gold Car Heating Company, of New York and Chicago. Pending the completion of his journal box tests on about forty railroads, Mr. Symington will devote his entire attention to the interest of the Gold Car Heating Company. He is a graduate of Johns Hopkins University, took the degree of mechanical engineer from the Lehigh University, and had a number of years' practical experience in the shops and mechanical department of the Baltimore & Ohio Railroad. He left the Baltimore & Ohio to become assistant superintendent and general sales agent of the Richmond Locomotive Works. During the past four years Mr. Symington has been superintendent of motive power of the Atlantic Coast Line Railroad.

MR. WM. H. CRUMB has recently resigned his position as general superintendent of the Pittsburg & Allegheny Telephone Company at Pittsburg, and has opened an office at 1211 Monadnock Building, Chicago, for the general practice of telephone engineering and contracting. Mr. Crumb is well known in Chicago, and the Middle West, on account of the important position he held with the Pittsburg & Allegheny Telephone Company, and also on account of his prior connection with the Central Union Telephone Company, whose headquarters are in Chicago. Mr. Crumb is specially well fitted for the business he has recently undertaken, on account of his wide experience in both the constructive and operative branches of the telephone business, his unquestioned business ability, and his technical training at Cornell University, from which institution he was graduated in electrical engineering in 1894. All of his friends wish him, and predict for him, the greatest success.

Trade Notes.

CROSS OIL FILTERS, manufactured by the Burt Manufacturing Company, of Akron, Ohio, were awarded a silver medal at the Pan-American Exposition.

THE CALIFORNIA ELECTRICAL WORKS now occupies its new four-story brick and stone building located at 547 Mission Street, San Francisco. The entire fourth floor is occupied by its shop and the remaining floors are devoted to salesrooms and offices.

TO MOVE PLANT.—It is practically decided that the Standard Automatic Gas Engine Company, of Oil City, Pa., will be removed to Cincinnati, Ohio. Contracts have been signed, and buildings are to be commenced at once. The factory when in complete operation employs 300 men.

ENCLOSED MOTORS AND DYNAMOS.—The Maxwell M. Mayer Electric Company, New York, has issued a bulletin describing and illustrating its line of enclosed direct-current motors and dynamos. These machines formed the subject of an article in ELECTRICAL WORLD AND ENGINEER of Nov. 2.

EMERSON BULLETINS.—Bulletins Nos. 3031 and 3032 are of recent issue by the Emerson Electric Manufacturing Company, St. Louis, Mo. The subject of the both is automatic start induction motors for single phase current. Both bulletins are illustrated with perspective views of the machines and diagrams.

"A PRETTY LIBERAL PROPOSITION."—A folder issued by the Western Electrical Supply Company, St. Louis, Mo., bears the title above quoted. The proposition relates to carbon brushes for motors, and a trial of the brushes will cost nothing. The company desires to convince its friends and patrons that it has a superior article in its brushes.

BESLY SPECIALTIES.—A new 50-page catalogue has just been issued by Messrs. Charles H. Besly & Company, Chicago, devoted exclusively to the specialties manufactured by this firm. The list is a long one, and includes Gardner grinders, Besly band grinders and polishing machines, spiral circles, etc. The firm will be glad to send a copy of this catalogue to any one free, on application.

THE AMERICAN BLACKSMITH.—A new monthly publication with the title of *The American Blacksmith* has made its appearance in Buffalo, N. Y. The first number contains illustrated articles of interest to the blacksmithing and kindred vocations, and the metal professions. One of the articles is about wheels of motor carriages. The new periodical is published by the American Blacksmith Company, 210 Pearl Street, Buffalo, N. Y.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, general sales agent of the Adams-Bagnall lamps, states that it is meeting with very flattering success with its weatherproof, solid copper case, constant current, series enclosed type of this lamp. The demand for this type of lamp has been increasing, and the company is installing them in a number of larger cities. Descriptive matter, prices, etc., will be mailed on application.

FIRE FELT PIPE COVERING.—This covering is recommended by the manufacturer, the H. W. Johns Manufacturing Company, New York, as a perfect non-conducting covering for steam and other heated surfaces. It is supplied in three forms, viz.: cylindrical sections for pipes; sheets for boilers, drums, flues, etc., and rolls for ground pipes, heaters, hot air pipes, etc. A little pamphlet just issued by the company gives information about these coverings and other asbestos goods manufactured by the company.

"THE FOUR-TRACK NEWS" is the latest addition to New York Central Railroad literature. It is a neat, illustrated pamphlet published under the direction of George H. Daniels, General Passenger Agent, and resembles in form the publications of the "Four-Track Series," of which it is called a sequel. "The Four-Track News" will be published monthly, and will contain timely notes of travel, interesting information relating to transportation and its development and brief notes on books of travel. An interesting item in the little book is the account of the growth of the New York Central Lines from 1831 to the present time. In that year the Company owned seventeen miles of railroad, the primitive locomotive DeWitt Clinton and three Concord stages transformed into cars. The system now controls 10,453 miles of road. Copies may be obtained from Mr. Daniels' office by sending a two-cent stamp.

KENTUCKY DYNAMOS AND MOTORS.—One of the few Southern Electrical industries of prominence is the Kentucky Electrical Company at Owensboro, Ky. This concern is manufacturing a line of dynamos and motors, which, judging from bulletins Nos. 214 and 215 (just issued), are well designed and well built machines. They are of the open multipolar, semi-enclosed and enclosed types. The open machines are made in sizes of 3½ to 13½ kilowatts as generators, and 4 to 15 horse-power as motors. The enclosed and semi-enclosed generators range, in capacity, between ¾ to 4 kilowatts, and the motors are built from ½ to 5 horse-power. The Kentucky incandescent lamp produced by this company is made according to modern methods to meet the most exacting service. The railway lamp has a special filament, consuming 4 watts per candle-power. It was specially designed to meet the severe conditions of railway service.

"COUNTRY LIFE."—Doubleday, Page & Company announce that their magazine, *Country Life in America*, has found a welcome of unexpected proportions and enthusiasm. The published announcement has led to orders for more than the first edition and of advance subscriptions from would-be readers in unexpected numbers. Not only does the idea of *Country Life in America* appeal to all who love the country, but the name of the editor, L. H. Bailey, of Cornell, gives solid assurance that the magazine will be popular, interesting, beautiful and of high standard. Certainly, no more superbly illustrated magazine has ever been printed. Among the contents is an article by the editor on Abandoned Farms, what they are and what may be done with them, with charming illustrations; an illustrated account of ex-Governor Levi P. Morton's place, Ellerslie; a two-page collection of suggestive pictures of Pleasant Country Homes; the history of the frog from tadpole to froghood, with remarkable photographs by A. R. Dugmore made from life; articles on planting the lawn, the art of letting things grow, the newest fruits, and a vast amount of practical matter about the garden, the greenhouse, and even the window box, all of which is abundantly illustrated.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOVEMBER 5, 1901.
[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

685,741. VALVE CONTROLLER; W. H. Clarke, New York, N. Y. App. filed May 10, 1900. A differential piston normally balanced by the pressure of steam and a spring, is caused to partially or wholly cut off the steam to the engine by electro-magnetic valves in circuit with the dynamo driven by the engine, and which admit steam to the differential piston in such a manner as to over-balance it and cause it to move.

685,742. WIRELESS TELEGRAPHY; A. F. Collins, Philadelphia, Pa. App. filed March 31, 1900. The secondary circuit of the coil is grounded at one end and connected with a condenser at the other; the transmitting key is in the circuit between the secondary and the condenser.

685,745. AUTOMATIC FIRE ALARM; B. A. Crisman, St. Elmo, Tenn. App. filed June 26, 1901. The fusing of a strip allows a weight to fall and close the circuit.

685,754. SEMAPHORE OPERATING MECHANISM; C. C. Gardiner, Topeka, Kan. App. filed April 13, 1901. Details.

685,755. CONTROLLER FOR ELECTRIC RAILWAY MOTORS; F. W. Garrett and E. W. Stull, Johnstown, Pa. App. filed April 8, 1901. The reverse switch of the controller throws resistance into the circuit at the moment it passes from one set of contacts to the other, which avoids the return of the controller handle to the off position before operating the reverse.

685,766. MAGNETIC FUSE CUT-OUT; N. Jones, Sparrows Point, Md. App. filed March 25, 1901. An electro-magnet is placed in the line opposite the fuse to blow out an arc that may be formed when the fuse is discharged.

685,776. INSULATOR SUPPORT; F. M. Locke, Victor, N. Y. App. filed July 22, 1901. The insulator pin is split at the top and receives a wedge which is forced inward by the screwing on of the insulator, the thread thus spreading and locking the insulator.

685,781. ELECTRIC RAILWAY MOTOR CONTROLLER; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed March 13, 1901. Details of construction affording convenient access for repairs, etc.

685,782. RAILROAD SIGNALING DEVICE; J. Merryweather, Greencastle, Ind. App. filed July 26, 1901. A circuit closer operated by the flange of the wheel.

685,795. MEANS FOR OPERATING AND CONTROLLING ELECTRIC MOTORS; C. J. Reed, Philadelphia, Pa. App. filed March 22, 1899. (See Current News and Notes.)

685,796. METHOD OF OPERATING AND CONTROLLING ELECTRIC MOTORS; C. J. Reed, Philadelphia, Pa. App. filed May 8, 1901. (See Current News and Notes.)

685,797. ACCUMULATOR ELECTRODE; Albert Ricks, Berlin, Germany. App. filed May 18, 1900. A storage battery plate consisting of a non-conducting base such as celluloid, mica or rubber, on each face of which the material to be made active is caused to adhere by designated means. In the case of celluloid, for example, the surface is treated with ether, which causes the electrode material to adhere when it is pressed against the plate.

685,817. MAGNETIC ORE SEPARATOR; W. P. Cleveland and C. E. Knowles, Joplin, Mo. App. filed May 7, 1900. A thin layer of the ore is carried on a conveying belt in close proximity to the poles of a rotating magnet.

685,846. SWITCHBOARD FOR TELEPHONE OR LIKE EXCHANGES; H. F. Jones, Wilson, N. C. App. filed Nov. 6, 1900. The annunciator contains an endless race-way for a number of balls which act in succession as visual signals and as circuit closers in connection with the several manipulations of the plug.

685,847. SWITCHBOARD FOR TELEPHONE OR LIKE EXCHANGES; H. F. Jones, Wilson, N. C. App. filed April 7, 1900. A modification of the preceding.

685,852. MOTOR STARTING AND CONTROLLING DEVICE; C. W. Kragh, Madison, Wis. App. filed April 9, 1900. Two resistances are wound upon the field magnet, one to strengthen the field and the other to weaken it; an automatic device cuts both resistances out when the speed is normal, and cuts one of them in when the speed decreases, and the other one in when the speed increases.

685,887. POLE CHANGER; W. F. Warner, Muncie, Ind. App. filed July 5, 1900. Details.

685,953. METHOD OF INTENSIFYING AND UTILIZING EFFECTS TRANSMITTED THROUGH NATURAL MEDIA; N. Tesla, New York, N. Y. App. filed June 24, 1899. Renewed May 29, 1901. (See Current News and Notes.

685,954. METHOD OF UTILIZING EFFECTS TRANSMITTED THROUGH NATURAL MEDIA; N. Tesla, New York, N. Y. App. filed Aug. 1, 1899. Renewed May 29, 1901. (See Current News and Notes.)

685,955. APPARATUS FOR UTILIZING EFFECTS TRANSMITTED FROM A DISTANCE TO A RECEIVING DEVICE THROUGH NATURAL MEDIA; N. Tesla, New York, N. Y. App. filed Sept. 8, 1899. Renewed May 29, 1901. (See Current News and Notes.)

685,956. APPARATUS FOR UTILIZING EFFECTS TRANSMITTED THROUGH NATURAL MEDIA; N. Tesla, New York, N. Y. App. filed Nov. 2, 1899. Renewed May 29, 1901. (See Current News and Notes.)

685,957. APPARATUS FOR THE UTILIZATION OF RADIANT ENERGY; N. Tesla, New York, N. Y. App. filed March 21, 1901. (See Current News and Notes.)

685,958. METHOD OF UTILIZING RADIANT ENERGY; N. Tesla, New York, N. Y. App. filed March 21, 1901. (See Current News and Notes.)

685,965. ELECTRIC FURNACE; C. P. Bary, Paris, France. App. filed Oct. 18, 1900. (See page 818.)

685,966. WINDING FOR DYNAMO ELECTRIC MACHINES; J. B. Blood, Newburyport, Mass. App. filed March 1, 1901. A winding composed of detachable counterpart coils, each coil having its layers wound horizontally and symmetrically with reference to a center line between the sides.

686,007. RELAY; H. Shoemaker, Philadelphia, Pa. App. filed May 13, 1901. Details.

686,017. TROLLEY; M. J. Wilson, Painesville, Ohio. App. filed Feb. 21, 1901. A mounting for the wheel preventing the conductor wires and guide wires from being caught between the trolley wheel and the parts adjacent thereto.

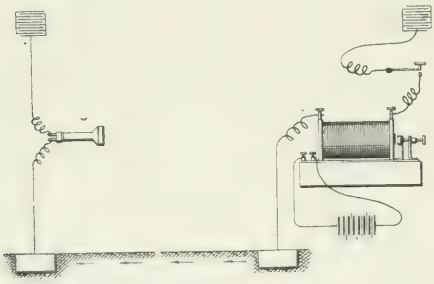
686,020. SYSTEM OF ELECTRICAL DISTRIBUTION; F. Bedell, Ithaca, N. Y. App. filed Sept. 1, 1900. (See Current News and Notes.)

686,023. ARMATURE FOR ELECTRIC METERS; C. W. J. Busch, Munich, Germany. App. filed July 30, 1901. The armature is composed of a number of coils arranged to cross one another, and also to obliquely cross the armature shaft.

686,052. CASING OR COVERING FOR CONDUCTORS IN BUILDINGS; J. H. Golding, Stoke Newington, London, England. App. filed Aug. 9, 1901. A metal case and a metal cover therefor, adapted to be fixed to the surface of a wall, spring clips being used under the cover to hold the conductors in place until the cover is adjusted.

686,128. NIPPLE FOR ELECTRICAL CONDUITS; A. C. Proudfit, New York, N. Y. App. filed Dec. 24, 1900. A sheet metal threaded nipple to be applied to the end of the conduit pipe to give a smooth finish thereto.

686,135. ELECTRICAL SOUNDER; U. G. Rogers, New York, N. Y. App. filed April 17, 1901. Details.



685,742.—Wireless Telegraphy.

686,136. ARMATURE ADJUSTING DEVICE FOR RELAYS OR OTHER INSTRUMENTS; U. G. Rogers, New York, N. Y. App. filed April 19, 1901. A cord attached to the armature adjusting spring, is coiled around a post set friction tight in a socket, so that any adjustment made will hold.

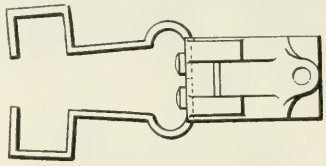
686,137. SOLENOID GRADUATING TUBE; U. G. Rogers, New York, N. Y. App. filed May 24, 1901. An outwardly expanded spun bead formed on an insulating tube for application to the core of a solenoid, for graduating the magnetic attraction.

686,138. ELECTRICAL INSTRUMENT CASE; U. G. Rogers, New York, N. Y. App. filed June 5, 1901. Details.

686,150. DIFFERENTIAL INDICATOR AND ELECTRICAL ALARM ATTACHMENT; J. G. Jones, H. G. Shortt and E. G. Shortt, Carthage, N. Y. App. filed March 11, 1901. A low water alarm for boilers.

686,152. MOTOR; A. W. Smith, Washington, D. C. App. filed Sept. 9, 1901 The conductor bars of the armature winding are interconnected by rings at each end of the armature.

686,162. SOCKET CARBON BRUSH HOLDER; O. M. Stiegler, Boston, Mass. App. filed March 15, 1901. The head is a metal casting, while the



686,162.—Socket Carbon Brush Holder.

brush holder proper is two pieces of bent sheet metal having the shape of an open socket and a natural spring to clamp the brush.

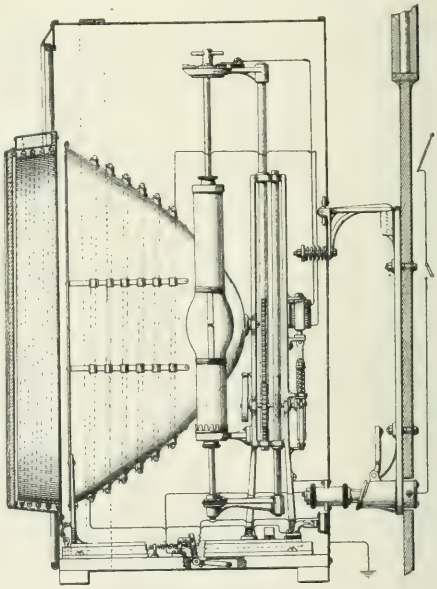
686,168. AUTOMATIC STOP AND EMERGENCY GEAR FOR MARINE AND STATIONARY ENGINES; H. J. Teiper, New York, N. Y. App. filed June 5, 1901. A trip lever for closing the valve when released electro-magnetically.

686,172. ELECTRIC HEADLIGHT LAMP; H. P. Wellman, Ashland, Ky. App. filed Nov. 14, 1899. Among various other features is a resistance coil wound around the outside of the reflector.

686,194. ELECTRIC SWITCH; H. P. Ball, New York, N. Y. App. filed Nov. 13, 1900. Details of a double push button.

686,206. REPEATER FOR TELEPHONE CIRCUITS; C. J. Coleman, Chicago, Ill. App. filed Nov. 8, 1899. (See page 819.)

686,207. AUXILIARY SIGNALING BOX; C. W. Cornell, East Orange, N. J. App. filed March 22, 1900. The first claim describes the invention as follows: In a signaling box of the sector type, the combination with the street box mechanism, of a lever controlling the starting and stopping thereof, a pin operated by the winding spring for restoring said lever, an auxiliary magnet the armature of which connects with said lever to allow the box mechanism to start, a starting lever for moving the armature, and means for winding the operating spring and simultaneously operating the starting lever.



686,172.—Electric Headlight Lamp.

686,218. INCANDESCENT ELECTRIC LAMP; M. E. H. Forst, San Francisco, Calif. App. filed March 29, 1901. An anchor for a lamp filament composed of two members connected by a slip joint, so that its length can be adjusted to avoid strains on the filament when it is mounted.

686,222. ELECTRIC CLOCK; T. E. Heeter, St. Louis, Mo. App. filed Jan. 7, 1901. Weights are deposited upon the rim of the wheel at one side of the center; when a weight reaches the lowest point, a circuit is automatically closed and a motor lifts the weight to its elevated position ready to again engage with the wheel.

686,228. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1896. Renewed March 1, 1901. (See page 818.)

686,231. AMALGAMATOR; G. W. Lee, San Francisco, Calif. App. filed March 13, 1901. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, NOVEMBER 23, 1901. No. 21

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 23, 1901.

CONTENTS.

PAGE
Editorial 841
New York Electrical Society 844
Interurban Trolleys 844
Electrical Engineers of the Day—XXI; Norman W. Storer 844
The Debt of Electrical Engineering to C. E. L. Brown—II; by B. A. Behrend 845
Telephony and Telegraphy in England 846
Surges in Transmission Circuits, by A. E. Kennelly 847
Measurement of Angle of Lag of Three-Phase Circuits with One Wattmeter, by A. S. McAllister 849
Novel Lightship 849
Elements of Illumination—XXXIV, by Dr. Louis Bell 850
Remarkable Automobile Records on Coney Island Boulevard 851
Illumination of the Richmond, Va., Carnival Tower 852
New Telephone Patents 852
Cost of Constructing and Operating the Port Chester Road 854
Philippine Tariff on Electrical Goods 855
Consolidating Western Independent Telephone Lines 855
Current News and Notes 855
LETTER TO THE EDITORS:
Switchboard Simplicity, by L. B. Stillwell 858
Digest of Current Electrical Literature 859
New Books 862
A New Type of Surface Contact Traction System 862
S. K. C. Converter 863
Signs for Street Corners 864
Water-Tight Floor Outlet 864
Induction Chamber for Feed Water Heater 865
An Electric Chromatropic Top 865
The Mietz and Weiss Gas Engine 865
Future Automobile Construction 866
The Police Telephone Signal System at the Pan-American 866
DEPARTMENTS:
Financial Intelligence 868
Commercial Intelligence 869
General News 871
Trade Notes 875
Illustrated Record of Electrical Patents 875

AUTOMOBILE RECORDS.

Our opinion as to the waste of time in automobile racing, so far as the permanent advance of the art is concerned, has been frequently and vigorously expressed, but we are, nevertheless, willing to admit that such races and records as those of last Saturday do make the blood tingle. We report elsewhere in this issue the contests on the Coney Island Boulevard, where, under the auspices of the Long Island Automobile Club, all the existing world records were smashed to pieces. It was a decidedly new experience and sensation to see huge machines, under perfect control, flying over the surface of smooth roads, at speeds of 70 miles an hour. To say nothing of the qualities in the machine, it takes nerve and skill to handle a vehicle going free at that gait; and the public interest in such performances is not to be gainsaid. We note with pleasure the brilliant record made by Mr. Riker, whose electric racer, stealing swiftly past, like a thief in the night, was conspicuous for its quietness as compared with the unloosened rattling avalanches, the gasolines, shaking the ground like flying earthquakes. A mile a minute for an electric automobile—and an American machine at that—is not to be despised.

But we doubt that a great industry can be built up on racing. Probably several American manufacturers will build machines to beat the record, and will not be happy until they do it; yet the great field for exploitation is that of the humble drudgery of pulling and hauling. Such beautiful animals as are being exhibited at the Horse Show this week will long continue to enjoy the love and patronage of the wealthy sportsman, but even at the Show one can hear utterances that reveal the firm conviction as to the desirability and inevitability of the automobile for "work." The automobile industry is still in an immature condition, although the strides of progress are being rapidly made. It will soonest reach the status of a staple and permanent and profitable business by getting itself hitched to the demands of heavy and regular transportation. Even then there will always remain plenty of sport and speed to be got out of it.

PACIFIC CABLES.

It is evident that the Commercial Pacific Cable Company does not intend to let matters slumber in regard to its new cable. The announcement of its plans is still fresh in mind when the news comes of the award of a contract for the first section of the line to the Hawaiian Islands, which, we learn upon inquiry, it intends to have in operation about next October—say, a year from now. This is quick work, and would imply that the fortunate recipients of the contract, the India Rubber, Gutta Percha & Telegraph Works, of Silvertown, are ready to do some "tall hustling." The cost of making and laying this section is put at about $3,000,000. The whole Commercial undertaking is put at about $15,000,000.

It is already known that England will have her Pacific cable to the Far East, and that work in such quarters has already begun; hence with the two services in existence, as they undoubtedly will be within another year or two, it is difficult to see how any third project can be carried through with great hope of financial success. There is a scheme which involves a subsidy or may result in an American Government cable, and it is coming before Congress this winter. We are open to conviction, but with these two other cables already building, we can hardly see why a third cable should be subsidized or why the Government should itself embark in the cable industry. In fact, Mr.

Mackay's readiness to go ahead without a subsidy is very creditable, to say the least, to his nerve and enterprise.

There is one point in the matter that Mr. George G. Ward, first vice-president of the Commercial Cable Company, touches upon in an interview, which strikes us as quite important. He thus explains why American money is being spent abroad for the work: "The Commercial Pacific Cable Company would have been very happy to have given an American company its contracts, but there is no company in the United States that could, we felt, perform the work. They have not the machinery, and we could not afford to have the work of laying the cable take the form of an experiment. The Silvertown Company has been established for over 40 years, and has laid most of the deep ocean cables throughout the world, so that it understands perfectly just how the work should be accomplished. The company has assured us that they will complete the cable and have it here in seven months." Now we must accept Mr. Ward's statement as true, and being true, it is cause for congratulation to our English friends that they thus more than hold their own in the great domain of submarine telegraphy. There were, in fact, three or four English bidders equal to the job. But we must confess that it would have been a keen pleasure to record the fact that American skill not less than American capital were engaged on this great work, which means so much in future relationships between this country and Asia, Australasia, India and all the land of Cathay. These cable plans now being executed by Englishmen are among the greatest of the age, and are equaled only in their class by the great Cape-Australian cable of some 15,000 miles, lately noted in our columns. One hears of French and German projects, but in the meantime England has her cables "in being," which means a good deal to her as well as to the rest of the world.

Three-Phase Traction Motors.

An article abstracted in this week's Digest on a Swiss polyphase railway is noteworthy as containing the first definite published statements regarding certain features of practical three-phase traction. The report from two and a half years' operation of the Burgdorf-Thun line, of literally no repairs to the motors, is both striking and encouraging. Many engineers have predicted that he who used three-phase motors on cars would find himself constantly between the devil and the deep sea—on the one hand eternal trouble due to the small air-gap, on the other enormously heavy currents in starting and acceleration. Brown, Boveri & Co. state squarely and without qualification that the small size of the clearance has caused not a minute's stop, and that the whole motor equipment has been free from trouble of all kinds. Moreover, for the first time we find data on the current taken by such motors during acceleration. The figure given for the Burgdorf-Thun trains is 1½ ft. per second (per second), which is certainly enough to meet ordinary conditions well, and the statement is made that this is accomplished without exceeding the normal—presumably full-load—current. This is, of course, more or less *ex parte* testimony, but it comes from a very reliable quarter, and it is not too much to say that the results attained on this now well-tested road have been such as to be very encouraging to engineers working along this particular line. It has regularly happened in the development of induction motors that bugbears of theory have vanished as the practical art has advanced to the attack. The extension of induction motor practice to tramway work was a serious step, calling for skill and courage, but the preliminary advance seems to have been successful to a very gratifying degree. That the larger work contemplated or recently undertaken abroad involves more serious problems than any hitherto faced, is true, but the inherent probabilities of the case seem to indicate that the chance of failure is rather remote.

Electrical Surges.

We commend the admirable article of Dr. Kennelly, printed elsewhere in this issue, to the reader who wishes to inform himself on the very interesting subject of electrical oscillations in circuits containing inductance and capacity. While the recent Institute paper of Mr. Steinmetz treated the subject in a most masterly manner, yet its mathematical character and condensed style render the reading of the paper difficult to those who approach the subject for the first time. That the subject may be set forth in the simple terms which Dr. Kennelly employs gives rise to reflections on the manner in which so much of the science of variable currents has in the past been sealed from all but the elect, through the employment of the methods of higher mathematical analysis. Indeed, it is in one sense a misfortune that for a long period of time this branch was a favorite field for the mathematical physicist. Had its cultivation been deferred until the entry of alternating currents into engineering, the development would have been along quite different lines. At the present time a great opportunity awaits the author who will put forth a book in which the whole subject of variable currents shall be treated in a manner conforming to the processes, not of the mind of the mathematical physicist, but that of the engineer.

As is made clear by Dr. Kennelly, some of the phenomena which have been observed in connection with long-distance transmission, and which have hitherto defied explanation, are quite simply elucidated when the proper principles, as developed in the article, are borne in mind. In the past such names as static and resonant effects have been applied to some of these phenomena, but, as Dr. Kennelly points out, it is quite probable that in most cases these designations are misnomers and that the effects were probably due to electrical surgings. The article possesses an additional interest from the illustrations it involves as to the mechanism of the actions resulting from the presence of inductance and capacity in a circuit. These actions, which give rise to surgings and which at first sight appear singular, are more readily understood if it is borne in mind that the reactance of a condenser is always opposite to that of an inductance. Thus when an inductance discharges, it charges a condenser in relation with it; the latter then in turn is discharged through the inductance, which again discharges into the condenser, and so on until the original energy is dissipated by resistance, in hysteresis and parasitic currents. The analogue of such a circuit is thus a vibrating spring, such as a tongue fixed at one end, the electromagnetic energy of the circuit under normal regime corresponding to the initial energy imparted to the spring, and its molecular friction and air resistance to the current-dissipating properties of the electrical circuit. The fact that a smaller capacity gives rise to a greater strain is easily understood when it is recalled that the e. m. f. of a condenser is directly proportional to the charge imparted to it; consequently, for a given surging current, the charge imparted will be greater the smaller the condenser, since it has to receive a quantity in proportion to the value of the current.

The Zossen High-Speed Experiments.

A note in the daily press, wandering from paper to paper within the last week, gives hope of some definite results being made public ere long concerning the Zossen polyphase traction trials. The report states that a speed of 105 miles per hour had been successfully reached, and then goes wandering off into incoherent details of the alleged air pressure found at this "hitherto unrecorded speed." We have many friends connected with the daily press, and we wish them well, but we hope that in some not distant day they will become more careful in their treatment of scientific matters. As to the speed attained we doubt not that the report is correct, for there is certainly no good reason why it should not be; but so far from its being the

highest speed yet attained by anything of human contrivance save projectiles, the figure named has been equaled or exceeded on this side of the water at least half a dozen times. In the experiments with the Weems high-speed road a decade ago, 105 miles per hour was at times materially exceeded by the light car employed, and in ordinary railroading locomotives with short trains have repeatedly made the measured mile in less than 40 seconds, the record, we believe, being 32 seconds, which has been closely approached several times. The time will have to be clipped to 30 seconds or thereabouts before the record can be carried across the water. We have no doubt that the Zossen experimenters will turn the trick in due season, and when they do so they shall have our sincerest congratulations, but the record is so far intact.

Solar Activity and Terrestrial Magnetics.

A paper was recently read by Sir Norman Lockyer before the Royal Society of Great Britain upon the "Solar Activity During the Period 1833-1900." In this paper the records of the number and area of sunspots are analyzed and compared during the last two-thirds of the nineteenth century. The results go to show that the sun may be regarded as a variable star, its luminous radiation undergoing periodic variation within a small range. The mean time separating maximum or minimum of sunspots is well known to be about eleven years, and at the present time we are just about the epoch of the sunspot minimum. Superposed upon the eleven-year maximum-minimum pediod there is, according to Lockyer's analysis, a further period of approximately 35 years. The course of magnetic variations continued from year to year seem to indicate in a corresponding manner the influence of both the 11-year cycle and a 35-year cycle. An analysis of frequency of the aurorea borealis is stated also to show the existence of a 35-year cycle.

The most interesting circumstance, however, to which attention is called, is the agreement of this 35-year period of terestrial sunspot variation with the results of terrestrial climatology, as investigated of recent years by Bruckner. It seems that Professor Bruckner has made a careful examination of meteorological records during the past 200 years, and finds, as a general result, that there is a small periodical variation in the climates over the whole earth, the mean length of this period being 34.8 ± 0.7 years. Moreover, the curve of variation in annual rainfall shown, as taken from Bruckner's work, closely follows the 35-year sunspot variation curve, indicating a general slight increase in rainfall during the years of maximum sunspot development, or when the solar radiation is at its minimum, and on the contrary, a reduced annual rainfall when the sunspot development is least in the 35-year cycles. At the present time we appear to be in the neighborhood of a minimum rainfall on this cycle. It is stated that a 33 or 34-year cycle period has been independently traced in the climatology of Sydney, Australia, and also a 35-year period in the movements of glaciers by Professor Richter.

It is, of course, only reasonable to expect that cyclic changes in the sun's activity should repeat themselves in the earth's meteorology, but the fact that the changes in the seasons are so slight as to escape ordinary observation from decade to decade, is sufficient to show how small is the range of variation in either. It is very common to hear people speak casually about variations in climate, which have occurred at some particular locality to their own knowledge within the limits of their lives, but in every case a careful examination of meteoroligical records made during the period referred to fails to establish any such supposed variation, and the mean annual temperature or rainfall is a wonderfully steady quantity in the long run, although so manifestly subject to numerous temporary fluctuations The predetermination of weather and climate is necessarily of enormous consequence and value to a community, and if the 35-year period of Sir Norman Lockyer is confirmed by subsequent analysis, it must prove of great interest, even if the range of variation be minute.

The Heyland Polyphase Motor.

The attention of our readers was called some months ago to the proposal of Mr. Heyland to produce a polyphase motor of unit-power-factor; that is to say, a motor which acts as though devoid of self-inductance, or requires no wattless component of magnetizing current. This consummation devoutly to be wished, was, in brief, to be sought by placing a commutator on the secondary rotor, and directing the positions of the poles thereon, by means of brushes. The reasoning involved is that if synchronism were obtained, the multiphase currents supplied from the commutator to the secondary would produce about it a rotating field advancing, say, clockwise, while the rotation of the secondary itself at synchronous speed, counter-clockwise, would cancel this rotation and leave the poles stationary with respect to its own windings. There was to be no self-induction in the commutator-fed secondary, because the rotating field therein is stationary with respect to the secondary turns. Consequently, the impedance of the secondary would be reduced to its ohmic resistance, and this would remain approximately true at the ordinary working speeds and small slips of the induction motor.

M. Maurice Leblanc, in a recent number of *L'Eclairage Electrique*, and also M. Bunet, in a recent number of *L'Industrie Electrique* (see Digest), have independently pointed out a fallacy in this line of reasoning. They show that if a polyphase-current-excited field rotating about a ring be apparently arrested in space by supplying the polyphase currents through a commutator, and rotating the brushes on the commutator in the opposite direction to the motion of the field; then although the field appears to be stationary in space, and seems to be stationary inside the turns of the ring, yet it is really moving to and fro by little leaps as the brushes pass the successive segments on the commutator. During each pause on a commutator segment the field is moving forward through the loops on the ring and producing c. e. m. f., while in the sudden leap back at change of commutator bar, the field is not bodily caused to retreat, but only altered in the points of its poles, so that there is no reversal of c. e. m. f. The more numerous the commutator bars, the smaller will be each advance and leap back, but, on the other hand, the more rapid will be their succession. Even with an indefinitely great number of commutator bars, the field in the ring, although apparently stationary in space, would actually be cutting turns all the time, and producing c. e. m. f. of self-induction. Consequently, the self-induction of a ring winding is essentially the same whether it be supplied through a commutator with moving brushes, or whether it be supplied through the commutator with brushes fixed and the ring moving, or whether it be fed through collected rings without the interposition of the commutator.

In other words, a rotating magnetic field established by polyphase currents in a ring winding apparently must be accompanied by self-induction or c. e. m. f. due to the advance of the field through the ring winding, whether the poles be allowed to advance around the ring, or be artificially restricted to nearly fixed lines in space by the use of the commutator. It would seem that the fallacy thus elucidated impugns the success of the Heyland unit-power-factor motor, although the object sought is so desirable that we could well afford to smile at any defect in theoretical reasoning which enabled it to be practically realized

New York Electrical Society.

The 218th meeting of the society will be held at the College of the City of New York, corner Lexington Avenue and Twenty-third Street, Tuesday, Nov. 26, at 8 P. M. Mr. Robert Lozier will present a paper on "The Electrical Operation of Modern Tools and Machinery." This paper will be profusely illustrated with lantern slides indicative of the remarkable manner in which the electric motor has been adopted for driving purposes in practically every branch of industry and manufacture. The following well-known members of the society and others engaged in the motor field have been invited to participate in the discussion: Professor F. B. Crocker, Gano S. Dunn, C. O. Mailloux, H. B. Coho, S. L. Nicholson, C. S. Jackson, Campbell Scott, E. H. Mullin, E. R. Knowles and Robert Lundell.

Interurban Trolleys.

Interurban trolleys is the theme of an interesting pamphlet by Mr. Guy Morrison Walker, recently issued in Boston. It says that in the evolution of American transportation we have reached the era of interurban electric lines which should lead investors to investigate the intrinsic value of those lines now in operation. Interurban railways are not so heavily capitalized as are the steam lines with which they compete, the average capitalization of steam railways in the United States in 1900 being $61,490 per mile, while that of electric lines is not over $35,000. In comparing earnings it should be remembered that those of interurban lines are derived almost wholly from passenger traffic. Again, they depend on a short haul; long haul is still undeveloped. In spite of this, average earnings of steam roads from passenger traffic in 1900 were $1,674 per mile, while that of interurban lines was $3,800 per mile. With the development of interurban roads into great systems there will come a large development of through traffic that will make their operations doubly remunerative. It is well known that steam roads have not found passenger traffic profitable. Yet the very traffic they find most unprofitable—short haul—the interurban lines find highly profitable at a low fare.

Electrical Engineers of the Day—XXI.

Norman W. Storer.

Norman Wilson Storer was born in 1868 in Orangeville, a little village in the northeastern part of the State of Ohio, on the Western Reserve. Mr. Storer has always been a hard worker, and his early life was by no means an easy one. The death of his father when he was scarcely three years old, left his mother with five children to care for, and but a small amount of property with which to do it. Indomitable energy on her part, however, overcame lack of fortune and she managed to give her children more than an average education. Mr. Storer also did much for himself in that line, and with the help given him by his mother, worked his way through college, taking the degree of Mechanical Engineer in Electrical Engineering at the Ohio State University in 1891. He was one of the first two who obtained that degree after the starting of the electrical engineering course in that university.

Shortly after graduation he entered the employ of the Westinghouse Electric & Manufacturing Company, and has been associated with them ever since then. He soon worked his way to the testing room, where his originality and persistence quickly brought him to the front, and he was given charge of important experimental work. Having received an offer from his employers to enter the designing department, in the spring of 1893, he first took up his work in that line as assistant to Mr. B. G. Lamme, then as now chief designer of the Westinghouse Electric & Manufacturing Company.

From the beginning, Mr. Storer devoted himself particularly to direct-current design. It is generally conceded by those who are familiar with both systems that alternate-current apparatus is much simpler than that of the direct-current type. As to whether or not it is easier to design alternating-current than direct-current apparatus, is a question that perhaps but few men can answer, for the simple reason that but few men have ever actually designed commercial apparatus of both types. The commutator presents difficulties in large and sometimes even in small direct-current generators of a kind that are not encountered in alternating-current design, and for this reason it has been referred to by one of our most noted electricians as an "excrescence" on an alternating-current generator. The direct current, however, is a necessity in many industries where the alternating current can never be used, and for that reason we may always expect direct-current apparatus to be in demand. Among the many engineers who have undertaken the design of direct-current apparatus, a small number have achieved marked success. One of the most noteworthy examples of the latter class—if we may judge by results—is the subject of this sketch.

Mr. Storer's first work as a designer was in developing a line of small multipolar generators and motors which were brought out in 1894, and which are still the standard of the Westinghouse Company. The fact that this line comprises between 250 and 300 machines, may give some idea of the work involved. His next work was on engine-type generators of all sizes, and in the line which was brought out some months later were embodied all the valuable features of the small belted machines, together with the new points which continual study had shown to be desirable. The result was a line of generators which for general all-around excellence remains unsurpassed.

In later years Mr. Storer's work has broadened out and he has designed machines for all classes of service, including those for lighting, power, railway generators and motors, electrolytic generators, as well as small motors for automobile work. Some examples

of the larger machines of his design may be found in the power stations of the South Side Elevated, of Chicago; the St. Louis Rapid Transit Co., and the Boston Elevated, including 650-kw, 800-kw, 1500-kw, 2250-kw, and 2700-kw engine-type railway generators. In electrolytic work the direct-coupled units at the Piitsburg Reduction Co. at Niagara Falls, ranging in size from 560 kilowatts to 1000 kilowatts; the 600-kw generators at Raritan Copper Co., Perth Amboy, N. J.; the 850-kw generators at the North American Chemical Company, Bay City, Mich., and the 810-kw generators at the Boston & Montana C. C. & S. M. Company, Great Falls, Mont., may be seen in daily operation, and are fair samples of the class they represent. Mr. Storer is largely responsible for the design of the present line of Westinghouse railway motors, and to him is also due the credit for the present method of rating motors of this class, which has been adopted by the above company, and which will undoubtedly come into general use as it becomes better known.

Among the patents taken out by Mr. Storer, the most noteworthy is on the method of building laminated poles so as to prevent distortion of the field, thereby insuring good commutation over a very wide range of load. That his reputation as a careful designer and conscientious worker is widely recognized is attested by flattering offers he has received from other companies, both at home and abroad.

Personally Mr. Storer is a pleasant man to meet. His character is above reproach, and his quiet modesty gives one an immediate and lasting confidence in his ability to do whatever he undertakes. Mr. Storer is a member of the American Institute of Electrical Engineers and of several other professional bodies.

The Debt of Electrical Engineering to C. E. L. Brown—II.

By B. A. Behrend.

LOW-TENSION DIRECT-CURRENT GENERATORS.

THE Swiss Metallurgical Company in Neuhaussen had taken up the process of Heroult for the manufacture of aluminum and of aluminum alloys, and they required dynamos for large currents and low tension. They required about 12 or 15 volts and 12,000 to 13,000 amperes. The Oerlikon Works undertook to supply these dynamos, which a contemporary engineering paper called "gigantic," and Mr. Brown designed them with his hole armature for 6000 amperes, 16 to 20 volts, six poles, at 180 revolutions. Generators of such great current capacity had never been built before, and the tests that were made on July 30, 1888, showed that the dynamos could yield as much as 12,500 amperes each without injurious sparking. We give an illustration of one of these machines in Fig. 5.

An extremely remarkable feature of these machines was the use of cross connectors. It may surprise contemporary engineers that Mr. Brown used cross connectors 13 years ago on his multipolar dynamos. These cross connectors in the six-pole generators illustrated by Fig. 5 were made in the form of rings, with three lugs seated in grooves in the commutator bars.

It was in 1889 that Brown designed the first vertical shaft generator for the Aluminum Works at Neuhausen. This machine was to deliver 12,000 amperes at 36 volts at a speed of 180 revolutions. Mr. Brown made this machine with 24 poles, using in the first construction a tunnel-wound drum armature. This machine was afterwards altered for 6700 amperes and 60 volts, the armature being changed to a smooth-core drum. This machine has run satisfactorily to this very day.

A few words about the winding of the first machine may not be amiss here. It was a triple series parallel drum, doubtless the first machine made with this kind of winding which was later on claimed by other as a new invention.

The smooth-core winding had cross connectors consisting of V-shaped pieces of copper strips well-known to those who have seen the later machines built by the Oerlikon Company.

The work in low-voltage, large-current machines made Mr. Brown take up the design of a unipolar machine, of which we have

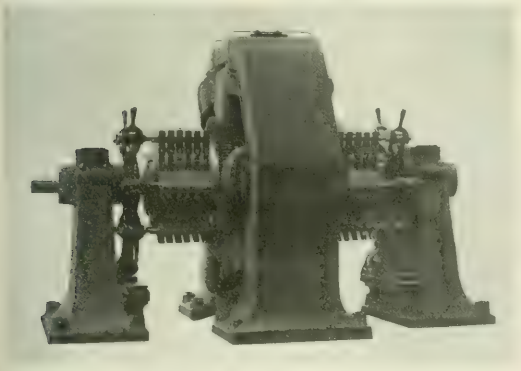


FIG. 5.—ONE OF THE LOW-POTENTIAL GENERATORS FOR THE SWISS METALLURGICAL COMPANY IN NEUHAUSEN.

no picture, however. This machine gave 200 amperes and 10 volts. During its tests, in trying to make the machine run faster, Mr. Sidney Brown, a brother of Mr. C. E. L. Brown, and about a year his junior, suffered a severe fracture of the leg by a pulley that flew to pieces. Mr. Sidney Brown is the head of the draughting department of Brown, Boveri & Co.

In connection with Mr. Brown's work in direct-current machinery we wish to give a few views of some machines of later design built at his own works in Baden. Fig. 7 represents a high-tension direct-current series dynamo, in form, outline and general design almost identical with his first machines of the same type. There was little to be changed in these first machines of which many are still in safe operation. Their commutators sometimes have almost fantastic shapes, the brushes deeply worn into them, yet they keep running sparklessly while receiving hardly any attention. An engineer of high standing once remarked of the Brush arc-light dynamo that it was so well designed at the outset that improvement has scarcely been made on it in the past 20 years, and the same might justly be said of Brown's Manchester type for high-tension work. These ma-

FIG. 6.—SIDNEY BROWN.

chines are admirable, they stand the roughest treatment, they never "buck" or flash over, they may be safely run at 2000 or even 3000 volts, and were it not for the fact that each motor required a generator of its own, these machines would hardly have had to make place to the polyphase system, which won the field because of its greater flexibility in the distribution of energy to several motors.

RECENT WORK IN DIRECT-CURRENT MACHINERY.

Though not following chronological order, we wish to describe in connection with Mr. Brown's early work in direct-current power transmission some of his later original constructions in the application of direct currents to electric traction. And here our attention is held by the Heilmann locomotive, the electrical equipment of which was designed and constructed by Mr. Brown. The "Société Anonyme de Traction Electrique, Systeme J. J. Heilmann," having to solve some difficult engineering problems, applied to Mr. Brown who worked out the driving mechanism and the many other novel constructive details that were demanded by the circumstances.[1] We present in Fig. 8 a detailed drawing of one of the 125-hp motors which are direct connected to the driving wheels, a construction that has been adopted more lately for some heavy electric hauling locomotives in this country. We are here not concerned with the relative

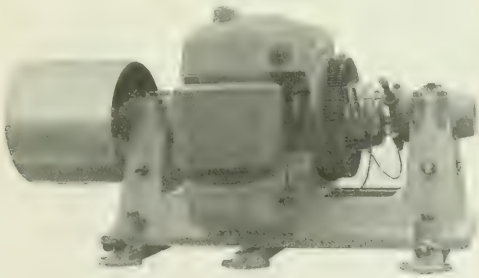


FIG. 7.—HIGH-TENSION MANCHESTER TYPE.

merits or demerits of the Heilmann system, it is the motor equipment especially that we wish to describe and to discuss, as there are some interesting features about it which have since become part and parcel of the modern dynamo.

The first Heilmann locomotive was built in 1892. Experiments with induction motors, though their results had not been unsatisfac-

[1]Mr. Brown writes to the author on this head: "With regard to the driving arrangement I would say that its design was developed rather by the Heilmann office, and especially by their engineer, Mr. Amsler, who is now with us in charge of our continuous current designing department. Of course we in Baden also assisted in designing this gearing and, as is often the case, it is extremely difficult to say how much of the design is due to the different parties individually!

tory, had shown the superiority of the direct-current motor for this particular problem, and consequently the latter was adopted for the earlier and later Heilmann locomotives.

The armature punchings of the motor are mounted on a hollow shaft, which engages by means of a driving arm direct with the driving wheels of the locomotive, a most simple and effective construction. The armature winding is a double layer winding, each slot containing two bars, one on top of the other. This winding, now com-

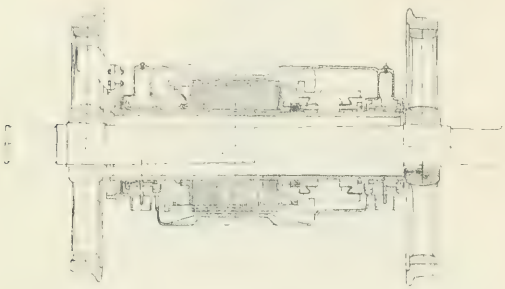


FIG 8.—MOTOR AND DRIVING ARRANGEMENT OF HEILMANN LOCOMOTIVE.

monly called the barrel winding and in almost general use for direct-current armatures and fields—if not first *invented* by Brown—was certainly *introduced* by him. It is extremely difficult, especially in this particular case, for a younger man to know how far this important construction had been foreshadowed in the eighties. The early Siemens dynamos for electroplating purposes had bar-wound drum armatures with an arrangement of the end connectors which was afterwards applied by Eickmeyer to wire-wound armatures, while C. S. Bradley described direct-current armatures with two conductors side by side and arranged in two layers. But there is a vast stride after all from the work of the professional inventor, who—like Nature—pours forth, seemingly without particular care or discernment, the creatures of his mind to let them sink or swim in the stream of

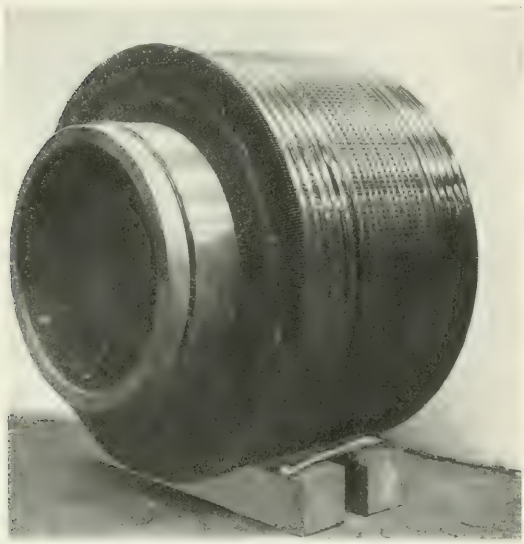


FIG. 9.—ARMATURE OF 300 KW RAILWAY GENERATOR.

new inventions, to the work of the designer full of important details which, if neglected, jeopardize the success of the whole construction. Even if there are among the rubble of inventions the constructions which able engineers have afterwards put into practical form, it hardly diminishes the merits of the designer, while, of course, it would be wrong not to acknowledge the merit of the inventor. It is certain that Mr. Brown was the first to employ the double-layer winding on a large scale, and publishing and describing his constructions with his usual liberality so rare among engineers, called attention to it in wider circles which ended in its general adoption all over the world.

RAILWAY GENERATORS.

Mr. Brown is one of the few men in Europe, if not the only one, who has not fallen behind in direct-current work, and his designs in this field are thoroughly American, which is surely the highest praise that can be conferred on direct-current machines. Figs. 9 and 10 show, respectively, the armature and the field of a 360 to 500-kw railway generator for 105 r. p. m. It is an eight-pole machine for 550 volts, the armature having 240 slots, the number of commutator bars being 480. The diameter of the armature is 1900 mm, the length of the core 460 mm. The winding is a parallel drum. The temperature rise after 10 hours' run with 360 kilowatts was only 22 degs. C. on the armature, and 25 degs. C. on the field coils. No brush shifting is necessary, in spite of the field being shunt wound. The weight of the machine with two foundation plates, but without shaft or bearings, is 45,000 lbs.

Telephony and Telegraphy in England.

The British Postmaster General has recently issued his annual report. In regard to the London metropolitan exchange system it is stated that the greater part of the underground work has been completed. About 160 miles of pipes have been laid, into which about 20 miles of cables (each containing from 200 to 434 wires) have already been drawn. In the other districts (Westminster, Kensington, etc.) about 110 miles of pipes have been laid, and about 16 miles of cable drawn in. Owing to unforeseen difficulties which have been met with in carrying out the underground work, and in obtaining and adapting buildings for the exchanges, it has not yet been practicable to bring the system into operation.

The number of telegrams sent during the year was 89,576,961, showing a decrease of .92 per cent. To cope with this vast amount of work is a staff of 173,000 persons, of whom 94,000 (including over 15,000 women) are on the regular establishment. Close upon 80,000 fill unestablished situations, and of these 20,000 are women. The total

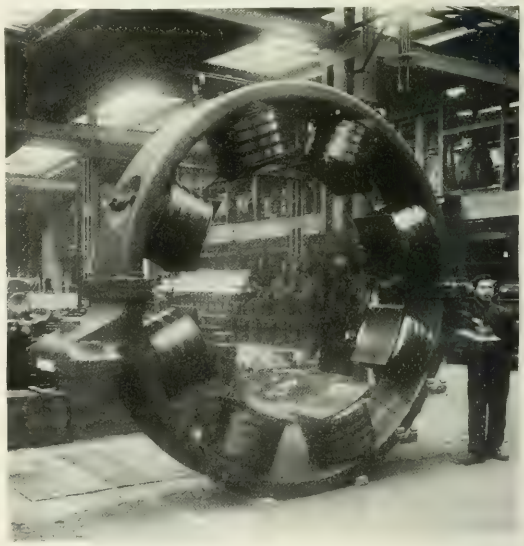


FIG. 10.—FIELD OF 360-KW RAILWAY GENERATOR.

wages of this great army amounted to nearly £9,000,000—almost exactly one-half of the total revenue of the Post Office. The net deficit on telegraphs was £353,216, or £64,624 more than last year. If allowance be made for interest on the capital—£10,868,663—created for the purchase of the telegraphs, the deficit on the year is raised to £652,104.

Surges in Transmission Circuits.

By A. E. Kennelly.

MR. STEINMETZ'S recent and able paper, read before the American Institute of Electrical Engineers (22d August, 1901), has drawn attention to the importance of considering the limits of pressure which may be attained in a high-pressure alternating-current circuit, by reason of sudden changes in the circuit's electrical condition, as, for example, by the rupture of a short-circuit. Mr. Steinmetz gave in that paper certain approximate formulæ for determining the oscillatory rise of potential in a transmission circuit of known electrical constants, under known conditions of sudden disturbance. The paper was, however, of a markedly algebraic character, and on that account may not have received its full appreciation at the hands of those who are not mathematicians. It will be seen, however, in what follows, that the essential conclusions of Mr. Steinmetz can be attained in a very simple manner, and that the process of reasoning is well within the grasp of the majority of electrical students.

The worst condition that can arise in connection with an electrical transmission circuit from the standpoint of the engineer, that is to say, the most violent and dangerous electric surge, is that which immediately follows the sudden rupture of a short circuit. The current that the circuit carries at the time of the short circuit is probably far in excess of the maximum normal working current, and consequently the circuit under the circumstances considered is first supplied with an unduly powerful current, and then this current is suddenly interrupted. If the said current in the circuit is continuous, or non-alternating, then no matter at what particular moment the interruption takes place, the resulting surge set up in the circuit will be the same. If, however, as is usually the case in practical high-pressure circuits the current is alternating, then the magnitude of the succeeding surge will depend upon the value of the current at the instant of rupture. If the alternating-current wave happens to be interrupted just at the zero point, the resulting surge will be negligibly small. If, on the contrary, the alternating-current wave of the circuit is at its crest or maximum, then the surge due to its interruption will be the same as though a continuous current of that full magnitude had been interrupted. The surge of interruption depends then upon the nature of the circuit and upon the magnitude of the suddenly interrupted current. If an alternating-current short circuit is broken gradually, i. e., through external resistance either automatically, or by hand, there will be no appreciable surge. Similarly, if the alternating current is interrupted at or near the zero point, either automatically or by hand, there will be no appreciable surge. The pressure acting upon the circuit at the time of interruption has a distinct but subsidiary, and practically negligible, effect upon the surge of interruption, partly because the pressure is greatly reduced in the case of a short circuit, and partly because the effect on the surge of even the normal pressure, at the time of interruption, is usually far less than the effect of the abnormally great current strength.

From an electrical point of view, therefore, the worst case that can happen is the sudden interruption of a current strength of I amperes in a transmission circuit consisting of a pair of wires, the inductance of which is l henrys per loop mile or kilometer, and the capacity between which is c farads per loop mile or kilometer. The value of I in the case of sinusoidal alternating-current waves may be anything up to $\sqrt{2}$ times the effective value of the assumed steady alternating current just before breaking. That is to say, the value of I may be as high as 41 per cent in excess of the indicated amperes, if there were time to obtain a reading just before the interruption, and it might happen to be anything between this maximum value and zero. Even with non-sinusoidal currents in practical alternating-current circuits, the maximum value at the crest of the wave is not ordinarily greater than 50 per cent in excess of the indicated or effective value. We have to assume, however, that the value of I is known, and if it be due to a sudden short-circuit occurring at the receiving end of the line, we must find out in some way what the greatest possible value of I could be under working conditions. It is usually limited by the reactance of the generator armature.

If the transmission circuit is L miles or kilometers in length, and all of this length carries the current I at the moment before interruption, then the circuit will contain a certain amount of electrical energy expressed as $\frac{LlI^2}{2}$ joules or watt-seconds; or, if $L^1 = Ll$ be the total inductance of the loop circuit, the energy of the circuit at interruption will be $\frac{L^1 I^2}{2}$ joules. This energy resides in the magnetic flux surrounding the wires and linked with the circuit. This is the energy whose sudden release is capable of doing damage to the circuit by breaking down the insulators or insulation. It evidently amounts to $\frac{lI^2}{2}$ joules per mile or kilometer, and thus increases as the square of the interrupted current strength. As the interrupted current strength doubles, the energy released and capable of doing damage increases four-fold.

For example: A pair of single-phase copper wires, No. 5, B. & S. gauge, supported on poles, at an inter-axial distance of 3 ft., would have an inductance of approximately 4 milli-henrys per mile of loop. If these wires carried a current of 1000 amperes, then the electromagnetic energy per mile would be $\frac{1000 \times 1000 \times 0.004}{2} = 2000$ joules, or about 1500 ft.-lbs. This is the magnetic energy in the external medium associated with the current. If that current is interrupted gradually, as, for example, by providing a resistance coil to its discharge, this energy will be expended as heat by the discharging current through the said coil. If, however, the two lines while connected by the short circuit at the distant end, are instantaneously disconnected at the generator end, this energy is not allowed to discharge. Nevertheless, the current cannot persist after the circuit has been broken, and the energy is automatically converted by a surge in the circuit from the magnetic to the electrostatic form. The condenser formed by the two wires considered as plates separated by the surrounding insulator, becomes charged, until the electrostatic energy in the dielectric is equal to the immediately preceding stock of electromagnetic energy. If there were no resistance in the conductors, and no leakage between them, i. e., if perfect conduction and insulation existed, the energy would continue to oscillate perpetually in alternate surges between the electromagnetic and electrostatic forms, the surging current crests being intermediate in time between the crests of potential difference in the circuit. In the very first actual current surge, however, i. e., during the decay of the interrupted current, and the transfer from the magnetic to the static type, there is a loss of energy by I^2R in the actual resistance of the wires, and consequently the electrostatic energy is not quite as great as the initial stock of magnetic energy. For the same reason the successive surgings grow less and less, until, under practical conditions, they become negligibly small in, say, a dozen swings, assuming that the insulation has not been destroyed.

The electrostatic capacity of the condenser formed by the two wires is $Lc = C$ farads, where C is the total capacity and c the capacity per mile or kilometer, and the electrostatic energy of this condenser charged to an e. m. f. of E volts is $\frac{LcE^2}{2}$ or $\frac{CE^2}{2}$ joules. Consequently, ignoring the deadening influence of resistance in the first half swing, we may equate the electrostatic energy and the original magnetic energy by the expression

$$\frac{LcE^2}{2} = \frac{LlI^2}{2} \text{ joules}$$

or simplifying, $$E = I\sqrt{\frac{l}{c}} \text{ volts.}$$

This indicates the maximum value of the e. m. f., which will be attained in the first surge by the exchange from magnetic to static energy. It is clearly independent of the length of the line (to a first approximation), and depends upon the ratio of inductance to resistance, for a given strength of interrupted current. If the capacity is small and the inductance large, the quantity $\sqrt{\frac{l}{c}}$ will be large, and the surging e. m. f. correspondingly magnified. This is just the condition met with in overhead wires. On the contrary, if the inductance is small and the capacity large, the quantity $\sqrt{\frac{l}{c}}$ will be correspondingly lowered, and likewise the e. m. f. of surge, for a

given interrupted current strength. This is practically the condition of affairs in underground wires. Consequently, it fortunately happens, that just where a surge e. m. f. can do the most expensive damage, namely, in underground wires, the tendency to surge is less violent than in overhead wires, where the damage is more readily traced, and less expensive to repair. Since E is the instantaneous maximum surge voltage, and I the instantaneous current of rupture in amperes, the quantity $\sqrt{\frac{l}{c}}$ is a resistance, expressible in ohms. It may be called the *free surge resistance* or *free oscillation resistance* of the circuit. In the case of overhead wires, this free oscillation resistance varies between 400 ohms, with large wires close together, and 900 ohms, with small wires far apart. We may take the mean as 600 ohms. For underground wires the electrical conditions vary more widely, but 40 ohms may be regarded as a common value of the free oscillation resistance. Consequently, we may say that in the case of overhead wires the first surge of e. m. f. will be about 600 volts per ampere, and in underground wires 40 volts per ampere, of *suddenly* interrupted current. Interruption through an ordinary arc at a switch will not usually be sufficiently sudden to produce the full e. m. f. Interruption through a magnetically blown-out arc, or through an oil-extinguished arc, may be almost instantaneous. It seems, however, that the ordinary arc in air sometimes acts automatically like a Wehnelt interrupter, and so may interrupt very suddenly.

If the overhead line is connected with a condenser, this condenser will share the electrostatic stress and energy of surge, and consequently will tend to reduce the e. m. f. of surge. In other words, the same amount of electrostatic energy will then be stored away in both the line and the condenser, by the automatic development of a more moderate surge e. m. f.

If the short circuit, which, as we have seen, is the most dangerous cause of surge, does not take place at the distant end of the line, but say near to the generator, then although there will be less resistance in the line circuit, and this might tend to increase the current, yet if the current is limited by generator reactance to about the same value in either case, the surge e. m. f. will be less than when the whole length of line is involved, because only a portion of the line carries the excessive current, and supplies electromagnetic energy, whereas all the line will be brought into action in absorbing electrostatic energy. The line beyond the short circuit will act, in fact, like an auxiliary condenser. Cases may arise, however, when synchronous motors beyond the short circuit will act temporarily as generators, and will cause powerful currents, through the short circuit, to be sent from both ends of the line, in which case the surge e. m. f. might be as great as when the short circuit is at the distant end.

If the short circuit acts through transformers at either end of the line, the inductance of the line will be virtually increased, owing to the magnetic leakage in the transformers, and the inductance of the circuit in the calculation should be increased by the additional stray field inductance of the transformer coil or coils included in the short circuit. Although high-tension transformers have some capacity, yet they have also considerable reactance, and they tend to increase rather than to diminish the surge e. m. f.

The surge produced by the sudden application of a generator to the transmitting end of a circuit is comparatively small, and its value cannot exceed the maximum cyclic pressure. The sum total of generator and surge pressure, when throwing the generator into the line circuit, cannot therefore exceed twice the maximum cyclic generator pressure.

A surge is sometimes produced when connecting a transformer into circuit, which is due to an entirely different cause, namely, to a large residual magnetic flux in the core.

The frequency of free surge in a circuit is such that neglecting the influence of terminal transformers the inductance reactance $Ll\,\omega$ or $L^1\,\omega$ is equal and opposite to the capacity inductance $\frac{1}{l\,c\,\omega}$ or $\frac{1}{C\,\omega}$ so that the pulsation $\omega = \frac{1}{l\sqrt{c\,l}}$ radians per second. But the quantity $\frac{1}{\sqrt{c\,l}}$ is the velocity v, expressed in miles or kilometers per second (according to the linear units in which l and c are expressed) with which the electromagnetic waves run through the dielectric, and which in air is the air-velocity of light. Consequently $\omega = \frac{v}{L}$ radians per second.

For aerial wires $\omega = \frac{300,000}{L}$ radians per second, when the length L of the loop is expressed in kilometers, and $\omega = \frac{186,380}{L}$ radians per second, when the length L is expressed in miles. Consequently, the number of radians per second in the pulsation frequency $\omega = 2\,\pi\,N$, of the surges, is numerically equal to the number of journeys that electromagnetic waves can make in running to and fro along the loop in a second. In a loop of aerial wires one mile long light could travel to and fro 186,380 times in a second, and this would be the number of radians of the frequency in angular measure, or expressed in cycles $N = \frac{186,380}{2\,\pi} = 29,650$ cycles per second.

We have assumed in the above statement that the only inductance and capacity of the circuit resided in the dielectric of air surrounding the two conductors. If transformer coils at the two ends enter consideration, their additional inductance and capacity will load the circuit and reduce its frequency. Even if there are no terminal inductances or capacities to load the circuit, there is always some slight extra inductance due to the magnetic flux inside the substance of the conductors themselves, which, therefore, tends to reduce the frequency somewhat below the theoretical light frequency. For practical purposes, however, we may say that the limiting frequency of free surge oscillations in a circuit is $\frac{30,000}{L}$ cycles per second, when L is expressed in miles. Terminal apparatus electrically tied to the line will always reduce this frequency.

In the case of underground wires employing solid dielectrics the speed of wave propagation $v = \frac{1}{\sqrt{c\,l}}$ is reduced by reason of the greater specific inductive capacity of the dielectric, and is inversely proportional to its square root. The electromagnetic wave speed v will be usually reduced somewhat below 100,000 miles per second, and is approximately $\frac{186,380}{\sqrt{\kappa}}$ where κ is the specific inductive capacity of the dielectric substance. The limiting frequency of free surge of the circuit will be usually in the neighborhood of $\frac{15,000}{L}$ cycles per second, or half the frequency of free aerial circuits, neglecting the retarding influences of electrically linked terminal apparatus. A 10-mile length of double-conductor cable would, therefore, have a free surge frequency of about 1500 cycles per second. It is evident that the free surge frequency depends only on the length of line, and upon the nature of the dielectric, and neither upon the frequency of the working alternating current employed on the line, nor on the cross sectional dimensions of the conductors. In regard to the influence of circuit length, the law of the frequency is the same as that of sonorous vibrating strings—it is inversely as the length.

The surges in electrical circuits here considered, and which may be of serious magnitude when a powerful current is suddenly interrupted, must necessarily take place to some extent whenever an electrical disturbance takes place in the circuit. Thus in the case of electrical transmission circuits, every change in the load or in the speed of the generator, must set up some electrical disturbance and corresponding set of surges, the intensity of which will depend upon the magnitude and suddenness of the disturbance.

These surges are sometimes popularly attributed, but incorrectly, to resonance. They are no more due to resonance than is the vibration of a suddenly plucked tuning fork. They are free oscillations due to a disturbance of the electromagnetic or electrostatic energy in the dielectric surrounding the conductors. Each disturbance produces a series of alternate current and potential waves, having the natural frequency of the circuit, until the energy of the disturbance has been entirely absorbed by the Joulean effect of the current waves.

The same surges in short insulated conductors are employed for wireless telegraphy. In this case the frequency is so high that a large part of the energy of surge is emitted in the form of the radiant energy desired, and only a portion is wasted in the conductor as heat.

The stationary waves of pressure and current in long transmission lines, under the influence of an impressed e. m. f., are due to forced oscillations depending on the frequency of the generator, and not necessarily possessing the free period of the circuit. These are properly attributable to the resonance of the circuit.

A comparison between free and forced oscillations may conveniently be made as follows: In a circuit containing inductance L^1

and capacity C, and represented in its simplest form by a series connection of inductance coil and condenser, the free frequency of oscillation of the system is such as makes the capacity and inductance reactances equal and opposite so that $\omega = \frac{1}{\sqrt{CL^1}}$ radians per second. This will make the total reactance of the circuit zero, and this will be the natural frequency of the circuit in radians per second, except in so far as the resistance of the circuit will slightly diminish the frequency. If a sinusoidal e. m. f. be impressed upon this circuit with variable frequency, resonance will occur at this, and only at this, natural frequency.

In a transmission circuit having distributed total inductance L^1 with total capacity C, and suddenly distributed as by the interruption of a powerful current, the pulsation frequency of oscillation is approximately $\omega = \frac{1}{\sqrt{L^1C}}$ radians per second, as above pointed out. This will make the total reactance of the circuit zero. These free natural oscillations or surges rapidly dwindle and expire. When a powerful short circuit is suddenly interrupted, these surge e. m. f.'s may be many times greater than the working e. m. f. of the circuit. Their magnitude does not depend upon the length of the circuit, to a first approximation.

If the same transmission circuit of distributed inductance and capacity be subjected to the impressed e. m. f. of any pulsation frequency ω, stationary waves will be established in the circuit of such length that in the πth part of them the total reactance is zero. These stationary waves of potential and current occurring along the line are due to resonance, or partial resonance, excited by the impressed frequency upon the distributed capacity and inductance of the circuit. As the frequency varies so will the positions, wave lengths and magnitudes of the stationary waves, or stationary forced oscillations, which remain constant so long as the impressed frequency and the terminal conditions remain constant. The resonant rise of potential and current increases towards the receiving end of the line, and when the wave form of generator e. m. f. is nearly sinusoidal, the magnitude of these resonant stationary waves is usually small in commercial transmission circuits. They depend upon the length of the circuit and tend to increase in magnitude with the length.

Measurement of the Angle of Lag of Three-Phase Circuits with One Wattmeter

By A. S. McAllister.

THE last few months have witnessed an unusual development in instruments for the measurement and indication of the angle of lag or of the power factor of alternating-current circuits, and the time appears to be fast approaching when a power factor indicator will be considered as essential to a transmission circuit equipment as the inevitable voltmeter.

Where such instruments are not at present available recourse must yet be had to the measuring instruments on hand. In most cases the determining of the angle of lag involves the measuring of the real and of the apparent power.

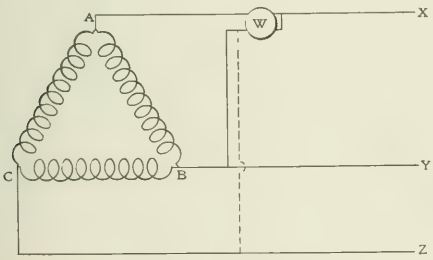


DIAGRAM OF CONNECTIONS.

In addition to the large number of instruments required for three-phase circuits by the amperes-volts-watts method of determining the lag angle the method is subject to several sources of errors. An error in the reading of a single instrument affects at once the results obtained, and though two wattmeters can in any case be so placed as to indicate the true power, yet unless the current be measured in each lead wire when the circuits are unsymmetrically loaded, the apparent watts may not be indicated by the product of amperes and volts. In fact, it is quite possible with three-phase circuits on unbalanced loads to obtain an indicated power factor greater than unity when this precaution is neglected.

A single wattmeter method which may be used for determining the angle of lag is outlined below. Though embodying nothing new in principle, it is believed that this method is not as generally well known as its simplicity and comparative freedom from errors justify.

If a wattmeter, connected as indicated by the diagram with its current coil in one lead of a three-phase circuit, be read with its e. m. f. coil across between this lead and first one and then the other of the remaining two leads, the two values thus obtained may be used to determine the angle of lag of the current by means of the following relation:

$$\tan \phi = \sqrt{3}\,\frac{W_1 - W_2}{W_1 + W_2}$$

where ϕ is the angle of lag and W_1, W_2 are two readings of the wattmeter, as indicated above.

When ϕ is greater than 60 degs. one reading will be negative, so that the difference of readings will be greater than their sum.

The proof of this relation is as follows:

Let I = current in lead $A\,X$,
E = e. m. f. of $A\,B$ and of $A\,C$,

then

$$W_1 = I\,E \cos(\phi - 30)$$
$$W_2 = I\,E \cos(\phi + 30)$$

and since

$$\cos(a \pm b) = \cos a \cos b \mp \sin a \sin b$$

$$W_1 - W_2 = I\,E\,[\cos(\phi - 30) - \cos(\phi + 30)]$$
$$= 2\,I\,E \sin 30 \sin \phi = I\,E \sin \phi$$

and

$$W_1 + W_2 = I\,E\,[\cos(\phi - 30^\circ) + \cos(\phi + 30)]$$
$$= 2\,I\,E \cos 30 \cos \phi = \sqrt{3}\,I\,E \cos \phi$$

hence

$$\frac{W_1 - W_2}{W_1 + W_2} = \frac{1}{\sqrt{3}} \tan \phi \text{ as above.}$$

If the e. m. f. of $A\,B$ be not equal to the e. m. f. of $A\,C$, the reading of the wattmeter in either position may be corrected to such a value as would have been obtained had the two voltages been equal, in which case the above relation will hold true.

Since any proportional error in the calibration scale of the wattmeter affects equally both the sum and the difference of the readings, and hence does not alter the ratio of the two, it follows that a wattmeter having a proportional scale error of any value whatever may be used to obtain the correct value of lag angle, and that any instrument of the dynamometer type, whether calibrated or not, may be used in place of the wattmeter.

The lag angle thus obtained is the true angle between the current in lead $A\,X$ and the mean voltage between $A\,B$ and $A\,C$.

If the circuits are symmetrically loaded the sum of two correct wattmeter readings will equal the real power, while from the difference of the two readings may be obtained the "wattless power."

Novel Lightship.

The Diamond Shoal lightship, No. 71, Captain Tawes, has arrived in Baltimore, where she is to be installed with a new electrical apparatus, which is to send a 13-inch beam of light from the ship's deck to the clouds. The clusters of lights now at the tops of the two masts are visible 13 miles at sea, but it is expected that the pillar of light rising to the skies may be seen 30 and 40 miles at sea. This new marine signal is the device of Commander Albert Ross, inspector of the Fifth Light-House District, and will be put in operation Jan. 1. It is expected that the sky-piercing shaft of light will also be adopted at Fire Island, Sandy Hook and Nantucket Shoals lights. It is not proposed to abolish the present masthead beacons. As a guide to mariners coming in from sea, the 13-inch electric beam, reaching up in the dome of night, will, it is asserted by those responsible for the scheme, be as far ahead of big electric beacons of the first order as the beacons were ahead of the oil lamps.

Elements of Illumination—XXXIV.

By Dr. Louis Bell.

THERE is at present no conventional method of comparing the brilliancy of different sources of light. Flames are universally rated by their intensity as measured in a horizontal plane, in a direction generally 45 degs. from the plane of the flame if the flame is flat, or irrespective of direction in argand and other symmetrical round burners, including mantle burners.

In the early days of electric lighting the photometric question assumed some importance, and all sorts of wild statements were afloat as to the power of the new illuminant. Arc lamps were apparently rated at their momentary maximum intensity on the most favorable direction. The rivalry between makers of arc lamps did not tend to depreciation of their intensity, and so it came about that an open arc taking about 450 watts was rated at 2000 candle-power, while a similar arc of about 325 watts was rated at 1200 candle-power.

While it is possible that some experimenter at an especially favorable moment may have obtained these intensities in a single direction, it is certain that the ratings were very soon regarded as merely conventional. They have long since been relegated to the category of merely commercial designations, the rating bearing no more precise relation to the thing than does the term "Best," as applied to flour or other commodities.

When an individual or a municipality contracts for a 2000-cp arc light the thing bought, received and paid for, is an arc light taking about 450 watts of electrical energy, and such is the general understanding of the term as interpreted at various times by the courts. There is not nor has there ever been in commercial use in this country or elsewhere an arc lighting system using lamps actually giving anywhere near 2000 candle-power, either as maximum zonal intensity or as mean spherical intensity. The former requirement would demand about 750 watts at the arc, the latter nearly 1200. Lamps of such power have only been used for searchlights and similar purposes, and are far too powerful to be advantageously used for ordinary illumination.

In incandescent lighting the ratings are intended to express the real candle-power of the lamps. Sixteen candle-power is a figure borrowed from the legal requirements for gas, and corresponded originally to a measurement corresponding to that applied to gas flames, i. e., in a horizontal plane 45 degs. from the plane of the curve formed by the filament.

With the introduction of looped and spiralled filaments giving a better distribution of light than the simple U-shaped filament, demand arose for a method of measurement which would credit these lamps with their just due. Hence arose the measurement of mean horizontal candle-power by rotating the lamp. This credits the lamp with its just horizontal candle-power as against a lamp giving 16 candle-power only in certain horizontal direction, but it fails to give credit for gains in spherical distribution and puts a premium on lamps with long U-filaments adapted to throw out a large proportion of horizontal illumination.

Mean spherical candle-power, i. e., total luminous flux, is unquestionably the fairest basis of comparison between various sources of light, but it is somewhat troublesome to measure, and runs counter to long established custom and legal requirements as to gas lighting. It is certainly desirable that a uniform method should be established for all radiants, and this is no easy matter. There is a strong tendency to apply the mean spherical measurements to arc lamps, although the lower hemispherical candle-power is sometimes used instead on the ground that downward light is the proper criterion of useful illumination. This rating is approximately true of lamps having reflectors over them, but it is certainly not true in general, for it neglects the very great effectiveness of diffuse reflection from walls and ceiling.

The fact is that no simple rating can be applied with equal fairness to all commercial sources of light, by reason of their very great diversity in the nature of the light-distribution.

The mean spherical measurement comes nearer to general fairness than any other, and could it be universally adopted it would afford a very satisfactory basis of comparison. As a practical standard at the present time it leaves considerable to be desired.

Mean horizontal candle-power is by far the easiest thing to measure, and is to be recommended, save in the comparison of radiants deliberately planned, as in cases of intensive gas burners, the American type of Nernst lamp and certain arcs and incandescents, to give particularly strong illumination in some other direction.

The thing most to be desired in practical photometric work is a general international convention defining empirically, if need be, certain bases of work. A working reproducible standard of greater intensity and better color than the Carcel or Hefner lamp is badly needed. As actual standards for use on the photometer, bar nothing, can be better than incandescent lamps, but as has already been noted, they are not reproducible. The nearest approach to a reproducible standard of good size and color at present available seems to be the Vernon-Harcourt 10-cp pentane lamp, which is the present official standard in London. It has not yet been subjected to as searching and protracted an investigation as the Hefner lamp, but the reports so far obtained from it are highly encouraging, while its intensity and color are great advantages in passing from it to the more powerful modern radiants.

Granted a proper standard, there is also needed a definite conventional method of dealing with the color difficulty. This involves a tougher problem even than the standard itself. Possibly Crova's method or some modification of it might be made to serve a useful purpose. Finally, aside from the difficulty of comparing lights differing widely in color there remains the question of the different illuminative values of such lights when put into practical service. This again suggests the question of measuring illumination instead of the intensity of the radiant, but as has already been indicated there are no methods of measuring illumination comparable in precision with ordinary photometry, which is saying little enough.

It is to be hoped that the recently organized Bureau of Standards may facilitate the study of these puzzling matters and promote an international photometric congress that can give general sanction to a definite programme in commercial photometry.

A great deal of time and effort has been wasted in this world in the promulgation of so-called "absolute" standards, referred in a perfectly definite way to immutable constants of nature. Desirable as they are, it is of far greater importance to have a convenient reproducible and international set of units in universal use. The metric system started on its career as an absolute system, but its value lies not in the supposed relation of its units to natural constants, but in their relation to each other, and in its well-nigh universal acceptance as the basis of scientific measurements of length and mass.

Standards as concrete things may be constantly susceptible of improvement without limit. They are important practically in proportion to their general recognition at a certain conventional determinable value.

THE FUTURE OF ILLUMINATION.

At the present time the ordinary materials of illumination are pretty well understood, and their proper use is a matter of good judgment and artistic sense. Illumination is not a science with well-defined canons of what one might call illuminative engineering, but an art wherein an indefinable and uncommunicable skill pertains almost as it does in the magic of the painter.

There are certain general rules that must be followed, certain utilitarian ends to be served, but whether the result is brilliantly successful or hopelessly commonplace depends on the skill that inspires it. There must be in effective illumination a constant adaptation of means to ends, and a fine appreciation of realms that quite defies description. One may attack the problem of illuminating a great building with all the resources of electrical engineering at his command and score a garish failure, or he may conceivably be confined to the meagre bounds of lamps and candles and still triumph.

The general tendency with the modern intense radiants at command is to light too brilliantly, to key the vision to so high a pitch that it fails to appreciate the values of the *chiar-oscuro* on which the artistic result depends.

The desideratum in illumination, except for a small group of scenic effects, is the possession of cheap and powerful radiants of low intrinsic brilliancy capable of modification in delicate color tones. It is doubtful whether these qualities are compatible with very high luminous efficiency with a flame or incandescent radiant. In modern gas and electric lighting the progress toward efficiency is in the direction of very high temperature, which implies high intrinsic brilliancy.

Vacuum tube lamps at present in only a crude experimental stage give hope of better things, but at great risk of color difficulties, particularly if high efficiency is reached.

Ideally a gaseous radiant with nearly its whole luminous energy concentrated in the visible spectrum would give magnificent efficiency, but it by no means follows that it would give a good light. Sodium vapor meets the requirements just noted tolerably well, yet

there is no more ghastly light than that given by a salted spirit lamp.

It might even be possible to work with a mixture of gases such as would give a light approximately white to the eye, and yet be very far from a practicable illuminant, for the phenomena of selective absorption are such, as we have already seen, that the color of a delicately tinted fabric depends on its receiving a certain scale of colors in the light which it reflects. To the eye a much simpler color scheme is necessary to reproduce light substantially white, and such light falling on a colored fabric would by no means necessarily bring out the tints that glow by daylight.

Even the firefly's secret, could man once penetrate it, might not prove such a valuable acquisition as it would seem at first thought. To the eye it seems greenish, and, in point of fact, it so completely lacks the full red and the violet rays that its effect as an illuminant on a large scale would be most disagreeable, far worse than an early Welsbach at its most evil stage of decrepitude. We must not only steal the firefly's secret, but give him a few useful hints on the theory of color before the net result will be satisfactory from the æsthetic standpoint. Firefly light might do for a factory, but it would find but a poor market as a general illuminant.

Remarkable Automobile Records on Coney Island Boulevard.

On Saturday, Nov. 16, the Long Island Automobile Club had a large parade of automobiles through Prospect Park, Brooklyn, and then in the afternoon conducted, under the rules of the Automobile Club of America, a series of "races" on the superb Coney Island Boulevard, which stretches from the southern side of the park down to the popular seaside resort, and is one of the finest thoroughfares in the world, with a broad central road, where a dozen teams can drive abreast, two fine cycle paths, a horse path, a side driveway and two paved foot paths. It is almost level and generally straight, constituting, therefore, an ideal place for speed tests with bicycles, trotters, automobiles, etc. With the aid of the police, it is easy to reserve any portion temporarily, and on this occasion Park Commissioner Brower lent his official assistance and countenance. Not only was there a wonderful show of automobiles, but lured by the brilliant weather and their interest in the new sport, at least 25,000 Brooklynites thronged along the edges of the smooth, hard course. But for the unhandiness of the club in getting things started, the day was a great success, for records were smashed to flinders, while scarcely an automobile endured the same fate.

Temporary headquarters at the southeastern end of the course were established at Bishop's Hotel, while two or three miles away there was a reviewing stand near the northern end, so that vehicles were able to make a flying start, come to the line and then be timed over the mile which had been most carefully measured by engineers. The timing over the course was done with electricity, the work being in the hands of the Second Signal Corps, who had a station midway, so that being advised of the flying start they were ready for the arrival at the line. There a pneumatic cable lay stretched across the road so that the machine as it crossed closed a circuit and this was at once clicked to the timers at the reviewing stand, giving them just enough interval to take the time at the end of the mile. While much confusion and delay resulted owing to the frequent passage of machines not racing, each automobile actually timed was sure of its own record to a tick when the work began. The Signal Corps was also helped greatly by its temporary telephone line, and by regular wig-wagging. About 20 Signal Corps men were employed in the work, under Captain Charles Baldwin.

Fig. 2.—Signal Corps Station on the Boulevard.

As already noted, all records were broken. Fournier, the famous French professional, ran his Mors 40-hp gasoline automobile over the measured mile in the wonderful time of 52 seconds on the first trial and 51 4-5 seconds on the second. Mr. Foxhall Keene, in another 40-hp Mors, did the distance in the hardly less remarkable time of 54 2-5 seconds. Mr. A. C. Bostwick, with a 40-hp Winton, did it in 56 2-5 seconds, but his machine hardly seemed to be getting the full value of regular "ignition." That the sparking devices should stand the racket at all seems surprising, for the masses of tubes and machinery hurtled through the air as if shot from a gun, and with frightful din, to which the quiet passing of Riker's electric was in striking contrast. In steam vehicles, new time was made by Mr. S. T. Davis, Jr., in a 4½-hp locomobile, which covered the distance in 1.15 seconds. A Waltham motor bicycle, ridden by Mr. R. Atkinson, was timed at 1.35 seconds, and a De Dion-Bouton motorette, under 1000 lbs., ridden by Mr. J. Longuez, got there in 1.27 3-5 seconds. In

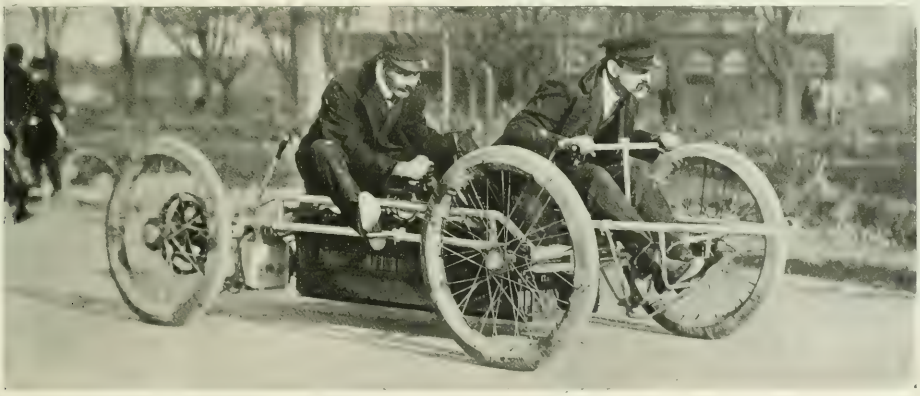


Fig. 1.—Electric Racing Automobile.

the gasolines over 1000 lbs. and below 2000, Mr. Percy Owen covered the ground in a 12-hp Winton in 1.53 2-5.

The Riker electric racer of the Electric Vehicle Company, designed and ridden by Mr. A. L. Riker, made a remarkable record, covering the distance in 1.03 seconds. It is shown herewith, although our photographer was unfortunately not able to secure a picture of Mr. Riker himself during the event. It will be seen that the machine is stripped down to the barest essentials, as in the case of the big gasoline racers. It is equipped with 60 cells, of a special type of storage battery, weighing 15 lbs. per cell, and is driven by two motors, approximately 2 horse-power each, driving the rear wheels by single reduction gear at a ratio of 5 to 1. The machine has four 32-inch wheels, with 3-inch pneumatic tires. The battery is carried between the axles on an independent frame, the frame being supported by springs attached to the reaches. The vehicle weighs complete 1850 lbs. The battery is divided into groupings of six cells each, and the controller is so arranged that it cuts in group after group, until the whole number are in series.

As a matter of fact, this machine is not intended for "road work," such as that of last Saturday, but is intended as a track racer. While the record made must be accepted, it was evident that the machine could have made better time, for Mr. Riker had to steer around sudden obstacles, which he did with wonderful nerve and dexterity, but with the certain loss of several seconds. The tests made at the works are reported to show this. The passage of the vehicle was startling not alone in its swiftness, but in its stillness, the approach being so sudden and quiet that people were not scared off the course as in the case of the racketting gasolines. This Riker machine is the one which carried off the Larz-Anderson cup last June, competing against all types of machines at the County Club, Brookline, Mass.

Illumination of Richmond, Va., Carnival Tower.

One of the features of Southern life is the indulgence in carnivals and mardi-gras festivals that are carried out with great vim and success, and with a spirit of fun that Americans, as a whole, are hardly credited with possessing. The Richmond (Va.) Carnival, held Oct.

FIGS. 1 AND 2. RICHMOND CARNIVAL TOWER

7-12, was a great success, the elements co-operating with superb weather. Its object was the betterment of the city, extension of business, and advertising its climate, industries and manufactures. The night pageants were very beautiful. Ten thousand electric lights were strung across Broad Street for a distance of about half a mile, making it as bright as day.

The main decorative feature was an elaborate arch constructed of wood and iron, and illustrated in the two accompanying engravings, one of which shows the decorations by day and the other by night. As will be seen, the outlines of the arch were shown by lines of incandescent lamps, while a star composed of clusters of lamps was placed at the top of the tower which surmounted the arch itself. One principal feature of electrical interest in connection with the carnival was the fact that part of the illumination of the tower was provided by electric railway headlights, which were also used to considerable extent in the city in connection with the other illuminations. The headlights on the tower are the five lights seen in the night view just above the arch, and located one on each of the pilasters. They were loaned for the occasion by F. Boykin Jacobs, Southern agent for the Syracuse changeable headlight of the Crouse-Hinds Electric Company, of Syracuse. This is the first time, so far as known, that electric railway headlights have been used for decorative purposes, and their employment offers a suggestion in other cities where illuminations form a prominent feature of a celebration.

In addition to the headlights on the arch, about 30 or 40 others were in use, adding greatly to the brilliancy of the scene; there were five in use on the arch, ten at the Carnival headquarters, four in the T. P. A. booth, four in the animal show, three in the Streets of Cairo, and others were scattered in different places in one and twos. The General Electric Company contributed the use of some apparatus for effects, and aside from private illuminations, the Virginia Development Company gave the gratuitous use of 3000 incandescent lamps, to which the Carnival Association added 10,000 more.

New Telephone Patents.

The weekly crop of telephone patents of the issue of Nov. 12 comprises a receiver detail, a silence hood to enclose only the head of the user, an inter-communicating system, a switchboard system in which the jacks themselves are switched on and off the line as required, and a two-party line toll meter. One misses temporarily the repeater and the selective signal, but the future is all before us.

To Walter F. Taylor, of Brookline, Mass., is granted a patent on a receiver embodying several minor improvements. The adjustment of the magnet in relation to the diaphragm is made by means of a supporting plate or collar attached to the magnet having a number of inclined surfaces which fit over similar inclined surfaces on an annular shoulder in the receiving shell. Rotation of the magnet will move one inclined surface over the other, causing it to be moved longitudinally. After the proper adjustment is attained the magnet is locked by screws passing through slots in the undulating collar. Other features of this receiver are semi-circular pole-pieces and an improved clamp binding post.

Canada furnishes a telephone patented by Edwin W. Smith, of St. Catherines, providing a telephone cabinet or hood, designed to take

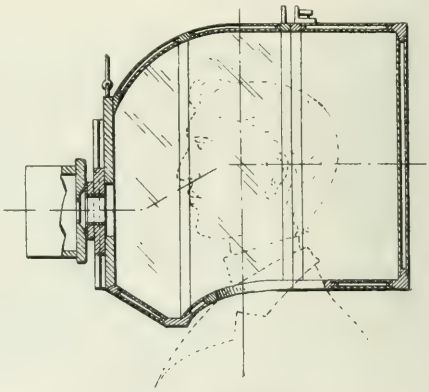
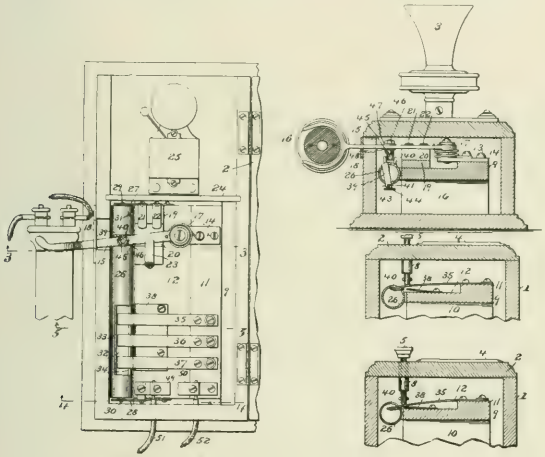


FIG. 1.—TELEPHONE HOOD.

the place of the regulation silence booth in situations where space is extremely limited. This device, which is a sort of diver's helmet of even more inelegant form than the real article, is intended to be clamped to the transmitter and to enclose what in photography are termed the "head and bust" of the telephone user. The receiver is fixed in the side of the hood, and the switch-hook consequently must be actuated by a cord and tassel, the tassel engaging in a fixed hook placed below. (Fig. 1.)

To Edgar W. Hazazer, of New York, is granted a patent on an inter-communicating system which has been ingeniously worked out and contains a clever cylindrical rocking switch that is worthy of a better cause. The place of the inter-communicating telephone system, never very solidly established, has largely been filled by the private branch exchange, which gives both interior and city service through the medium of a switchboard and a trained operator. The operation of Mr. Hazazer's switch, which is the gist of the invention, will be understood by Figs. 2, 3, 4 and 5. A metal cylinder, 26, mounted on journals so as to be capable of rotation, has a slot, 32, cut in it. Opposite the slot are springs 35, 36, 37, connected to the various lines of the system and operated by means of buttons passing through the face of the intrument case. When a spring is pressed down the end enters the slot in the cylinder which rocks forward, allowing the line spring to come in contact with a plate 38, connected to battery, and so to set a calling current flowing in the line. On releasing pressure on the line spring its end engages in the upper edge of the slot in the cylinder and so maintains the connection between the line operated and the home or calling station. When the home station receiver is replaced a cam, 45, mounted on the switch lever actuates a pin, 39, attached to the upper part of the cylinder, causing the cylinder to rotate back and release the line spring engaged in the slot. The releasing pin is pivotted at 41, and held in position by a spring 44, so that the switch-hook in passing up merely works the pin against the spring and only in passing down causes the pin to rock the cylinder.

Mr. Ernest C. Robes, of Medford, Mass., patents and assigns to the American Bell Telephone Company a service meter adapted for use in connection with two-party lines. The meter is of the push-button variety, necessitating the pushing of a button by the operator to register a call. This would be necessary in any case with party lines, as a selective meter could scarcely be hoped for, but it is found also the most practical way of operating meters for direct lines, since a purely automatic meter necessarily registers all calls whether they result in completed messages or not.



FIGS. 2, 3, 4 AND 5.—HAZAZER SWITCH.

In Mr. Robes' invention (Fig. 6) most ingenious use has been made of parallel circuits. The meters M and N for stations A and B, respectively, are in parallel with the cut-off relay R of the line L carrying the two stations; the magnet O of meter M is specially made so as to be slow acting and a controlling magnet w, quick-acting under a strong curent, serves to operate a detent 14 which engages in 15 and locks the meter movement of M when it is desired to operate N and not M. The magnets of the meters, it will be seen from the diagram, are all in circuits parallel with the circuit of the cut-off relay R, but the amount of current flowing though them under ordinary conditions is not enough to excite any of them.

The operation of the meters is as follows: One of the stations on line L has sent in a call by taking down his receiver. The line-relay R^2 responds, the operator plugs P into one of the spring jacks J, and proceeds to take the order and to establish the desired connection. As soon as the plug is inserted the local circuit W is closed and the normal current thereof excites and operates the cut-off relay R. The said current is competent to work the supervisory lamp S^2, but does not, because the main line current exciting the relay R^2 establishes the shunt around S^2. The said normal current is not strong enough to work either of the meters M or N. When, however, the connection called for is established, it becomes necessary to make a charge against the sub-station originating the call, and should the said call have been sent in by sub-station A it is to be registered by the service meter M. To effectuate such registration, the operator presses the key K, and this, making contact with point 24, closes the short circuit from point 46 through conductor 29, and around the lamp S_2, its controlling shunt and resistance r^2.

The resistance of the local circuit being thereby reduced, the current of battery F is correspondingly strengthened, and is now strong enough to fully excite the actuating-magnet O of the meter M, which accordingly registers the call against sub-station A; but the said current thus strengthened to a medium degree is still too weak to affect the magnet x of meter N, or the detent-magnet of meter M, and no registration is made, except by meter M. In case, however, the call shall have proceeded from sub-station B the operator presses the key K^2 to make the required registration or count. In this case all of that portion of the normal local circuit W that lies between said key and point 33, including the battery F, is dissevered from the portion of the circuit which includes the meters and a new connection between the latter and the more powerful generator source G is established, the old circuit being opened at the back contact 26 and the new one closed through the front contact 23.

The current from source G thus thrown on the line is strong enough to excite the actuating magnet x of meter N and the said meter is operated, registering the call against sub-station B; but the current of maximum strength sufficient for the operation of magnet x is clearly strong enough to operate magnet O also, and it is, therefore, necessary to provide means for preventing the operation of meter M when the key K^2 is manipulated to operate meter N. This is done by the detent or locking magnet w, which responds to the current of source G, and is operated simultaneously with magnet x of meter N. The locking magnet w operates much quicker than magnet O, which, as has been stated, is sluggish or slow operating, and registration by the meter M is thus prevented by the prompt movement of the armature of magnet w, which is attracted into line with the stop pin 15 of armature 16 and consequently blocks the movement of that armature. The meter M, representing sub-station A, is thus exclusively responsive to the manipulation of the key K, and the meter N in like manner is exclusively responsive to key K^2.

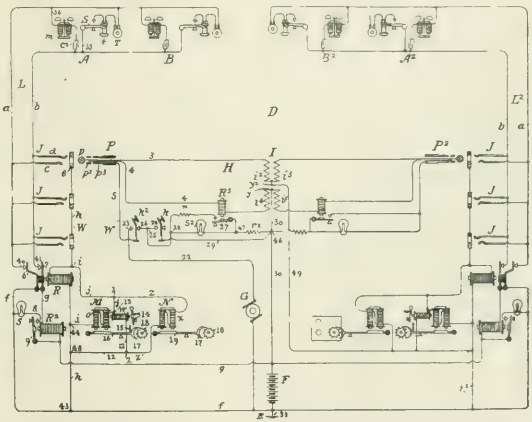
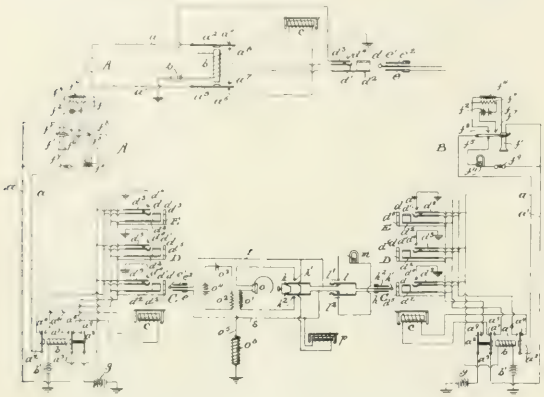


FIG. 6.—ROBES TWO-PARTY SERVICE METER SYSTEM.

Mr. F. W. Dunbar, of Chicago, patents a switchboard system in which the principal idea is that the spring jacks are normally disconnected from the line and the line signal is automatically disconnected and the spring jacks connected on the insertion of the plug in the answering jack. Mr. Dunbar claims that in many telephone systems where the line signal and answering jack are normally connected to the line it frequently happens that the insertion of a connecting plug serves to accidentally actuate the signal at a time when it should remain inert, and this fact leads to difficulty. Moreover, the arrangement limits the number of different circuits which may be employed. In Mr. Dunbar's invention, a relay energized when the plug is in-

serted in the jack disconnects the line signal and connects the jack to the line at practically the same moment. In the case of multiple



FIGS. 7 AND 8.—DUNBAR PATENT.

switchboards the whole set of jacks belonging to a line may be controlled by the same relay.

Fig. 7 shows the application of the invention to a line with a single jack, and Fig. 8 to a line with multiple jacks. It will be seen that the relay *b*, whose circuit is closed by spring a^3 making contact with a^4 when the plug is inserted, disconnects the line signal and connects the

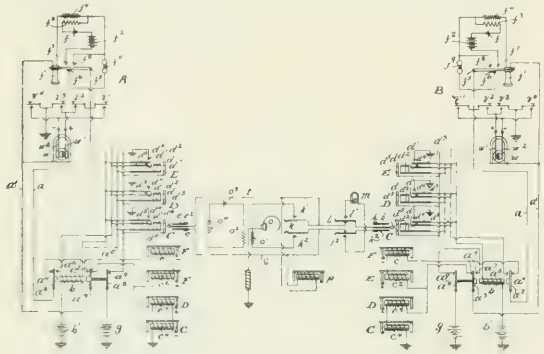
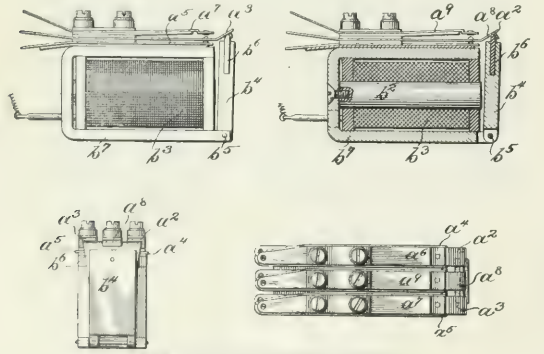


FIG. 9.—DUNBAR PATENT.

line springs of the jack to the line by opening the contacts between a^2 a^4 and a^5 a^5, and closing the contacts between a^2 a^6 and a^3 a^7. In Fig. 8 the relay *b* carries an extra spring, a^8, which closes the test circuit by making contact with a^9.

Fig. 9 shows the adaptation of the invention to the divided multiple system, which method of operating Mr. Dunbar probably had chiefly



FIGS. 10 TO 13.—DUNBAR PATENT.

in mind in working out his invention, since the difficulties which it is to cure are not of frequent occurrence in standard or ordinary multiple systems, and in the regular common battery system the cut-off relay keeps the line signal quiescent when once the connection is up. In this style of divided multiple system the subscriber signals at will any one of four portions of the switchboard, according to the location of his correspondent's switchboard line, as indicated by the directory number. Here, of course, it is of distinct advantage to have the four polarized indicators cut off as soon as the call is answered and, moreover, the arrangement of jacks normally disconnected and of signals cut-out when the jacks are in use permits, as Mr. Dunbar points out in his specifications, of using advantageous circuits that could not otherwise be employed.

Figs. 10 to 13 show the type of relay used for changing the circuit over from signal connection to line connection. Three sets of springs are used, as shown clearly in Fig. 10. The springs a^2 and a^3 normally rest on contact plates a^4 and a^5. When the armature is attracted the insulating block b^6 pushes a^2 into contact with a^8, a^3 into contact with a^7 and a^8, which has no lower contact, into contact with a^9. When the test is desired to be silent for "busy" and a click for idle a^8 and a^9 are normally in contact and break when the relay is energized.

Cost of Constructing and Operating the Port Chester Road

Few electric railway projects have excited more interest in New York and vicinity than that of the New York & Port Chester Railroad Company, which is being promoted and engineered by Mr. C. O. Mailloux and other well-known electrical engineers and capitalists. It is warmly supported in the region to be traversed, but is opposed by the New York, New Haven & Hartford Railroad, which apparently fears a loss of passenger traffic from the competition. The new road, of which details have already been given in these pages, will connect at its southern end with the new underground system of the Rapid Transit Commission. Last week a large amount of interesting and important evidence was given on the subject before the New York State Railroad Commission.

Mr. Frank J. Sprague, vice-president of the Sprague Electric Company, pronounced the plans of the New York & Port Chester Company the best he had ever seen. He declared the construction of the road along the lines proposed to be perfectly practicable. He declared that more power could be put on the electric cars than it is possible to give to the Empire State Express. The petitioners sought to show by Mr. Sprague that his company would accept a contract to electrically equip the proposed road at the figures estimated by the new corporation. Mr. Sprague said he would be glad to take the contract, and stated that the electrical equipment would cost about $2,717,500. To this he added $365,000 for cars and trucks and $190,000 for buildings and stations, making a grand total of $3,272,500. In addition he estimated that the cost of the telegraph and telephone service would be from $125,000 to $150,000. He asserted that the road could be operated for less than $600,000 per year, exclusive of the cost of the maintenance of way, structures, bridges and roadbed.

Mr. William H. Coverdale, a railroad engineer, deposed that he had made a thorough study of the company's plans, and an examination of the territory to be traversed. He believed the company could keep its promises and operate the road at a profit. He estimated that the company could count on 21,000 10-cent and 16,000 5-cent fares daily, and this would mean an annual revenue of about $1,110,000, with mail and express business of $100,000, making net earnings of $550,000. In his opinion the proposed railway could be operated at less expense than any other in this section. He figured the per capita value of every inhabitant along the route north of West Farms to be worth $11 a year to the company, and below West Farms $3.

Mr. Edwin Thacher, of New York, a civil engineer since 1863, expressed the opinion that the company's figures of the estimated cost of the road were ample.

Mr. William C. Gotshall, president of the New York & Port Chester Railroad Company, gave some interesting figures to the Commission relative to the probable earnings and operating expenses of the projected railroad. He estimated the operating expenses at $669,921.44. He placed the gross annual earnings at about $1,400,000, with net earnings of about $800,000.

Asked for details regarding how he arrived at such results, Mr. Gotshall testified as follows: "I estimate the population of Port Chester at about 7000, which should give 60 round trips each year at 15 cents, or $126,000. Harrison and Rye, with 2000 people, are expected to make trips enough to bring in $36,000. Mamaroneck and

vicinity, with 5000 inhabitants, should, according to all statistics, paying a 12-cent fare, brings us $72,000. New Rochelle and Larchmont, with 20,000 population, paying a 10-cent fare, ought to be good for 75 trips a year, netting $300,000. The interchange of traffic between New Rochelle and Port Chester at a 5-cent fare, should return $90,000; from the 28,000 people in Mount Vernon and Pelham, with a 6-cent fare, the returns should be $252,000; the interchange of traffic between New Rochelle and Mount Vernon, with a population of 35,000, paying a 5-cent fare, should return $52,500, and between Mount Vernon and Port Chester, at a 7-cent fare, $86,800; the business between the Bronx, with its population of 100,000, and New York ought to be worth $250,000 per annum, while the receipts in the summer from persons seeking recreation at resorts along the route ought to bring in $225,000, making a total of $1,490,300.

Mr. Gotshall placed the operating expenses as follows:

Train crews	$84,080.89
Station men	80,300.00
Maintenance of cars and equipment	90,000.00
Maintenance of roadway	96,000.00
Power and maintenance of stations	253,116.55
Rotary stations	16,425.00
Salaries of officers	50,000.00
Total	$669,921.44

Asked by Mr. Taft if any provision had been made for suits for damages decided against the company, Mr. Gotshall replied: "We don't intend to have any accidents."

Philippine Tariff on Electrical Goods.

On Nov. 15 the Philippine Commission's new tariff law went into effect. The section relating to the importation of electrical machinery and appliances makes the following rates: Apparatus and appliances (not machinery) for electric lighting and power: Switches, cut-outs, lamp sockets, shade holders, rosettes, plugs, brushes of copper and carbon, wet and dry batteries complete, tapes and compound for winding wires, testing sets, testing bells for current, arc lamps and fittings for same, fuse-boxes, insulating coils, and all insulating materials not elsewhere expressly provided for, $3 per 100 kilos, net weight; galvanometers, amperemeters, voltmeters, $25 per 100 kilos, net weight. Only articles used exclusively in the generation and distribution of electric currents for light or power shall come under this classification. Storage batteries for lighting or power, $25 per 100 kilos, net weight; dynamos, generators, exciters, and all other machinery for the generation of electricity for lighting or for power, also transformers, $5 per 100 kilos, net weight; incandescent lamps, electric, mounted or not, $2 per 100; porcelain, plain, in electric insulators and other similar articles, not decorated, $4 per 100 kilos, gross weight; cables, 75 cents per 100 kilos, net weight. Copper and alloys of copper in wire, galvanized or not: One mm. or more in diameter, $4.50 per 100 kilos, net weight. Less than 1 mm. in diameter, $4.50 per 100 kilos, net weight. Silvered or nickeled, 35 cents per kilo, net weight. Copper and alloys of copper in wire, covered with textiles, not elsewhere provided for, or with insulating materials, cables for conducting electricity over public thoroughfares, $5 per 100 kilos, net weight. Carbons prepared for electric lighting, $5 per kilos, gross weight. Automobiles for passengers and merchandise, $60 each.

Consolidating Western Independent Telephone Lines.

Note was made in these pages recently of the intention to use the independent telephone system of Elgin, Joliet and Aurora as a nucleus for combining independent lines in the West into one consolidation. The principal owners of the Northwestern Telephone Company, operating lines in the Fox River Valley, are among the incorporators of the Inter-State Independent Telephone & Telegraph Company, which received lately a charter in New Jersey, authorizing a capital of $3,000,000 and bonded indebtedness of $9,000,000. The purpose of this company is stated to be the unification of all independent systems in the West, and, probably, ultimately to reach into the East. The Oskaloosa (Ia.) and other independent companies are interested in the venture, and it is expected to enlist all similar concerns in the Northwest.

The board of directors and officers of the new company have not been chosen, but they will include two or three Chicago capitalists and many or all of the present board of the Northwestern Telephone Company. This board includes Senator H. H. Evans, E. J. Clapp, E. B. Conklin, A. B. Conklin and J. F. Harral, of Aurora; C. W. Devoe, of Orwell, Ohio; W. T. Campbell, Cleveland, Ohio; Charles F. Stotzer and E. H. Harison, of Wauseon, Ohio. The Northwestern Telephone Company was organized only a year ago, and it now has in service 3200 telephones. Besides having a conduit system in Joliet, Aurora and Elgin it links the Fox Valley with the Mississippi, has 634 miles of poles and 3600 miles of wire, and has service in half a hundred towns in its territory. Selon H. Case, who is interested in the new company, said last week:

"The interests that we represent have taken over the Northwestern Telephone Company, of Aurora, as well as the Whiteside-Harrison interests and the Oskaloosa Telephone Company in Iowa. We will soon have lines operating in the States of Indiana, Iowa, Ohio, Illinois and Wisconsin. There is a large gang of men working in western Illinois, and we hope to invade the cities of Springfield and Peoria, and in doing so reach the smaller towns in the vicinity of these cities. We will work as far east as Akron, Ohio, but I am not able to say whether the company will be extended farther. The intention is to put in a reasonable and satisfactory telephone service and one that will have the interests of the people at heart. There will be no party line service. The incorporators of the company have not as yet elected any officers, and this matter will come up later. The entire investment in these telephone interests up to date represnts something about $3,000,000.

CURRENT NEWS AND NOTES.

LIGHT WITHOUT SWEETNESS.—Professor Gorham, of Brown University, Providence, R. I., who is seeking to find an artificial light which is free from the element of heat, has extracted from a decayed porterhouse steak sufficient illumination to take photographs. He believes he is on the road to definite results.

BUYING PARIS RAILWAYS.—A cable dispatch from Paris of Nov. 15 says: The European edition of the *New York Herald* asserts to-day that a group of American capitalists, headed by John D. Rockefeller and others interested in traction companies, has practically secured control of the Paris Compagnie Generale de Traction, which owns a number of lines entering Paris.

FRENCH ENGINEERS' AMERICAN VISIT.—The greater part of the current issue of the *Bulletin* of the Société Internationale des Electriciens is devoted to a report of the delegates of the Société who were commissioned to attend the recent general meeting at Buffalo of the American Institute of Electrical Engineers. Professor Janet gives a general account of the visit of the French delegates and their reception by the Institute and members thereof in the different cities visited, Messrs. Steinmetz, Hering, Arnold, Mailloux and Tapley receiving particular notice in this connection. Following Prof. Janet's report are abstracts of the various papers read at Buffalo. Fifty odd pages are devoted to a description by MM. Courbier and David of the various plants and workshops visited by the delegates.

AUTOMOBILISM IN FRANCE.—It is stated that poachers and burglars are adopting the automobile as a useful implement of trade. They have been learned that acetylene lamps suddenly lighted in a dark field are very attractive to pheasants and other small game. The ruse is effected by laying out nets and then turning on the light. After an hour's time the marauders collect their quarry and escape. Robbers with an automobile drew up in front of a Neuilly residence recently during the proprietor's absence, and after loading the vehicle with a hundredweight of loot sped swiftly away. The Mayor of Gannat has issued an extraordinary decree as to speed of automobiles while traversing the town. Their speed must not be faster than that of a horse on a walk, and in the commune not faster than that of a horse on a trot. He furthermore invites the citizens to assist in stretching ropes and wires across the roads to catch chauffeurs who go too fast.

CABLE RIGHTS IN CUBA.—Secretary Root has denied the claim of the Western Union Telegraph Company that, under its concession from Spain, it possesses the exclusive right to transmit private messages between the United States and Cuba.

ELECTRIC FREIGHT LINE FOR TROY, N. Y.—The Troy Terminal Electric Railway has just been incorporated. It will be a freight business only, and will be run over the streets on which the large business houses are situated and from the Hudson River docks to the railroad yards.

NEW YORK WATER POWER.—There is a probability that the water power offered by Salmon Falls, in the town of Orwell in Oswego County, will soon be utilized. The falls are in the Salmon River, and are about half-way between Altmar and Richland. They have a height of 110 ft. Options have been secured on the rights controlling the falls and the adjacent property. The promoters expect to develop 20,000 horse-power at the falls.

ATTEMPTED ELECTRIC MURDER.—A recent cable dispatch from Paris says: The French criminal authorities are investigating an extraordinary attempt to murder the director of a factory at Mascara. He went to a telephone and picked up the receiver, when he was knocked senseless to the floor. Some one had cut the wire and switched on a 10,000-volt current from an electric lighting plant. Fortunately for the director, the current partly destroyed the telephone apparatus, so that only a portion of the current was received, otherwise the director would have been instantly killed.

PARIS UNDERGROUND ROAD.—Parisians, while they delight in their underground railway, have of late been complaining about the atmosphere in the tunnel. Their misgivings were so serious that science was called in. A thorough investigation has just been made of the air conditions. According to experts, it appears that the Metropolitan, as regards atmospheric conditions, may be ranked almost as a health resort, and that the air in the tunnels is as pure as in Paris. The atmosphere in the tunnels was found to be entirely free from carbonic acid gas and to contain, in nearly every case, the normal quantity of oxygen.

WATER POWER DEVELOPMENT IN MINNESOTA.—The Twin City Rapid Transit Company, of St. Paul-Minneapolis,, is having plans made for a water-power development at Corn Creek, on the Mississippi River, five or six miles from St. Anthony Falls. The dam contemplated at this point will render available 10,000 horsepower. It is stated that the same company is interested in surveys lately made in the St. Croix River above Taylor Falls, and about 50 miles distant from St. Paul. It is also reported that the Twin City Company will double-track its line between St. Paul and Wildwood and extend it five miles around White Bear Lake to White Bear Village. In addition, the line will be strengthened and grades cut down. It is also contemplated to replace the present four-motor, 200-hp equipments with equipments of larger power.

TROLLEYS IN ST. PETERSBURG.—The following cable dispatch from St. Petersburg, of Nov. 9, would appear to have some reference to the plans of Mr. Murray Verner, recently noted in these pages: An American company has received a franchise to construct a street railway line here, which involves building an enormous bridge over the River Neva. The whole cost of the enterprise is estimated at $50,000,000. The franchise has already received the sanction of M. Witte, the Minister of Finance. In financial circles it is believed that this will have a powerful political and economical effect on the future of Russia and the United States. M. Witte certainly is anxious to develop a connection between the two countries, and will have no hesitation in doing so even at the expense of France, though two strings to his bow will be better than one.

ELECTRIC RAILWAYS IN SAXONY.—Mr. J. F. Monaghan, United States Consul at Chemnitz, Saxony, reports as fallows: The traffic on the electric street railways of Saxony has increased about 400 per cent since 1896—taking into account the number of persons carried, the number of cars and the capacity of the motors—and 150 per cent so far as the length of the railways is concerned. The length amounts to 356.33 kilometers (221.4 miles). The number of motor cars at the disposal of all the railroads amounted at the end of 1900 to 844 without and 184 with accumulators, and 403 trail cars. There were 147,645,690 persons carried in 1900, and the number of accidents was 338. There were 23 collisions with railroad cars, 74 with ordinary wagons, and 139 with pedestrians, horseback riders and bicycles. In Chemnitz, especially, the railways are well patronized by the working classes, as it enables them to live in the suburbs. The usual fare is but 10 pfennigs (2.38 cents). The line in Chemnitz paid 52 marks ($12.37) last year for every 100 marks ($23.80) invested.

A GENERAL ELECTRIC DINNER.—Two hundred members of the testing department, etc., of the General Electric Company held their second annual banquet on Nov. 9, at the Stanwix Hall, Albany, N. Y. At least two-thirds of the States of the Union were represented at the banquet, and there were included among the diners men from England, Russia, Germany, France, Brazil, United States of Colombia, Canada, Italy, Austria, Ireland, Australia and Mexico. Those present represented at least 75 per cent of the technical schools of the United States. The Japanese quartet sang the national air of Japan and received the plaudits of every man present. Brice Morrow was the toastmaster, and General Manager Emmons and Foreman E. B. Raymond spoke on the history of the company from the time of the opening of the works in Schenectady. Messrs. C. P. Steinmetz, J. C. Schermerhorn, G. W. Redfield and F. Jones made humorous addresses, which were well received. The whole affair was under the direction of Messrs. E. L. Simpson, W. H. Hutchinson, M. A. Atuesta, F. L. Reed, R. W. Cousins, L. T. Rainey and A. B. Lawrence.

ELECTRO-COPPERING METALS.—In electro-coppering metals, such as iron, steel and zinc, the metallic deposits are apt to be in a more or less imperfect state, the surfaces being composed of a succession of small semi-spheres. To obviate this defect is the subject of a patent granted Nov. 12 to Emile Louis Dessolle, of Levallois, France. In preparing the metals for the bath it is recommended that any cavities be filled with a metallic cement consisting of a hydrate of metallic tin, which may be produced by immersing two thin plates of tin in a sulphuric acid solution and subjecting them to an electrical current. After about half an hour the plate constituting the negative pole will be covered with a gray deposit, which may be removed by the air of a scratcher, this deposit being stannus hydrate. After the cement has been applied, the metal is immersed in an alkaline bath and submitted to an electric current, whereby it receives its first copper coating. It is then placed in a bath, in which a rapid circulation of the electrolyte is maintained, the electrolyte being also heated. The patent relates principally to the apparatus for producing the circulation, which is continuously maintained by a pump, the electrolyte being caused to traverse through a cycle. It is stated that by the means described a current density of 100 amperes to the square foot may be maintained.

COMPOSITE ELECTRICAL DISTRIBUTION.—Recently we printed an account of a patent granted to Dr. Frederick Bedell on the distribution over the same circuit of direct and alternating currents, and a year or more ago an account was given of a composite distributing system invented by Dr. Pupin, in which apparatus operating at different frequencies are supplied from the same circuit. Still another composite system of distribution is the subject of a patent issued Nov. 12 to Professor E. Arnold and two associates, to which the name "Dependent Polycyclic Current Distribution," is given by the inventors. From the preamble it appears that the patent just issued is subsidiary to another not yet granted. This system provides for the distribution of alternating currents of different frequency employing conductors in common, and the employment of transformers having secondary circuits for deriving currents of different frequency from the said conductors, no choking coils being employed. If two systems are superimposed, they possess one terminal and one conductor in common. The current of one system when the other is unloaded can flow through the common conductor, but when the latter system is loaded then the current of the first system can take two paths from the generator or transformers to the place of consumption—namely, one path through the common conductor and a second path through the other system, and its receiving apparatus. While both systems are theoretically not independent of each other, practically the effect of a change of voltage of one system due to a great change of load of the other system, is negligible.

AROUND THE WORLD IN AN AUTOMOBILE.—Our Cincinnati correspondent informs us that Mr. Edward V. Wilbern, a banker and clubman of that city, is making arrangements to make the trip around the world in an automobile. He will take a steamer from New York to a French port. He will then cross France, Germany, Russia and Siberia, following the line of the Trans-Siberian Railway through the latter country. After touring Japan he will cross the Pacific Ocean by steamer to California, and then ride home in his automobile. He expects to make the circuit of the globe in 300 days.

FRANKLIN INSTITUTE MEETINGS.—Among other papers the following will be read at the meetings of the Franklin Institute during November and December: Nov. 20, "The Organization and Work of the National Bureau of Standards," by S. W. Stratton, director; Nov. 21, "The Electrical Arts at the Pan-American Exposition," and "The Edison Storage Battery," by Dr. A. E. Kennelly; "Polarization in Batteries," by C. T. Reed. Nov. 27, "The Divisibility of the Atom," by Dr. A. S. Mackenzie. Dec. 11, "The Constitution of Metals and Alloys," by William Campbell. The papers for other meetings will be announced later.

ELECTRIC POWER ON THE NEW YORK ELEVATED.—President George J. Gould, of the Manhattan Elevated Railway, at the annual meeting of the stockholders on Nov. 13, made some definite statements in his report with regard to the work of equipping the roads with electric power. The central power station at East Seventy-fourth Street and sub-stations at Allen Street, Thirty-fourth Street and Ninety-ninth Street, are completed, and the machinery is being rapidly installed in all of them. Motor equipments are arriving in quantity and deliveries of 300 new cars will begin within two weeks. It is expected that the first 8000-hp engine and dynamo will be turned by Dec. 1, and the first train on the Second Avenue line run during the month.

CATS CAUSE TROUBLE.—A cat climbed a pole of the Buffalo & Lockport Electric Railway one day last week at Hoffman, N. Y., and while attempting to walk along one of the feed wires her tail touched one of the 22,000-volt Niagara transmission lines. Instantly there was a flash and the cat was killed. The dead body fell across the wires, causing a short circuit, which resulted in the shutting off of the power at Niagara for two hours. In the meantime, several of the electric railways and lighting systems in western New York were without power. The next day (Nov. 14) a cat in Utica, N. Y., prowled around the power house of the Utica Belt Line and came in contact with some live parts. A short circuit was caused, several fuses were blown, and the cars were stalled for some time, but puss still lives.

THE ZOSSEN TESTS.—A special cable dispatch from Berlin of Nov. 16 says: "The experimental trials of the electric high-speed railway between Zossen and Marienfelde, near here, have been signally successful. A speed has been attained equal to 105 miles an hour. The air pressure at this rate was found to be equal to a wind force of 12 ft. a second, a force only registered once on the German coast in a hurricane in February, 1894. The engineers are satisfied that the speed can be increased, although it is the highest ever yet attained by any object mechanically propelled except projectiles." The point of interest in the above is that a speed as high as 105 miles per hour has been attained with an experimental equipment almost at the beginning of the trials. As the preliminary trials were to test the equipment, this apparently has required little or no change in its important details. It will be recalled that the main tests are to be made at a speed of 125 miles per hour.

NOVEMBER MEETING OF THE A. I. E. E.—Systems of electrical distribution form the programme of the November meeting of the American Institute of Electrical Engineers, and the six papers to be submitted will be read and discussed simultaneously in New York and Chicago on the evening of Friday, Nov. 22. The meeting in New York will be held, as usual, at 12 West Thirty-first Street, and in Chicago at the headquarters of the Western Society of Engineers, Monadnock Block. The papers to be read have the following titles: "Distribution of Electrical Energy in Large Cities," by Mr. Louis A. Ferguson. The paper is based on the author's experience in Chicago and his observations in Berlin and Milan. "Locating Faults in Underground Distribution Systems," by Mr. Henry G. Stott; "Alternating Current as a Factor in General Distribution of Light and Power," by Mr. Charles F. Scott; "The Buffalo High-Tension Cable Distribution System," by Mr. Harold W. Buck; "Notes on the Alternating-Current System of Distribution," by W. S. Barstow; "The Distribution by the Three-Phase System, and the Operation of Single-Phase Circuits by It," by W. L. R. Emmet.

WHAT A LIGHTNING FLASH TOLD.—According to a newspaper account, Professor Pickering, of Harvard University, has made some remarkable deductions from a photograph of a lightning flash. It appears from a statement of Professor Pickering that the spectrum of a streak of lightning was photographed last July. "From such a small beginning two discoveries have developed. Not only are the chemical elements so-called compounds, but it is likely that hydrogen itself, which chemical theorists have thought to be the one element of which the others would sooner or later prove to be compounds, seems to be of composite nature." The newspaper account adds that other photographs made at about the same time show the curious fact that the spectrum of lightning is not always the same. Some of the photographs show a doubling of the bright lines. Professor Pickering was at first inclined to believe that this was a sort of composite photograph, but he now concludes that the doubling looks as though hydrogen, the only element studied in the lightning spectrum, and hitherto believed to be least likely ever to be proved a compound body, is made up of at least three components. This conclusion he bases upon the fact that there were 30 lines in the hydrogen spectrum on one photograph, three in another, and one in the third, the different flashes having been photographed under different circumstances. Another remarkable circumstance is that the spectra are similar to that of the second new star in the constellation Perseus, known as Nova Persei No. 2.

REDUCING THE CHARGING CURRENT OF TRANSMISSION LINES.—As is well known, one of the drawbacks to long-distance power transmission is the amount of current required to charge a line due its capacity. In a paper recently read before the American Institute of Electrical Engineers by Dr. F. A. C. Perrine, it was stated that in one long-distance plant the amount of charging requires 1500 kilowatts of the capacity of the generating plant. In a patent issued Nov. 12 to W. M. Mordey, of London, means are described for removing this difficulty by enabling the so-called wattless charging current to be produced without increase of the size of the generating plant. Another object of the method is to lessen the danger of a rupture of the insulation of cables having considerable capacity, which arises at times from suddent changes of load or otherwise. The method consists in placing one or more choking coils in parallel with the mains. If properly designed and proportioned, such a coil or coils will take a wattless current opposite in phase, and as nearly as may be equal in amount to the wattless capacity or charging current of the mains. By this means the generator will merely keep up the pressure, working with a power factor of unity and sending out only the energy current for the choking coils, which by suitable designing may be reduced to insignificant proportions, and any energy current required to supply the loss by leakage, by dielectric electrical hysteresis in the mains, and the loss in the conductor due to the working current. The idle current, which is alternately a capacity current with a positive phase displacement, and a self-induction current with a negative phase displacement, passes to and fro between the mains and the choking coil at each reversal of the e. m. f., and thus does not entrench upon the capacity of the generator. The choking coils also provide a path or paths for the harmless discharge of current or the relief of high pressure, which otherwise may be productive of serious consequences, and which may arise, for instance, in the case of violent fluctuations from various causes. In such cases the choking coil has a double effect—it tends to reduce or to limit the main circuit of excessive pressures, and it acts as a relief valve or outlet and so prevents breakdown of insulation or sparking between the mains or to earth. The specifications describe in detail the construction of choking coils for the purpose of the invention, which are made of the lowest practical resistance and to require a minimum of energy for magnetization. They also have an adjustable air-gap to enable the strength of the idle curent supplied or taken by the coil, to be regulated to a certain extent.

AZORES CABLE.—It is stated that the Commercial Cable steamer, the "Faraday," has sailed from Waterville to lay another cable between this country and Fayal, Azores.

GIRL MESSENGERS.—At Cleveland, Ohio, the Council of Jewish Women has denounced the employment of girls as telegraph messengers. A few weeks ago a local telegraph company hired girls as an experiment. The innovation was successful, and most of the boys were dismissed.

TUNING TELEPHONE VOICES.—It is stated that under the tutelage of the Chicago Telephone Company 900 female voices are being given an elocutionary training. The company now requires that operators on the long-distance lines must be proficient in this new art, known among the officials as "telephonic elocution." The pitch, the modulation, the elasticity of the voice are all given special attention, and also many smaller details. The proverb of Solomon that a soft answer turneth away wrath is also inculcated into the minds of the operators, so that it becomes second nature with them to reply sweetly to an irate subscriber.

THE PACIFIC CABLE.—Representative Hepburn, of Iowa, chairman of the Inter-State and Foreign Commerce Committee of the last House, and Representative Sherman, of New York, a member of the same committee, had a long conference with the President last week about Isthmian canal and Pacific cable legislation. As a result of the consultation they announced that it was their purpose to press legislation on both subjects at the earliest possible moment. The cable bill will be practically identical with the one reported from the committee in the last Congress. It provides for the laying of the cable by a private corporation under a contract with the Postmaster General, with an alternative provision for the building of the cable by the Government if no satisfactory contract can be made. It is understood that the President concurred in the proposed programme.

ELECTRIC FURNACE.—A carbide furnace recently patented to James H. Morley, of Springfield, Mass., and appertaining to that type in which a vertical depending electrode is used in connection with interchangeable carbon hearths constituting the opposite terminal, presents, in addition to the usual complement of devices for automatic charge feed and current regulation, a point of decided novelty as regards the carbide art. This lies in the construction of the upper carbon, which is fashioned as a tubular rectangular prism, and is fitted with mechanism for imparting to it a reciprocating rotary movement about its longitudinal axis, whereby the surrounding charge is continuously loosened and stoked into the arc. The central perforation communicates above the furnace with the air, and the movement of the furnace gases serves to induce through the carbon a downward current of air, which not only prevents overheating, but by introducing the air at the very point of liberation of the reaction gases, is said to prevent the occasional explosions of gas which otherwise occur near the fusion zone.

STORAGE BATTERY PLATE.—Mr. Leonard Paget, of New York, has patented under date of Nov. 12, an interesting method of making storage battery plates of the type in which a grid or support is dispensed with, the active material being itself hardened into a strong and light plate, with which connectoin is directly made by soldering or otherwise. The composition used consists of 4 parts of litharge or other oxide of lead, 1 part of lead sulphate, and from 1 to 2 parts of zinc dust, the ingredients being mixed dry, pressed into shape, and while under pressure carefully and evenly moistened with water. Reaction ensues rapidly, the zinc reducing the lead from its sulphate and the mass hardening at once to a stone-like composition. The zinc sulphate must then be washed out, an operation best effected in an electrolytic vat in which the plate is connected as cathode, whereby the rate of solution is somewhat lessened and disintegration of the plate avoided. The plates so prepared are then electrolytically formed as usual and mounted for use in conjunction with any of the ordinary electrolytes.

TRACTION IN LONDON.—A cable dispatch from London of Nov. 13 says: At yesterday's meeting of the London County Council a proposal was unanimously adopted to ask the consent of Parliament to the consruction of subways and a shallow tramway from the Victoria Embankment under New Street to Holborn, connecting a little further north with surface trams. In the course of the session the delegates who recently visited the United States described the systems in Boston and New York, J. Williams Bonn declaring his conviction that what had been done in these American cities could be done in London and that efforts should be made before subterranean London was handed over to foreign control. This statement was greeted with considerable applause. Commenting editorially upon the importance of the decision of the County Council, the *Daily Chronicle* says: "It appears that while the district railways of the metropolis are engaged in a tedious dispute, the County Council and Charles T. Yerkes have entered for a neck and neck race to supply London with cheap and efficient electric traction. We prefer that the Council should be the winner."

METALLIC MANGANESE.—The method long since applied by Hall to the manufacture of aluminum, and later by Liebmann to the electrolytic production of beryllium, and which consists in dissolving the oxide of the metal in a fused fluoride bath and subjecting it to a direct current of sufficient volume to maintain the fusion of the bath and to separate the metal, has now been applied by Albert Simon, of Bordeaux, France, to the production of manganese and its alloys. Manganese is difficult of treatment by ordinary reduction methods, and the electric furnace cannot be economically applied to its production on account of the loss of metal due to its ready volatility at high temperatures. A molten bath, however, fusing at a temperature approximating the melting point of manganese and its commercial alloys, is readily formed, and from this bath the metal or its alloy separates as a cathode product, while any silicon which may be present escapes as gaseous fluoride. M. Simon has constructed a special furnace for the purpose, the distinctive features of which are the use of a protective sheath for the anode composed of a manganese slag containing the metal in its lower state of oxidation, and, therefore, incapable of oxidizing the carbon; and of a series of temporary carbon connectors between anode and cathode, which carry the initial current and bring the bath to an operative temperature. These structural features form the subject of a patent issued Nov. 12.

LETTER TO THE EDITORS.

Switchboard Simplicity.

To the Editors of Electrical World and Engineer:

Sirs.—I have read the interesting article in your issue of Nov. 9 upon "Important Power Station Work at Kansas City," and your editorial comments in same issue under the heading "Switchboard Simplicity," and I am glad to note that Mr. Pierce, in his work at Kansas City, has adopted the diagrammatic pilot switchboard idea which, in my opinion, will contribute largely to certainty and safety in operation of the large and necessarily complicated organizations of power-operated switch gear used in the larger and more modern electric plants. It is interesting to note that Mr. Pierce mounts the switch handles and dummy bus-bars on the face of the instrument board instead of upon a special operating panel or bench board, as in the case of the Manhattan Railway Company's power plant at Seventy-fourth Street and the East River, but I may point out that Mr. Buck, at Niagara Falls, has adopted the same plan in the case of the new plant now under construction at Niagara.

Where all switches connected into the power circuits at the generating station are of a type that may be relied upon to break the power circuits under all conditions, as is the case in the plants mentioned, the location of the diagrammatic pilot board upon the instrument panels is perhaps preferable to the use of a separate bench board, where the instrument board is not too long; but there are arguments in favor of each of the alternative plans. To place the pilot board upon the instrument panels would seem to leave the operator positively no excuse for throwing the wrong switch, but on the other hand, where he is standing close to a given instrument panel and manipulating a pilot switch something demanding his attention may happen elsewhere. If the separate bench board be used, manipulation of the switches does not require him to leave a position from which all switchboard instruments are under his eye.

But there is another argument in favor of the separate bench board

construction which, while it does not apply to the Manhattan or Niagara boards (in which all alternating-current switches are of the circuit-breaking type) may become of considerable importance in connection with organizations of switch gear providing similar connections of alternators and feeders to two sides of bus-bars, but using non-circuit-breaking selector switches for the alternators and the feeder groups. The reason referred to is the fact that where the pilot switches are compactly assembled upon a bench board instead of being distributed along the instrument board, it becomes easy to mechanically interlock the circuit breaking and non-circuit-breaking switches in such a way that the attendant is compelled to open and close these switches in their proper sequence; that is, he cannot open a non-circuit-breaking blade switch before he has opened a circuit-breaking switch in series therewith, and he is compelled to first close an automatic circuit-breaking switch, connected into a feeder, for example, before he can close the selector switch in series with it. In other words, it is convenient with a bench-board arrangement to mechanically interlock the switches and circuit breakers much in the same manner as railway switches are interlocked by the operating mechanism in the switch towers of large railway yards and terminals.

It would probably not be difficult to adopt this interlocking idea in connection with the pilot bus-bars and switches even when the latter are placed upon the instrument panels, but it is somewhat more conveniently accomplished when they are compactly assembled upon a bench board.

New York. L. B. Stillwell.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers.

Properties of Armatures with Commutators when Used with Alternating Currents.—Leblanc.—A short article in which he endeavors to show that certain conceptions concerning the action of armatures with commutators when alternating currents are passed through them, are incorrect. Although the new Heyland motor (see Digest, Aug. 31), is not directly mentioned, yet an editorial foot note refers to the description of that motor, which immediately follows the article. He states that for some time past, new properties have been claimed for armatures with commutators, which would have a great industrial importance (such as in the Heyland motor). He states these properties as follows: "It would be possible to have a magnetic flux produced by one of these armatures by sending into it alternating currents of a frequency f, by the use of brushes resting on the commutator, without having to overcome other impedance than that due to the resistance of the circuits, the only condition being to communicate to the brushes a speed in a suitable direction with reference to the commutator, relatively equal to f. If this relative speed is equal to $f—U$, the impedance which one would have to overcome would be the same as if, the relative velocity being zero, one would send into the armature through the brushes, currents of the frequency U." He then discusses this question by showing what would happen in such cases, and states that he does not believe that these properties have ever been found to exist, and that the above mentioned statements are incorrect. He first discusses the phenomena in the armature when the brushes continue to rest on the same commutator bars, and then those due to commutation. Concerning the former he shows that the e. m. f.'s developed between the brushes are the same as those between the primary terminals of a polyphase transformer, of which the secondaries are closed through resistances. If these resistances are great relatively to the secondary circuits, which should always be the case, the e. m. f.'s developed between the brushes are made wattless with relation to the currents which pass from one brush to the other. Also that the impedances which must be overcome are independent of the speed of rotation of the brushes, as the frequency of the currents in the sections of the armature is always equal to f during the time under consideration. He concludes that "if we send K polyphase alternating currents into an armature with commutator by means of K brushes successively displaced by angles equal to 360 degs. divided by K, the e. m. f.'s which it is necessary to develop between the various brushes to cause the current to pass, are the same whether the brushes remain stationary or whether they revolve with relation to the commutator." One can, however, make use of the properties of such armature in alternating-current machines for producing fluxes capable of revolving with respect to them, without requiring that the currents which pass through these circuits have to overcome any other impedances than the one due to the resistance of the circuits, but it is necessary to do it otherwise. He does not say how. In conclusion, he calls attention to his French Academy paper of July 29, 1899 (which is reproduced as a foot note), and which describes a self-starting, alternating-current motor or variable speed, in which a Gramme armature with collectors is used.—*L'Eclairage Electrique*, Oct. 26.

New Alternating-Current Machines.—Bunet.—There is considerable discussion, he says, at present concerning new alternating-current machines, most of which, however, he believes are based on incorrect principles. He believes the results obtained would be very different from those hoped for by the inventors. A principle on which a number of them are based is as follows: "It is possible, by virtue of certain devices, to excite a magnetic field in such a way as to produce a certain flux, by using alternating currents in the coils, without having to furnish a wattless current, or, if one prefers, without self-induction." He believes, however, that quite the contrary is true. Also that it is also impossible to make a self-exciting alternator without being obliged to use special devices for creating the field, using a special current, or modifying the current of the machine for producing the field. He does not wish to say that it would be absolutely impossible by means of certain discoveries to obtain that which these inventors have sought, but thinks it is useless to try to do it with their present means, or in other words, he believes that some discoveries must first be made. He discusses what is claimed will take place in a Gramme armature with a commutator and revolving brushes through which alternating currents are passed into the armature, and then goes on to show that the above claims are incorrect. In the first place the field obtained is never a constant one revolving with a constant speed, but it is of an elliptical character, thus causing parasitic e. m. f.'s and sparking at the brushes, but there is a remedy for this, and the objection is, therefore, only of secondary importance. Suppose a continuous current is sent through a Gramme ring as usual by means of two brushes. If the armatures of the brushes are rotated at any velocity, the field will rotate with reference to the windings, that is, the poles will always follow the points of the application of the brushes. No e. m. f.'s will be induced either in one direction or the other, and the difference of potential necessary to cause the current to pass will always be the same whatever the speed even for a speed equal to zero, neglecting the action of the coils under commutation. If in place of a continuous curent, an alternating current is used, there will be found to be a certain induction which remains the same for all relative displacements of the armature and brushes. Such an armature for alternating currents, he shows, will have the same self-induction which it would at rest, when the armature and the brushes have any relative speeds whatever. He believes he has thereby demonstrated the fallacy of the principle that the self-induction, when the armature or brushes rotate, is zero. A revolving field is often for convenience represented by a permanent magnet revolving at the same speed, but he claims that they are not identical and that the analogy should not be carried beyond where it is legitimate. He discusses the general case of the movement of the brushes, and the field in such an armature, and shows the oscillating action of the field as the brushes pass over the commutator bars. He summarizes his conclusions as follows: "The flux is balanced around a mean position; its displacement in one direction acts on the stationary circuits; its displacement in the reverse direction does not act on the circuits movable with it in the same direction." If commutator bars are connected by resistances, as has been suggested (by Heyland), the case will not be different, and there will simply be a useless consumption of energy.

(The Heyland motor described in the Digest, Aug. 31, and in ELECTRICAL WORLD AND ENGINEER, Sept. 28, page 492, is not referred to by name, but is apparently one of those to which the criticisms refer). He concludes by saying that he is led to believe from his arguments that a revolving Gramme ring cannot be considered as being without self-induction for any currents whatsoever, and that the only difference, from this point of view, between such an armature and one that is fixed, are of a secondary order, and are disadvantageous. These differences are chiefly in sparking and loss of energy due to commutation.—*L'Ind. Elec.*, Oct. 25.

Operation in Parallel of Alternators Run by Tandem-Compound Engines.—GARFIELD.—A communication referring to a fomer article on the electric railway between Milan and the Italian Lakes, in which a statement was made that the alternators, which are direct coupled to tandem-compound engines, are run in parallel, and that this fact might introduce certain complications. He says that after running for some time in regular service no trouble has been experienced. The total weight of the flywheel is 36 tons, of which 27 tons is in the rim. The revolving parts of the generators weigh 17 tons. The writer also says that generators operating under similar conditions are in use in certain other plants. Balanced poppet valves are used throughout, and this type of valves has been very well suited for use with superheated steam.—*St. R'y Jour.*, Nov. 2, and Int. Ed., Nov.

REFERENCE.

Theory of Shunt-Wound Dynamos.—BERNARD.—A brief illustrated note on the graphical construction of the characteristic curve for the behavior of a shunt-wound dynamo.—*Elek. Zeit.*, Oct. 24.

POWER.

Electric Power in Shipbuilding Works.—An illustrated description of the electrical equipment of Palmer's shipbuilding works at Jarrow-on-Tyne. The shipbuilding department and the engine department have recently been equipped with elctric apparatus for all power purposes. When the installation was made, the works were exceedingly busy, and a system, the installation of which interfered least with the continuous output of the works, was chosen. The long lengths of shafting and the numerous belts and pulleys were practically retained in their entirety, the steam engines were each replaced by a three-phase induction motor, and the steam plant centralized at one point, the electric generating station. The result is "a considerable reduction in the quantity of fuel consumed for the power generation," but no exact figures are given. There are two steam-driven 750-kw, three-phase alternators, and in all upwards of 80 induction motors in use, aggreating a total capacity of 1500 horse-power.—Lond. *Eng'ing*, Nov. 1.

Electricity in Mines.—GOETZE.—An illustrated paper, read before the German Soc. of Mining Engineers, on applications of electric power to mines in Germany. Six large German electric companies furnished 15,000 kilowatts of plant for mines in 1898, 27,500 kilowatts in 1899 and 46,600 kilowatts in 1900. A characteristic feature of this great progress was the general introduction of the three-phase system, and the use of e. m. f.'s of 2000 to 3000 volts. He discusses at some length the use of electric pumps, which he shows to have the advantages of greater economy and less trouble in operation. He further discusses the use of electric power for driving ventilators and hauling machines. For large hauling machines direct current is preferred sometimes in combination with storage batteries, although the three-phase system is also used for this purpose. With the three-phase system, water resistances are often used for starting. To avoid the water getting heated to the boiling point, the water is continually circulated by means of a small pump.—*Glueckauf*, Oct. 19.

Refuse Destruction.—PRIESTLEY.—An abstract of a paper on refuse destruction at Nelson. He gives the results of recent tests on a furnace of the Pheldrum regeneration type, by which all the refuse of the town of Nelson is destroyed. He describes in detail the means adopted for determining the temperature in the combustion chamber. The results of a test, extending over one month from Feb. 19 to March 16, are given. He brings out the average evaporation of water per pound of refuse from and at 212 degs. F. to 1.85 lbs., and this result is almost identical with that obtained during a short-hour test. No details are given regarding the cost of the process.—Lond. *Elec. Rev.*, No. 1.

REFERENCES.

Italian Water-Power Plant.—BIGNAMI.—An illustrated description of the water power and electric installation at Vizzola-Ticino, Lombardy, for transmission to Milan and numerous smaller manufacturing centers. At present 19,000 horse-power are developed. Later there will be 24,000 horse-power.—*Eng. Mag.*, Nov.

Canadian Water-Power Plant.—An illustrated article on water power development at Shawinigan Falls, Quebec. Power is supplied to the new aluminum plant of the Pittsburg Reduction Co. and to the Belgo-Canadian pulp mill.—*West. Elec.*, Nov. 2.

TRACTION.

Three-Phase Traction.—A communication by Brown, Boveri & Co., on the electrification of the Metropolitan railways in London. It is denied that there is any necessity of calling the proposal of three-phase traction by Ganz & Co., a new system—the Ganz system—as there is nothing new about it. Cascade (concatenation) control of induction motors is not thought to be "the" solution of the problem. When they studied in 1895 their first three-phase line, the Lugano tramway, they tested the cascade system, but found that it presented no advantages, and that the total starting torque obtained by switching two motors in tandem was smaller, instead of greater, than that obtained with one motor alone. Later on, when designing the Burgdorf-Thun railway equipment, they repeated these experiments and obtained the same results. They prefer to adhere to the ordinary resistance control until they can find an equivalent to the series-parallel control, which is sure to be invented sooner or later. They claim the simple resistance control is not so bad after all. On the Burgdorf-Thun line they start heavy trains on the level with an acceleration as high as 1½ ft. per second, without taking more current from the line than the normal current. The Burgdorf-Thun railway has now been running on full service for two years and a half, and during this time no repairs whatever have been necessary on any of the motors. The winding and sliprings are as good as new. They have not had to replace a single bearing brush, and the small air-gap, which everybody declared would turn out to be a continual source of trouble, has caused none whatever, not even a minute's stop.—Lond. *Eng'ing*, Nov. 1.

New Orleans & Carrollton Railroad.—Many of the streets in New Orleans are laid out with a strip of turfed ground in the middle of the street. This is called neutral ground, and makes an ideal place for street railway operation, as the grass is allowed to grow nearly to the top of the rails, and there is no dust raised by the passage of the cars. The New Orleans & Carrollton Railway has about 33 miles of track and 100 cars. The track on the neutral ground is laid with T-rails weighing about 100 lbs. per yard. A careful record is kept of the life of all parts, as well as the mileage of all cars, and when a car has run from 15,000 to 20,000 miles new armature bearings are installed, and the whole equipment is carefully overhauled. Some particulars are given as to the life of other parts of the equipment. Owing to the spongy soil in New Orleans, the use of pits in the repair shops was not feasible, and instead the cars are run on elevated tracks. This allows the use of a convenient device for the removing and replacing of wheels. Compressed air is used for cleaning motors, registers and controllers and removing dirt and scale from the trucks which are to be painted. It is also used for car cleaning and sweeping the floor. A record of the cost per kilowatt-hour of the company shows that this varied during the last year from 7.7 mills to 9.2 mills. Other detailed expenses and life of various parts are also given.—*St. R'y Jour.*, Nov. 2, and Int. Ed., Nov.

REFERENCES.

Budapest.—SPAENGLER.—The first part of a well illustrated paper on the changing of the Budapest horse car lines to electric operation. The conduit system is used in the central part of the city and the trolley in the suburbs.—*Zeit. des Oest. Ing. u. Arch. Ver.*, Oct. 18.

Association Meetings.—An account of the proceedings, and all papers and reports presented before the Am. St. R'y Ass. and the St. R'y Accountants Ass. of America, are published in *St. R'y Jour.*, Oct. 12, 19, 24; also Int. Ed., Nov.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Lighting Station.—An illustrated description of the Keighley electricity works. There are three steam-driven dynamos, two of 120 kilowatts, and the third of 200 kilowatts. They are shunt wound for lighting purposes, but can be used as compound generators for the future traction load by cutting in series coils, with a range of voltage from 460 to 550 volts. There is also a balancer-booster set, consisting of a pair of balancers which can supply a load of 50

kilowatts out of balance, direct coupled to two boosters giving 100 amperes each at from 20 to 30 volts for charging the batteries. The batteries consist of 256 cells, with a capacity of 700 ampere-hours.—Lond. *Elec. Rev.*, Oct. 11.

REFERENCE.

Storage Battery and Sixty-Cycle Railway Synchronous Converters.—Reynolds.—A description of a plant at Hamilton, Ont., where storage batteries are used in connection with 60-cycle synchronous converters. Power is obtained from a waterfall 34 miles distant, and is transmitted at 22,000 volts, to the sub-station containing three 300-kw converters with transformers, storage battery, etc. The battery is operated in parallel with the direct-current side of the converter, and enables the latter to run steadily so that incandescent lights and railway cars can be run from the same bus-bars.—*St. R'y Jour.*, Nov. 2, and Int. Ed., Nov.

Wires, Wiring and Conduits.

Resistance of Dielectrics.—Ashton.—A paper, with numerous tables and diagrams, on the resistance of dielectrics and the effect of alternating e. m. f. on the insulating properties of india rubber. His principal results are as follows: In the case of an okonite cable the current during the first hour's electrification increases as the charging pressure increases. This does not necessarily prove that the dielectric does not follow Ohm's law, since the true conduction current must be considerably less than the total current unless electrification is continued for very lengthened periods. In the case of an okonite cable and a paraffin paper condenser, the charging current is a power function of the time reckoned since electrification commenced, and on this may be superimposed a current of true conduction. For the okonite cable, the mica, and the paraffin paper condensers, the discharging current is a power function of the time, which has elapsed since discharge began. The only deterioration in insulating properties of india rubber due to alternating pressure was in the case of pure Para, and appeared to be due, not to any effect of alternating stress on the rubber itself, but to chemical action taking place between the rubber and gases produced by the action of alternating stress on the air.—*Phil. Mag.*, Nov.

Electro-Physics and Magnetism.

Magnetizing Action of Lightning.—Pockels.—A note giving some further results of observations in which a rod of basalt had been placed close to a lightning rod and from the permanent magnetization of the basalt rod conclusions were drawn regarding the maximum current of lightning discharge through the lightning rod. The observations have been made on the observatory of Monte Cimone. In one case he found the maximum current at 8600 amperes. In a few cases it was found that the basalt rod had not been magnetized.—*Phys. Zeit.*, Oct. 15.

REFERENCES.

Change in Dimensions Caused by Magnetization in Iron.—Rhoads.—An account of experiments made to investigate the relation between the changes of length and width in a long, thin specimen due to its magnetization. He has not been successful in settling this point as yet, but has obtained good curves for the change of length.—*Phil. Mag.*, Nov.

Electromagnets for Lifting.—An illustrated article on the use of lifting electromagnets in combination with cranes for loading and unloading metallic plates, etc.—*Sc. Amer.*, Oct. 26.

Electro-Chemistry and Batteries.

Freezing Points of Dilute Solutions.—Griffiths.—An abstract of a Brit. Ass'n paper in which he gave a summary of his work which has now lasted four years. He has made more than a thousand experiments, each taking about 1½ hours, with pure water alone. The subject is of great importance for the dissociation theory. When any salt is dissolved in water the freezing point of the solution is depressed. According to Raoult, quantities of substances proportional to their molecular weights, produce the same depression. If electrolytes are in solutions dissociated into ions, as the modern theories assume, the freezing point depression should be two, three, etc., times larger than in the case of non-electrolytes like sugar, according to the number—two, three, etc.—of ions. The proof that the partial dissociation becomes complete with extreme dilutions had so far not been given by the freezing point method. No two observers agreed quite about very high dilutions, as then the impurities of so-called pure water, make their influence felt very strongly. The present author arrives at the conclusion that the freezing point depression in the chlorides of potassium, sodium and barium, is really twice as much as for cane sugar. "Thus, as Professor Ramsay expressed it, the dissociation theory is placed on a firm foundation."—Lond. *Eng'ing*, Oct. 4.

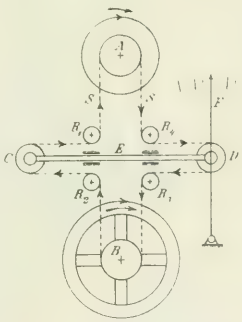
REFERENCES.

Alkalies and Chlorine.—A continuation of the illustrated review of new patents on the electrolytic production of alkalies and chlorine. Among other things the gradual development of the "bell process" (gravity process without diaphragm) is described.—*Zeit. f. Elektrochemie*, Oct. 10.

Migration Velocity of Ions.—Jahn.—An account of a redetermination of the transport numbers of the kation in dilute solutions of the most important salts and acids.—*Zeit. Phys. Chem.*, July 12; abstracted in *Science Abstracts*, Oct. 25.

Units, Measurements and Instruments.

Determining the Degree of Uniformity of the Revolution of Prime Movers.—Franke.—An illustrated paper read before the Ass'n of German Elec. Eng. The "degree of non-uniformity" is defined as the difference between maximum and minimum speed divided by the average speed during one revolution. He points out that any machine which has not an entirely uniform speed during one revolution, also invariably shows at constant load some variation of the number of revolutions per minute. He describes quite a number of methods for measuring the degree of non-uniformity during one revolution. In the first group of such methods the distances passed over in equal time are compared or else the times for equal distances. In the second group of methods the variation of the non-uniform rotation from a uniform rotation made at the same time is investigated. In the third method the speeds at different phases of the revolution are directly measured. In a frequently used method of the first group, a vibrating tuning fork describes a curve on a cylinder revolving on the axle of the prime mover, but there is an error in this method due to the fact mentioned above, that the number of revolutions per minute always varies. To the second group belongs the well-known stroboscopic method. An apparatus of Schaefer and Budenberg for plotting the curves of movement, is described. Another very simple, but not very accurate apparatus for measuring the degree of non-uniformity is shown in the adjoining figure. *A* is the shaft of the prime mover to be tested, *B* is the shaft of a flywheel revolving with uniform velocity, R_1 R_2 R_3 R_4 are fixed rollers, *C* and *D* loose rollers connected together by a rod; *S* is a rope, running around the axles *A* and *B* and the six rollers. When *A* runs quicker than *B* the rope is tightened in the part $C\ R_1\ A$, and gets loose in the part $A\ R_4\ D$, with the result that the rod *C D* with the two loose rollers is moved to the right hand and deflects the needle *F*. The deflections of the needle may be plotted. Several other methods, belonging to the same group, are also described. He believes that methods of this group are well adapted for demonstration purposes, but cannot be made exact enough for fine measurements. Nor are the methods of the third group satisfactory for very exact measurements. When the speeds are measured at different phases of the revolution, they would give exact results, if the prime mover always made the same number of revolutions per minut, but this is not the case, as mentioned above. Methods in which this source of error is overcome are very complicated and not suitable for use in practice. He concludes that the measurement of a "degree of non-uniformity," smaller than 0.01 is not possible with out present instruments and methods. The electrical



APPARATUS FOR MEASURING REVOLUTIONS OF PRIME MOVERS.

engineer, in specifying prime movers for driving dynamos, and especially alternators for parallel operations, should not require a smaller degree of non-uniformity than 0.005.—*Elek. Zeit.*, Oct. 24.

Electrograph for Atmospheric Discharges.—A brief illustrated description of an electrograph, devised by Lancetta, for registering the electric discharges of the atmosphere. A coherer is in series with a battery and a galvanometer. When an atmospheric discharge acts in the coherer and renders it conductive, the galvanometer needle is deflected and closes the circuit of a vibrator. This causes the registering device to make a mark on the registering cylinder. A ball then strikes the coherer and brings it back to its normal state.—*Sc. Am. Sup.*, Nov. 9.

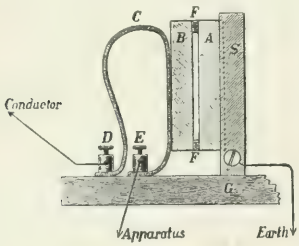
REFERENCES.

Lippmann Electrometers.—CRAW and COTTRELL.—Brief abstracts of two Brit. Ass'n papers. The one paper, by Craw, deals with the effect of non-electrolytes on the Lippmann electrometer. He finds Nernst's view, that non-electrolytes should have no effect not confirmed. The other paper, by Cottrell, deals with the theory of the capillary electrometer. He thinks that the Helmholz-Lippmann theory cannot in general be correct.—Lond. *Eng'ing*, Oct. 4.

Voltameter Balance.—PFANHAUSER.—An illustrated description of a voltameter balance. The cathode is suspended on the one arm of a balance. When the needle of the balance is on zero, the circuit is automatically broken and an electric bell gives the signal that the desired number of ampere-hours has been obtained and that the electrolytic process has been interrupted. The instrument is adapted especially for the silvering of weights.—*Zeit. f. Elektrochemie*, Oct. 10.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Coherence Phenomena in Carbon Lightning Arresters.—GANSANGE.—An article on carbon lightning arresters used for protecting telephone instruments. The construction is shown in the adjoining diagram. *G* is a wooden baseboard supporting a metal plate *S* connected to earth. A number of plates, equal to the number of lines to be protected, and made of compressed carbon, are fixed in a series of parallel grooves in *S*, and against each of these plates *A* is pressed a second carbon plate *B* by a steel stirrup spring *C*. The plates *A*, *B* are kept apart by two insulating blocks *F*, about 0.08 inch thick, and have their inner edges serrated to facilitate discharge between the plates. The line connectios are at *D* and *E*. In ordinary working no current passes from *B* to *A*, but if the line is struck, or inductively acted on by lightning, a discharge takes place along this path to earth rather than along the high-inductive path through the telephone instruments so that no damage is done to the latter. The carbon plates of the lightning arrester must be very carefully dusted when setting up the instrument, otherwise carbon dust is liable to settle on the insulating blocks *F* and destroy the insulation. This insulation may not be destroyed at once, but only after a spark has passed with the result that the dust coheres and forms a short circuit, as in coherers used for wireless telegraphy. It is, therefore, necessary when testing the insulation, to first pass a spark between the plates *A* and *B*, otherwise the instrument may appear all right, but after a time suddenly go wrong, owing to a short circuit produced by a discharge between the plates, due to atmospheric causes. Microphones consisting of carbon particles, mixed with carbon dust, are also liable to be affected by these coherence phenomena, and the noises sometimes heard in telephones, when the circuits are not in use, may be explained in this way.—*Jour. Teleg.*, May; abstracted in *Science Abstracts*, Oct.



CARBON LIGHTNING ARRESTER.

Automatic Train Recorder.—A description of the automatic train recorder of the Brooklyn Rapid Transit Company, which consists of a circular record sheet of paper ruled in concentric circles and placed in the general manager's office. The sheet is revolved by clockwork, and is divided by radial lines into five minutes' spaces. In front of the sheet are several needles operated by electromagnets, each needle being operated from a different section of the elevated lines. The track of the elevated lines at these sections is supplied with a length of insulated rail, and the cars in passing over this portion energize through a system of instruments the magnets of the needles and produce a dot in the record sheet. In this way the manager has before him at all times an absolute record of the number of trains and their frequency on any division of his lines. Means are provided in the mechanism whereby the needle makes an instantaneous punch in the disk, and is then released so as not to retard the movement of the clockwork.—*St. R'y Jour.*, Nov. 2, and Int. Ed., Nov.

Wireless Telegraphy.—A note, taken from the daily press, stating that Marconi has succeeded in sending messages over a distance of 350 miles, and that he has offered to give a demonstration to the British Admiralty of wireless telegraphy over a distance of 500 miles.—Lond. *Elec. Rev.*, Nov. 1.

REFERENCES.

Telephony.—WIETLISBACH.—The first part of a reprint of a series of articles on telephony. After an introduction on the history of telephony and on the theory of sound vibrations, the construction of the telephone is described in detail.—*Tel. Mag.*, Oct.

Telegraph Repeater.—An illustrated description, taken from a United States patent specification, of a new automatic telegraph repeater, devised by Cordovez.—*Sc. Amer.*, Oct. 19.

France.—The first part of a reprint in full of the new regulations which have been introduced in France on Oct. 1 for telephony, regarding the tariff, the installation and maintenance of the lines, etc.—*L'Elec.*, Oct. 12.

MISCELLANEOUS.

Electric Burner for Blast Furnaces.—GRAMMER.—An abstract of a paper read before the Am. Inst. of Min. Eng. In starting new or abandoned plants with untrained labor, and in running some of the large 100-ft. furnaces, slips which result in very cold furnaces, may occur, even under experienced managers. When he experienced such a misfortune, the elctrician proposed to open the tuyerers and cinder-notch by means of the heat of the electric arc. This was very successful, and he recommends making a permanent installation for this purpose, as it is badly needed in such cases.—*Eng. and Min. Jour.*, Nov. 9.

Aluminum as a Substitute for Copper.—An editorial. It may be assumed to be possible to substitute aluminum for copper in electrical work to a considerable extent, provided the metal can be had in sufficient quantities for the purpose. The latter is the most important question. In 1900 the total production of aluminum in the world was 5570 metric tons, of which the United States furnished 2053 tons, while that of copper was 492,625 metric tons, of which 272,536 tons were supplied by this country. That is, the total output of aluminum last year was only 1.1 per cent that of copper. Until these figures are greatly changed, the competition of aluminum is not likely to affect the copper market.—*Eng. and Min. Jour.*, Nov. 9.

[The supply of aluminum, unlike that of copper, is purely a manufacturing question, and practically only dependent on the demand.]

REFERENCE.

British Manufacturing Company.—An illustrated article on the Electric R'y & Tramway Carriage Works and the English Electric Manufacturing Company, at Preston, and especially on direct-current generators for light and power, made by the latter company. The title of the article is "American methods in English manufacture."—Lond. *Lightning*, Oct. 10.

A New Type of Surface Contact Traction System.

Of the numerous surface contact systems that have been proposed, the well-known one of Diatto has demonstrated some points of value in practical operation on one or more street railway lines in France. The system which we illustrate herewith, the invention of Mr. L. M. Maxham, has many points in similarity with the Diatto system, and appears to be mechanically a considerable advance over that system. As will be recalled, in the Diatto system the contact is made through the attraction by a magnet carried on a car, of a contact plunger floating in mercury, the weight of the plunger being partially sustained by the mercury. In the Maxham system, while mercury is used as

the means of contact, the plunger itself is made so light that the use of mercury floatation is obviated.

Briefly, the system consists of a sectional third rail midway between the traction rails, each section of which is capable of electrical connection with the feeder system by means of the circuit device above

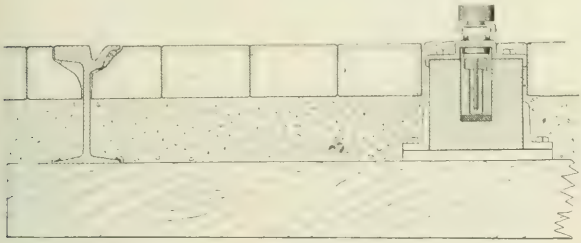


FIG. 1.—CROSS SECTION OF CIRCUIT CLOSER.

referred to. The third rail is normally disconnected from the feeder circuits, but when a car is over a section that section is immediately electrically connected with the feeder system and becomes "live." The means by which this is accomplished is shown in the two accompanying illustrations. Attached to the bottom of the car by a spring suspension is a pair of powerful electromagnets, but which require the expenditure of only a small amount of current in their coils,

FIG. 2.—DETAIL OF THIRD-RAIL SECTION.

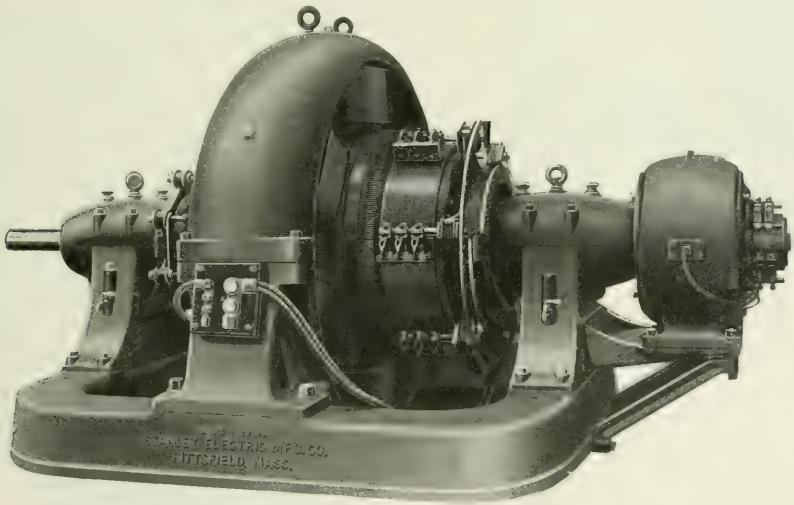
supplied by a small storage battery carried on the car. Under the rail at fixed intervals are placed the small circuit closers, which are shown in Fig. 1 in cross section. These consist of a deep cup made of copper, or aluminum, containing mercury, in which rests an aluminum pin having an iron head. When the magnets are above one of the sections of the third rail, which are of iron, they magnetize this rail and cause it to attract the iron heads of the pins in the circuit closers, raising them up and electrically connecting the bottom of the rail to the mercury. The cup is placed in a porcelain receptacle and directly connected to the feeder system, represented in Fig. 1 as a rectangular bar running below the series of cups. In order that no sticking of the plunger may occur either from residual magnetism or from the fusing of the iron head to the bottom of the rail, the contact is made between a disk of carbon on the rail circuit, and a similar disk on the iron head. The stringer which supports the rail and which forms the insulation for the feeder running under the cups, is made of some insulating material such as reconstructed granite, which not only forms a firm support but thoroughly insulates the electrical system. A form of shoe which can be used for the collecting of the current is shown in the illustrations, but, of course, this being a matter of detail may be modified to suit any assumed requirements.

The height of the top of the third rail above the bottom of the stringer is less than that of a 9-inch girder rail, so that the system can be installed on a road without cutting or interfering with the roadbed. As only the section under the cars is alive there is no appreciable loss from leakage no matter what the conditions of the pavement may be. In order that all danger from leaving a section alive may be obviated, a brush is provided at the end of the car which is grounded on the axle, so that should a section be alive when it is reached by this brush, a short circuit is produced between the third rail and the traction rails, and the circuit breaker on that division is opened immediately, thus cutting out the dangerous section. This condition, of course, is very unlikely to occur, for as soon as the magnetic influence of the third rail has ceased the plungers immediately return to their lower position.

This system is being put upon the market by the Bay State Traction Company, Bennett Building, New York, of which Mr. L. M. Maxham is president and Mr. F. W. Toppan secretary and treasurer. This company, besides promoting this system is also entering the electric railway construction field in all its branches.

S. K. C. Converter.

The illustration shows a Stanley converter, one of several machines recently built for the Detroit, Rochester, Romeo & Lake Orion Railway. The electrical design has been carefully worked out and embodies the experience with this class of machines up to date. The armature winding is thoroughly sub-divided, and a large number of slots are used. This prevents local heating, conduces to good commutation, gives a wave of e. m. f. free from harmonics, prevent eddy current loss in the pole faces, and allows the use of desirable magnetic constants. The armature is well ventilated at the ends, and a number of ducts are placed in the core at short intervals. The coils are held in the slots by means of fiber wedges and by bands at the ends.



Rotary Converter.

The commutator is built up with a large number of bars. While productive of the best commutating constants they also interpose a high resistance against flashing over the commutator. The mechan-

ical factor of safety of the commutator is high. The alternating and continuous-current brush-holders are mounted independently of the cup bearings. The latter may be removed without interfering with running conditions, thus facilitating continuous operation.

It is not perhaps widely known that small lack of symmetry due to careless erection, accidental causes, or natural wear of bearings may bring on the bearings a pressure which is many times in excess of that due to the weight of the revolving part. In order to forestall any possible trouble from such cause ample bearing surface for all contingencies has been provided. The continuous-current brush-holders give a parallel motion to the carbon and allow of easy adjustment of the pressure. The carbon is easily removed or replaced, and can instantly be thrown out of service should it become desirable.

As will be noted the machine has been made pleasing to the eye, and evidently every care taken to provide a substantial machine in every detail and which may be relied upon for severe, continuous service.

Signs for Street Corners.

Since the disappearance of the gas lamps, which in the old days, if at street corners, often carried, as the survivors still do, the names of the thoroughfares meeting at that point, many complaints have been heard of the difficulty experienced in finding one's way about in such a city as New York. Even a person familiar with the town has difficulty in the daytime in locating himself, and at night the trouble is even worse. The work of the car conductor is greatly added to by inquiries, which, if there were legible signs, would be quite unnecessary.

FIG. 1.—SIGN BROADWAY AND BARCLAY STREET.

In New York City efforts to deal with the problem have been made by the New York Edison Company, and attention is now called to another form of indicator that is being introduced by Mr. C. S. Knight, well-known in electrical circles. The sign is shown in Fig. 1 as in use at the corner of Broadway and Barclay Street, New York City. Figs. 2 and 3 show it in greater detail. In Fig. 2 it is seen in place ready for service. In Fig. 3 it is depicted as it appears when thrown up so that the arc lamp can be trimmed. The letters in the sign are of white opal glass, and are therefore legible a long way off, day or night. The structural material is sheet metal, and the whole sign does not weigh more than about 3 lbs. Such efforts as this deserve hearty encouragement, for, if reports be true, there is hardly a city in the Union where such signs, or something similar, could not be used with advantage and benefit.

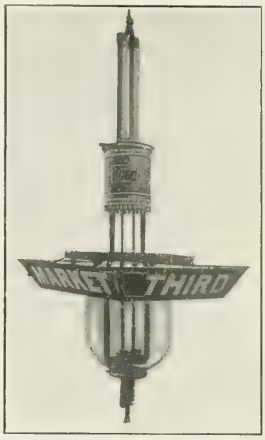


FIG. 2.—SIGN IN PLACE.

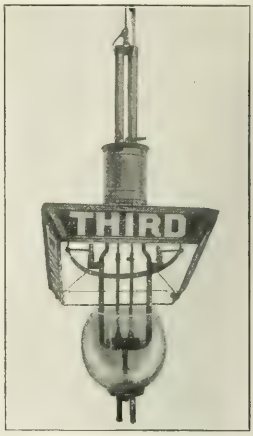


FIG. 3.—LAMP READY FOR TRIMMING.

Water-Tight Floor Outlet.

The floor outlet box shown in the accompanying illustration is specially adapted for construction work in which wires are to be brought to floor outlets for making connections for electric lights, fans, push buttons or telephones on desks, tables or store counters. It has been designed especially to meet conditions where an outlet is exposed to water and dirt when floors are scrubbed and swept, or

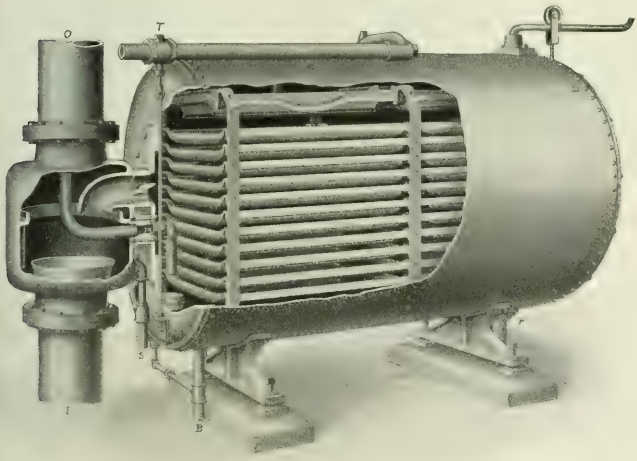
FLOOR OUTLET.

installed in situations where it is subjected to hard usage. It is made thoroughly water and dust-proof, being provided with gaskets at the joints and leaded where screw thread connections are made. An important feature is that it is adjustable with respect to the floor level, the wiremen being enabled to place the inlet at any exact level by simply turning the top of the box. It can be applied to any use without interchange of parts, a standard socket and plug being used for connection inside of the box, it may thus be applied for making connections to electric lights, fans, push buttons or telephones. For the same reason a change of service can be readily made.

It will be noted that the flexible cord comes from the side of the outlet nozzle, thus rendering it less subject to injury. When not in use a brass plug supplied with the box may be substituted for the outlet nozzle, which will make the plug plate perfectly water-tight and flush with the floor. In installing the lower casting is set from one to one-half inch below the floor level. When conduit is run the iron collar with adjustable floor plate is not set in place until the time the floor is being laid, or after. The manufacturers, the General Incandescent Arc Light Company, New York, furnish the box with or without porcelain enamel lining inside.

Induction Chamber for Feed Water Heaters.

We illustrate a device for connecting the exhaust steam to feed-water heaters, which has for its object the reduction of cost in pipe work. The device is also an oil eliminator, both for the steam used in the heater and that which flows to the atmosphere or to be used in heating systems or for other purposes. As shown in the illustration, this device consists of an attachment at the rear end of the heater through which all of the exhaust steam is intended to flow. The exhaust passes through this device in an upward direction, and as much as is required to heat the water passes into the heater through the large curved pipe, the open end of which is in line with the flow of the steam through the chamber. The small pipe curved upwards leads from near the bottom of the heater to the upper portion of the chamber and carries the non-condensable gases and air from the heater into the main exhaust line. This produces a perfect circulation throughout the heater, and by so doing the temperature of the water flowing through is always raised to the maximum. The two



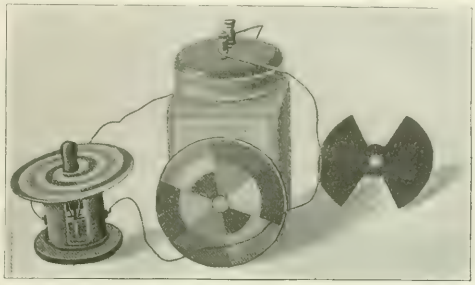
INDUCTION CHAMBER FOR FEED HEATERS.

pipe connections to the heater are provided with valves for shutting off the heater for cleaning or inspection.

From the above it would appear that this device will not only save the expense of two or three straight-way valves and a number of large fittings, but also considerable space, which is a valuable consideration, especially in steam plants of large office buildings or other places where little room is available for this purpose. This device is manufactured by the Hoppes Manufacturing Company, of Springfield, Ohio, and they have arranged by an interchangeable system of flanges to attach it to either their standard or cast iron heaters of any size.

An Electric Chromatropic Top.

One of the most interesting novelties of the holiday season is an electric top manufactured by Kendrick & Davis, Lebanon, N. H. It consists of a little electric motor, with the armature revolving horizontally on a vertical shaft. It easily operates with one cell of dry or other battery. At the top of the shaft is a grooved pulley on which is placed a card board disk lithographed in colors, which fits down tightly over the pulley. The black disk shown in the engraving is placed on top of this, fitting loosely, which permits the colored disk

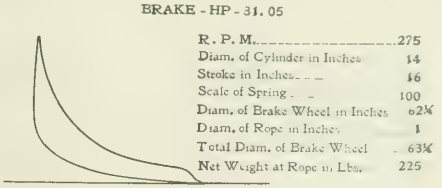


ELECTRIC TOP.

underneath to revolve with the speed of the motor while the upper disk slips just enough to make delightful color changes. The disks are lithographed with different combinations of color on each side, thus making four variations of color scheme. The motor may be used as such to operate mechanical toys, with a belt running from the pulley. The motor is finished in red enamel with polished nickel trimmings, and is placed on the market at a low price. It will be an acceptable Christmas gift to the mechanically-inclined boy, while affording pleasure and even instruction to the older members of the family.

The Mietz and Weiss Gas Engine.

The accompanying cut is a reproduction of an indicator cord from a Mietz and Weiss kerosene engine, made by August Mietz, 132 Mott Street, New York. The Mietz and Weiss engine, which is claimed to be the simplest form of heat engine made, uses either gas or ordinary kerosene (lamp oil), or even crude petroleum. A small pump controlled by a graduating charge governor forces the oil directly into the cylinder at every revolution of the crank-shaft, thus keeping a constant speed at all



GAS ENGINE INDICATOR CARD.

loads, and rivaling, it is claimed, the best steam engine in regulation. An instantaneous vaporization of this oil mixing with the entering air in the cylinder completes the charge which after a compression of about 100 lbs. per square inch, is automatically fired. The type of self-ignitor is one of the notable features of the engine, as it causes even the smallest quantity of kerosene, as when the engine is running light, to explode with remarkable certainty. The accompanying diagram, which is from a 30-hp single-cylinder engine

running at 280 r. p. m., indicates the precision with which the explosions take place at light, half and full loads. The maker states that the oil consumption of this engine is 0.6 pint of kerosene per horse-power-hour. The comparative cost of running of a 30-hp Mietz and Weiss kerosene engine and an up-to-date 30-hp steam engine is given as follows:

With coal at $4 per ton, an engineer at $500 per year and $67.10 for lubrication, the total annual cost of the steam engine is $2,017.10. With kerosene at 7½ cents per gallon, attendance at $100 per year and $25.80 for lubrication, the total for the kerosene engine is $845.80.

Future Automobile Construction.

President R. Lindsay Coleman, of the American Bicycle Company, who has observed with much satisfaction the degree of public interest manifested in this year's automobile show in Madison Square Garden, said at the close of the week:

"It begins to look now as though the automobile had fairly started upon a long and sucessful run of public recognition and favor. I had anticipated a lively show this year, in which New Yorkers would exhibit marked appreciation of the many improvements made within the past 12 months, but I confess that my expectations have been exceeded to a most gratifying extent. Until recently few, if any, conscientious makers have been able to guarantee their products as embodying those features in construction and operation, which would make them safe, satisfactory and reliable. We, ourselves, with perhaps unrivaled facilities for manufacture, have been for months past engaged principally in the work of experiment and investigation, and not until now, as exemplified in the models shown here, have we been able to say that the experimental stage has been passed, and that in the steam, electric and gasoline types of our manufacture, have we finally produced machines for business, pleasure and merchandise transport purposes in which full reliance may be placed, and in which simplicity of operation and construction have been attained to a degree that we had not at first thought practicable.

"Which type do I think will become most popular? Oh, that depends upon the purpose for which the machine is desired. For business purposes, and for merchants and professional men; for comparatively short pleasure rides about the city and suburbs; and for the transfer of merchandise and the delivery of parcels and packages; in fact, for vehicles used in and about the city where recharging facilities are conveniently at hand, the electric vehicle will be most largely used. For long-distance touring purposes, however, and for track and road racing, the steam vehicle has already shown its capabilities. The gasoline motor is also better fitted for the last-named fields than is electricity.

"Perfection in the construction of steam vehicles," continued Mr. Coleman, "is a far simpler problem than that presented by the electric type. It is not, on the whole, difficult to apply the principles of steam propulsion to automobiles, and the only really puzzling questions that have delayed makers of this class of vehicles, have been those arising from the necessity for economy of space and simplicity of construction and operation. In the electric vehicle, however, the field of investigation has not been nearly so well threshed out, while the fact that power, once exhausted, can only be re-created at charging stations has stimulated inventive genius as never before, to the end of devising a storage battery that may be carried by a vehicle of ordinary proportions, and that will give the electric vehicle a touring radius and a reserve of power well above any ordinary demands that may be made upon it. If electric power could be generated as easily and as simply as can steam power, the problem would cease to exist. Until that becomes possible, makers will place a standing premium upon the battery that will store the greatest amount of power, and thereby give the greatest touring radius. In the Sperry battery, with which our Waverley machines are equipped, giving a radius of over 60 miles, we have the best battery for the purpose yet produced, but we shall not feel satisfied until we have greatly improved upon this, and perhaps have solved the problem entirely by producing a battery whose storage capacity shall be so greatly increased that long-distance work may be attempted successfully.

"As yet, motor vehicle construction is, comparatively speaking, in a primitive stage. Judging from what has been accomplished in the past two years, it is perfectly safe to anticipate improvements in the near future far greater than any yet introduced, and these improvements, you may feel assured, will be the outcome of Yankee grit and genius. The automobile is a product of old world origin, but in time America will be selling to Europe and Great Britain better motor vehicles of all types than Europe and Great Britain can turn out, just as we have sold them bicycles so far superior to those of their own make that there was no room for comparison from any essential standpoint."

The Police Telephone Signal System of the Pan-American.

One of the most interesting features of the Pan-American Exposition was the new police system that was in use throughout the Exposition grounds. The system differs materially from the circuit telegraph signaling systems that have largely been in use in the past. It was leased to the Exposition Company, and installed at its opening, and remained in service during the entire season for the Police and Guard Departments. The system was divided into three stations, in which all reports were received. Fig. 1 shows the Central Office equipment at Station No. 1, located in the Service Building. This was a board for 50 patrol box circuits, and 10 private telephone lines. These boards are provided with two sets of indicators for each line and patrol box. The regular officers' report signal is a shutter-drop, and one for each line is placed in the middle of the face of the board above the corresponding number of spring-jacks. In the center of the board are mounted the telephone line visual signals, to which are connected the private telephone lines from the commandant of police's office, the sergeant's office, and the captain's office, to the sub-stations, and also trunks to the main telephone exchange. Immediately below the visual signals, are mounted the "clearing out"

FIG. 1.—50-LINE CENTRAL STATION PATROL SWITCHBOARD.

signals. Just above the regular reporting signals, are mounted a set of polarized ringers with gongs, for the emergency or wagon call signal. Each set of bells is provided with a small numbered indicator which corresponds in number with the station calling, and indicating which bell was rung.

The board is equipped with a complete operator's telephone, and is also provided with a portable desk telephone, which may be connected as a duplicate of the regular operator's set. The board is also provided with sufficient number of connecting cords and plugs, so that one line may be connected with another, and connection made between the patrol boxes, and the offices and the public exchange subscribers. Immediately in front of the plugs, on the plug shelf, are mounted a set of listening buttons, one for each line. When an officer reports, the operator presses the corresponding number listening button, which directly throws into circuit the operator's telephone, thus avoiding the use of the connecting plugs. Provision is made for using a power-generator. A hand-generator is provided for emergency use.

Fig. 2 shows a sub-station desk switchboard in one of the tents in Guard Station No. 3. This sub-station board was an ordinary roller-top desk, and equipped for 30 patrol box circuits and 10 private telephone lines. Station No. 2, located in the Dairy Building, was provided with a main office switchboard, the same as Station No. 1. The three stations' switchboards were connected with direct-wire trunk lines, so that connection could be made from any of the patrol boxes connected with any one of the boards, direct to any of the other

stations, or any of the other station patrol boxes, as well as with the commandant's office, the other officials, and the main telephone exchange connected with Station No. 1 switchboard.

With the 50-circuit board in Station No. 1 were connected by wire 47 patrol boxes. Forty patrol boxes were connected with the 50-circuit board in Station No. 2, and 26 with the 30-circuit board in Station No. 3. All lines were run with rubber-covered braided and

FIG. 2.—SUB-STATION PATROL BOARD IN TENT.

twisted Hazard wire. In the central part of the grounds all wires were placed in conduits.

Fig. 3 shows one of the police boxes open, and a guard giving the regular reporting signal. Taking the receiver from the hook throws the drop on the central office switchboard, which corresponds with the number of the box with which it is connected. When the signal is received, the operator presses the listening key corresponding in number, and the guard reports his name or number, of which the operator makes a record, as well as the time the report is given. A hand generator is mounted in the box, with a crank projecting through the inner door, seen in the center of the box. This generator is used as the emergency or wagon call, and when operated, rings the bell on the switchboard; and the shutter between the gongs indicates the number of the box calling. The bells in the box immediately above

FIG. 3.—PATROL BOX OPPOSITE ELECTRICAL TOWER.

the wagon call generator, are for the answer-back signal, and are rung from the central office when a wagon call is received, to indicate to the officer that there is no trouble on the line, that the call has been received, and the wagon is being sent.

Back of these bells are a pair of heavy compound ringers, with a pair of four-inch gongs placed in the top of the box, which are used for the recall bells. The top of the box has an opening on each side for the emission of sound from the bell. These bells will ring only when the door is closed, being cut out by a spring key when the door is open. The recall bell is for calling the officers instantly to the box at any time from the central office. The recall bells on any of the boxes can be rung separately, or all in the entire district rung simultaneously.

Immediately under the wagon-call generator is mounted a long-distance transmitter, with the mouthpiece projecting through the inner door. The receiver hook is a special platinum contact gravity switch, cutting out of the circuit the entire box, excepting the recall bell, when the receiver is on the hook. The emergency call generator is provided with an automatic shunt, and cuts itself in when operated. The receiver is a strongly built, double-pole horseshoe magnet, adjustable instrument, and is provided with a special weather-proof long conductor cord. The apparatus is mounted in a heavy cast-iron weather-proof protection box of neat design, well painted with weather-proof paint, all main parts being mounted back of an inner door, excepting the receiver, which is provided with a weather-proof cord enabling the system to be used in rainy and wet weather without affecting its working parts.

Fig. 4 shows box 37 in District No. 1, at the entrance of the Temple of Music, where President McKinley was shot Sept. 6, and from which box the ambulance was called to remove him. This box was located on the outside of the building at the south entrance, where it was most convenient for emergency use, as well as for regular reporting of the guards. All the boxes on the grounds were placed in the most prominent and convenient places, and it is said that the

FIG. 4.—PATROL BOX AT TEMPLE OF MUSIC.

system was one of the most important and satisfactory features for the protection of the Exposition. This system, above noted, is that of the Municipal Signal Company, of Chicago, Ill., as invented some years ago by N. Banks Cregier, of that city. It has, of course, been considerably elaborated and improved in the past decade.

New-Angle Boring Bit Stock.

ANGLE BIT STOCK.

The Smith & Hemenway Company and the Utica Drop Forge & Tool Company, of 296 Broadway, New York City, are introducing the 1901 model of their new angular bit. It is adapted for use in connection with any bit or boring machine, also for reaming holes, turning screws, nuts, etc., in angles heretofore impossible. The chuck part of the machine bends as far as the dotted lines shown in the cut, and is locked firmly with the set pin at any angle desired. The gearings are turned out of the finest bar steel with cut teeth, and the shaftings and side plates are of the finest Bessemer stock. All parts are turned and fitted to run perfectly true. A few of the uses to which it can be put are boring against partitions, alongside the wall, between beams, around projections, shelves and in close, straight angles.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Realizing sales and declines followed the announcement of the terms of the Northern Pacific settlement. The bearish tendency was also aided by large gold shipments and fears regarding money, but there was a general recovery late in the week on the expectation of a satisfactory bank statement. Traction stocks were quite active. There were alternations of pressure and support in Metropolitan and Brooklyn Rapid Transit was apparently cared for by a pool in the stock. All through the week there were rumors in a variety of forms regarding traction consolidations in Greater New York, but these were diligently denied by the officials of the companies concerned. The effect was exhilarating on Metropolitan and Brooklyn Rapid stocks. There was great activity in trading in both stocks, 157,810 shares of the former and 150,400 of the latter having changed hands. Metropolitan ranged between 163 and 169¾, closing at 167¾, a net gain of 5⅞ points, and Brooklyn Rapid Transit, after fluctuating between 66⅞ and 71, closed at 68⅝, a net gain of 1¼ points. General Electric was quiet, ranging between 256 and 259, closing at a figure one point below the highest, and making a net gain of 1½ points. Western Union showed some activity, the sales aggregating 42,800 shares, the range of prices being 89⅞ and 92½, closing at 90⅛, showing a net loss of 2½ points. American District Telegraph made a net gain of ¼ point. Call money is quoted at 4¼ per cent, nominal, and 4½ for high grade time loans. Following are the closing quotations of Nov. 19:

NEW YORK.

	Nov. 12.	Nov. 19.		Nov. 12.	Nov. 19.
American Tel. & Cable	100	96	General Electric	259	257⅞
American Dist. Tel	—	36	General Carriage	¾	¾
Brooklyn Rapid Transit	68¼	68¼	Hudson River Tel	110	110
Ches. & Pot. Telephone	67½	—	Illinois Elec. Veh. Trans.	—	—
Commercial Cable	—	170	Metropolitan Street Ry	166¼	168¾
Electric Boat	18	17	N. E. Elec. Veh. Tran	—	—
Electric Boat pfd	40	40	N. Y. Elec. Veh. Tran	6¾	5⅝
Electric Lead Reduc'n	2	1⅞	N. Y. & N. J. Tel	166	166
Electric Vehicle	2	2¼	Tel. & Tel. Co. of Am	—	—
Electric Vehicle pfd	4½	4½	Western Union Tel	92½	90⅝

BOSTON.

	Nov. 12.	Nov. 19.		Nov. 12.	Nov. 19.
Am. Tel. & Tel	157	157	Mexican Telephone	2¼	2
Cumberland Telephone	—	—	New England Telephone	—	132
Boston Electric Light	—	—	Westinghouse Elec.	—	70
Erie Telephone	22	21¼	Westinghouse Elec. pfd.	—	—
General Electric pfd	—	—			

PHILADELPHIA.

	Nov. 12.	Nov. 19.		Nov. 12.	Nov. 19.
American Railways	42	44½	Phila. Traction	95⅞	97⅛
Electric Storage Battery	55	57	Philadelphia Electric	5¼	5
Elec. Storage Batt'y pfd.	55	57	Pa. Electric Vehicle	¾	¾
Elec. Co. of America	6⅝	6⅞	Pa. Elec. Veh. pfd	1	1

CHICAGO.

	Nov. 12.	Nov. 19.		Nov. 12.	Nov. 19.
Central Union Telephone	—	40	National Carbon pfd	82½	84
Chicago Edison	158	—	Northwest Elev. com	40	39
Chicago City Ry	195	188	Union Traction	12¾	12⅝
Chicago Telep. Co	225	—	Union Traction pfd	50	52½
National Carbon	20¼	20			

PITTSBURG TROLLEYS.—The board of directors of the Philadelphia Company, of Pittsburg, has completed arrangements to increase its bonded indebtedness to $22,000,000 and the capital stock to $36,000,000. The Southern Traction Company is to be absorbed, the stock issue of which amounts to $5,000,000. Negotiations are pending for the absorption of the Suburban Rapid Transit Company and other smaller interests, which, when completed, will give the Philadelphia Company entire control of traction operations in the Pittsburg district. A report of a committee of the Philadelphia Company directors will be presented to the stockholders of the Philadelphia Company for their approval on Dec. 4, when the committee, which is arranging for the absorption of the outside interest, will be ready with its report. The present bonded debt of the Philadelphia Company is $6,500,000. Of the proposed new $22,000,000 bond issue, the $6,500,000, to cover the old issue, will be reserved to take up the outstanding bonds when they mature. Of the rest $12,000,000 will be available to exchange as part payment for $12,000,000 preferred stock of the Consolidated Traction Company, if this amount is turned in under the proposition of the Philadelphia Company. The remaining $3,500,000 bonds will be directly available to provide funds for the betterment and extension of the properties of the companies. The entire issue of $5,000,000 stock of the Southern Traction Company is to be transferred for $2,500,000 of the common stock of the Philadelphia Company. This will be done by an exchange of one $50 share of Philadelphia common for one $50 preferred and one $50 common share of the Southern stock. Owners of this stock of the Southern Company have agreed to the sale on this basis.

CONSOLIDATING NEW ENGLAND TROLLEYS.—A consolidation of the Newton, Newton & Boston, Wellesley & Boston, Commonwealth and Lexington & Boston Street Railway companies has been effected under the title of the Boston Suburban Electric Railway Company, with a capital of $6,000,000 equally divided between common and preferred stock. The company will operate 66 miles of road. Of the $6,000,000 stock a large portion will remain in the treasury to provide for future extensions. The stock issued has all been taken in exchange for stock of the five controlled roads. The consolidation is formed after the manner of the Massachusetts Electric Companies—a voluntary association—and the following board of trustees elected: Leonard D. Ahl, Adams D. Claflin, Winthrop Coffin, William H. Coolidge, William F. Hammett, Sydney Harwood, Frederick H. Lewis, Horace B. Parker, Alfred Pierce, Frank W. Remick, James L. Richards, Charles W. Smith, George W. Morse, R. Elmer Townsend, Alden E. Viles. The securities of this association will be listed upon the Boston Stock Exchange.

MANHATTAN ELEVATED shows $10,455,872 gross for 1901 and net just half. The passengers carried were 194,152,316, a gain of 10,363,465. At the annual meeting, President Gould said: "During the year the change to electrical equipment has made great progress. The buildings for central power station at East Seventy-fourth Street, and sub-stations at Allen Street, Thirty-fourth Street, and Ninety-ninth Street are completed, and the machinery is being rapidly installed in all of them. Motor equipments are arriving in quantity, and deliveries of 300 new cars will commence within two weeks. Our engineers expect to turn the first 8000-hp engine and dynamo by Dec. 1, and run the first trains on Second Avenue during the month, to be followed up as rapidly as the equipment can be assembled and put in operation."

ELECTRIC VEHICLE BONDS.—The bondholders of the Electric Vehicle Company have voted to change the agreement under which the bonds were issued, to meet the conditions that have developed by the business so as to release a certain amount of securities and cash for working capital. The amount which will be realized in this way is not stated. There are $1,675,000 of bonds. The mortgage under which these bonds were issued is dated May 1, 1901. The head offices of the company have been removed to Hartford, Conn. Electric Vehicle does not lease vehicles any more, but sells them outright. The outlook for business is said to be good. Automobiles are in growing demand, and electrics remain deservedly popular. The company has also good gasoline vehicles.

RAILWAY MORTGAGE.—The following securities will be retired when the new $35,000,000 blanket mortgage on the properties of the Detroit District Railways is issued: Detroit Citizens' bonds, $7,000,000; Detroit Railway bonds, $2,800,000; Ft. Wayne & Belle Isle bonds, $1,200,000; Pontiac & Binghamton bonds, $1,100,000; Detroit & Northwestern bonds, $855,000; Detroit & Romeo bonds, $2,500,000; Detroit & Wyandotte bonds, $425,000. Total, $15,880,000.

DIVIDENDS.—The American Railways Company has declared a quarterly dividend of 1¼ per cent, an advance of ¼ per cent over the regular rate, payable Dec. 15. The earnings statement laid before the board showed about $75,000 net earnings for the quarter ended Sept. 30, 1901, or equal to 8 per cent per annum on the $3,750,000 capital stock.

WESTERN UNION was weak last week. The break was said to be due to pool selling. To explain it, the reason was offered that the contract with the Pennsylvania Railroad just renewed is much less satisfactory than the one that formerly obtained, while there was talk also of competition in the South by a new company.

CHICAGO ELEVATED.—The statement is made that arrangements will be made about the end of this month for the sale of an additional $5,000,000 4 per cent bonds of the Northwestern Elevated of Chicago, making the $15,000,000 to be issued out of the $25,000,000 authorized when the purchase of the Union Loop was completed.

NASHVILLE, TENN., TROLLEYS.—The Nashville Street Railway will be sold under foreclosure proceedings, and C. K. C. Billings will acquire the property, said to be worth about $7,000,000. He owns the Memphis Street Railway.

TELEPHONE MORTGAGE.—The United States Telephone Company has filed a $1,000,000 mortgage in favor of the Cleveland Trust Company covering all its property, which represents one of the largest interests in the independent telephone field.

PHILADELPHIA UNION TRACTION.—An official of the Union Traction Company, of Philadelphia, is given as authority for the statement sent from that city that there will soon be an assessment of $5 a share on the stock, payable in two installments, and that there will be no dividend at present.

WEST END STREET RAILWAY.—The Massachusetts railroad commissioners have received a petition from the West End Street Railway Company, asking for the approval of an issuance of 4 per cent bonds due 1915 to the amount of $1,800,000 for improvement of the company's property required under the lease to the Boston Elevated.

Commercial Intelligence.

WEEK IN TRADE.—The reports received by the commercial agencies during the past week are even more encouraging than they have been in the recent past. The favorable features are still largely in the ascendant, and the current of business is running free the country through. The iron and steel situation has gained rather than lost in activity and strength, and production and consumption at present find no parallel in the past. The demand is heavy. The rail situation is one of special strength, the leading interest being reported as having booked its output for the entire year of 1902. The shortage of cars restricted furnace operations in the Central West and complaints from all of the heavy buyers are heard in addition. The railroad earnings reports confirm the more sanguine predictions of good business enjoyed by the transportation interests. For the month of October they were 11.3 per cent greater than in October last year, and 21.2 per cent over the same month in 1899, while those roads reporting for the first week of November show an average gain of 9.8. The business failures, as reported by *Bradstreet's*, aggregated 213, against 191 the week previous, and 227 the corresponding week last year. The copper market continues quiet and steady without any special feature, and there seems to be a disposition on the part of consumers to operate somewhat more freely. A cut in the price of copper wire has been reported. Quotations are unchanged at 16⅝@16¾c. for Lake, 16¼c. for electrolytic in cakes, wire bars and ingots, 16c. for cathodes and 15⅞@16c. for casting copper.

IMPORTS OF MANUFACTURED MATERIAL.—A detailed examination of imports of manufacturers' material in the first nine months of 1901 shows a large increase. While the total imports of manufacturers' material in the nine months ending with September, 1901, exceed in value by $4,000,000 those of the corresponding nine months of 1900, the actual increase in quantity is probably considerably greater than that indicated by the statements of values simply. This is due to the fact that there has been during the last year a marked decrease in the prices of the principal articles imported for use in manufacturing, and, therefore, while the figures of value show a material increase, those of quantity show an even greater increase. The importations of manufacturers' material are largely made up of six great articles—india rubber, silk, fibers, hides and skins, tin for use in manufacturing tin plate, and chemicals for use in the manufacturing industries. In nearly all of these the prices per unit of quantity in 1901 are less than those of 1900. In raw silk, for instance, the value of the importations of the nine months ending with September, 1901, is $26,377,699, against $26,256,077 in the corresponding months of last year, the increase in value being very slight; but the number of pounds imported in the nine months ending with September, 1901, is 8,404,824, against 6,561,880 in the corresponding months of last year, an increase of about 30 per cent in the quantity imported. In fibers the figures of value show a slight decrease, while the quantity shows an increase, the value being in the nine months ending with September, 1901, $19,259,909, against $21,351,842 in the corresponding months of last year, a slight decrease, while the quantity in 1901 is 199,832 tons, against 187,976 tons in the corresponding months of last, a material increase in quantity. In crude rubber this is also true. The value of rubber importations in the nine months of 1901 is $20,869,070, against $21,449,246 in the same months of last year, a slight decrease in value, while the quantity imported in 1901 is 40,481,040 lbs., against 34,493,337 lbs. in the same months of last year, an increase of more than 15 per cent. In pig tin the same improvement in price is noted, the value of the imports in 1901 being $14,679,768, against $15,281,577 in the corresponding months of last year, while the quantity in 1901, 56,308,901 lbs., against 54,847,417 lbs. in the corresponding months of last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Nov. 9: Antwerp—Materials, 26 pkgs., $1,838; machinery, 8 pkgs., $800. Amsterdam—Material, 1 pkg., $12. Argentine Republic—Material, 125 pkgs., $3,381. British East Indies—Material, 9 pkgs., $225; machinery, 28 pkgs., $2,200. Bristol—Machinery, 44 pkgs., $14,442. Brussels—Material, 3 pkgs., $200. Bremen—Material, 3 pkgs., $108. British Guiana—Material, 52 pkgs., $2,930. Barcelona—Material, 14 pkgs., $500. British West Indies—Material, 117, $2,443. Cuba—Material, 108 pkgs., $2,298. Central America—Material, 2 pkgs., $90. China—Material, 2 pkgs., $70. Chili—Material, 46 pkgs., $2,245. Copenhagen—Material, 2 pkgs., $550. Chemnitz—Machinery, 1 pkgs., $700. Dutch West Indies—Material, 2 pkgs., $30. Glasgow—Machinery, 26 pkgs., $1,595; machinery, 64 pkgs., $2,610. Hamburg—Machinery, 82 pkgs., $1,252. Hong Kong—Machinery, 73 pkgs., $3,489. Havre—Machinery, 9 pkgs., $115; material, 7 pkgs., $418. Japan—Material, 134 pkgs., $31,197; machinery, 100 pkgs., $17,967. Liverpool—Machinery, 6 pkgs., $450. Lyons—Machinery, 1 pkg., $150. London—Material, 33 pkgs., $1,793; material, 80 pkgs., $4,043. Mexico—Material, 79 pkgs., $1,845; machinery, 42 pkgs., $1,606. New Zealand—Material, 72 pkgs., $2,112; machinery, 2 pkgs., $239. Nice—Machinery, 5 pkgs., $200. New Castle—Machinery, 29 pkgs., $2,500. Philippines—Material, 23 pkgs., $950; machinery, 74 pkgs., $5,560. Peru—Material, 15 pkgs., $236. South Hampton—Material, 4 pkgs., $239; material, 103 pkgs., $732; machinery, 2 pkgs., $275. U. S. Colombia—Machinery, 4 pkgs. $191; material, 13 pkgs., $359. Venezuela—Machinery, 3 pkgs., $44.

THE COPPER SUPPLY.—Returns of the stock of copper in and afloat for Europe Oct. 31 show large reductions during the past month. The visible European supply is 20,965 tons, against 24,765 on Sept. 30, a decrease of 3,800 tons. European stocks of copper compare as follows for a series of months:

	Tons.		Tons.
Nov. 1, 1901	20,965	Nov. 1. 1900	28,812
Oct. 1, 1901	24,765	Nov. 1. 1899	26,847
Sept. 1, 1901	25,811	Nov. 1. 1898	25,798
July 1, 1901	27,461	Nov. 1. 1897	34,389
April 1, 1901	28,236	Nov. 1. 1896	35,779
Jan. 1, 1901	28,921	Nov. 1. 1895	50,383

The highest level reached by European supplies in the recent "boom" was 30,215 tons, on Sept. 1, 1900, but the amount has been much larger at other periods. On July 31, 1897, it reached 34,004 tons; on June 30, 1895, it rose to 58,182 tons; on Jan. 31, 1890, to 95,714 tons; and on July 31, 1888, when the Secretan syndicate was in active operation, the very large amount of 118,116 tons was reached by European supplies. The present foreign stock is smaller than that of any month in at least sixteen years. It is alleged that production is being kept down by large miners, in order to maintain present prices.

THE DEMERARA ELECTRIC COMPANY, LIMITED, of Georgetown, British Guiana, in which Sir William Van Horne, late president of the Canadian Pacific Railway, is largely interested, and of which H. P. Bruce, formerly of the Consolidated Traction Company, of Pittsburg, is general manager, is reported to be placing some substantial contracts for general electrical supplies in the United States. The Morris Electric Co., of 15 Cortlandt Street, New York, is reported to have secured a $5,000 order for miscellaneous supplies by last mail. Further contracts are expected to be placed with American manufacturers very shortly, as advices have been received from Georgetown that the local gas company has ceased to exist on account of the competition of the electric company, and that a considerable lot of work is in hand for additional city lighting and private customers with a view to the replacing of gas by electric light.

TRAMWAYS IN MEXICO.—The Compania Limitada de Tranvias Electricos de Mexico, of the City of Mexico, is reported to have just forwarded a substantial contract to the Morris Electric Company, calling for the shipment of stock supplies sufficient for the next six months. The order embraces 10,000 incandescent lamps of 16 candle-power, track bolts, linen tape, linen, mica, magnet wire, asbestos, wire nails, air hose, switches, etc. A large portion of the contract, which in all is said to be valued at over $20,000, will be sub-let.

BALL ENGINE CONTRACTS.—The Ball Engine Company, Erie, Pa., will furnish three tandem compound engines arranged for direct connection to Westinghouse generators, for the Pennsylvania Railroad Company's Arcade Building, Philadelphia, Pa. The Bisbee Improvement Company, of Bisbee, Mont., has recently ordered a compound direct-connected engine from the Ball Engine Company for its electric plant. M. R. Williams & Co., of Piedmont, N. Y., have recently installed an engine built by the Ball Company.

EQUIPPING STEEL WORKS.—It is reported that the Westinghouse Electric & Manufacturing Company, of England, has received a very large contract from Bolckow, Vaughn & Co., Limited, of England, for electrical equipment. The Westinghouse people have already done some heavy work in England in steel plants.

SWITCHBOARD FOR P. R. R.—The Walker Electric Company, registered, Philadelphia, Pa., has secured the contract from the Pennsylvania Railroad for the main switchboard in the new Union Station at Pittsburg.

HENRY TRAIN-LIGHTING SYSTEM.—The Henry Electric Equipment Company has been formed at Denver, Colo., with a capital stock of $1,000,000. The president is Mr. C. F. Elliott, former traffic manager of the Florence & Cripple Creek Railroad. Mr. J. H. Peabody, president of the First National Bank, of Canon City, is treasurer. Mr. D. Carl Henry, of Denver, is secretary and chief electrician. Successful trials have been made of the system to be exploited. The object of the company is to manufacture and sell electric train lighting equipment, for Pullman cars. The device is now in practical operation at the company's shops. It is the intention of the company to erect a large factory in Denver, and to equip cars with the system, consisting of a direct-connected generator, mounted on the axle of the train, in combination with storage battery and other devices, the invention of Mr. John C. Henry, who died in Denver last spring, and who was one of the original inventors of the modern electric railway. Improvements on the inventions have been made since the death of the inventor by his son, D. Carl Henry. The company owns three United States patents, with a number of others pending. The stock is held by Denver, Canon City, Omaha and Colorado Spring people, a controlling interest, however, being held by the incorporators. About $250,000 will be expended in Denver, it is said, for the erection of a factory, and the manufacture of the apparatus. It is the intention of the company to equip as many as possible of the Western railways with electric lights, electric fans, and a branch of the company will place electric refrigeration apparatus on all fruit and meat cars, doing away with ice. In addition to the Pullman cars to be equipped by the company there will be electric heaters, instead of steam, electric stoves in the diners, electric fans, and electric curling irons in the ladies' dressing room. Besides electric fans in various parts of the cars, the cars will be heated in winter by electricity and cooled in summer by the same power.

REPRESENTATION OF FOREIGN INTERESTS.—The Goudey-McLean Company, of 88 Maiden Lane, New York City, recently established with a view of acting as managers for foreign sales of a syndicate of manufacturers of electrical apparatus and fittings, has just entered into contracts for that purpose. Among the manufacturing concerns referred to are the Milwaukee Electric Company, of Milwaukee, Wis.; the Browning Manufacturing Company, makers of dynamos up to 7½ horse-power, of the same Western city; the Fostoria Incandescent Lamp Company, of Fostoria, Ohio; the Electric Motor & Equipment Company, of Newark, N. J., manufacturers of Deshler-McAllister photometers and Brewster sign receptacles; the Keystone Electrical Instrument Company, of Philadelphia; the Pittsburgh Transformer Company, of Pittsburg, Pa., and the Wheeler Reflector Company, of Boston, Mass. Mr. Edward E. Goudey, who was formerly manager of the foreign department of the Wagner Electric Manufacturing Company, of St. Louis, Mo., is secretary of the Goudey-McLean Company. He is now in Europe for the purpose of appointing agents in the principal electrical centers in Great Britain and the Continent, and will be abroad for nearly three months. Mr. James W. Boyle, late of the Wagner Company, is also connected with the Maiden Lane concern.

UNITED STATES CARBON COMPANY'S AFFAIRS.—The plant and business of the United States Carbon Company, of Cleveland, which was placed in the hands of a receiver some months ago, was sold a few days ago for $87,000 by the receiver, W. D. Sayle, to Frank Masten, as trustee. The creditors have formed a new company with Mr. Masten as trustee, and the company will be chartered in New Jersey. The plant which has been running as usual is now under the management of B. P. Foster. The company expects to enlarge the plant and double the present amount of business. In addition to the production of arc carbons, it is the intention to branch into the manufacture of battery carbons and special electrical apparatus. A new brick building 50 by 100 ft. and two stories high, to cost $50,000, is about being started. It is being erected principally for the specialty work. The company hopes to have it completed and in operation by Jan. 1.

CANAL LIGHTING IN CANADA.—The General Incandescent Arc Light Company, of New York City, is naturally proud of the excellent piece of work just done in lighting the Cornwall (Canada) Canal, for which it supplied the entire outfit of 275 series alternating current enclosed arc lamps, with regulators and switchboards. A contract for this work was placed by the Department of Railways and Canals, with Mr. M. P. Davis, of Ottawa, who has installed a fine water power plant, with turbines from Hamilton Co., of Peterboro, equipped with Lombard governors, and Bullock generators. Current at 2200 volts is raised to 11,000 for the line and then lowered to 220 for use in the G. I. lamps of 2000 candle-power each, the net cost of operation being figured at $32 per lamp per year. The lights are very successful, and extensions seem to be in order, increasing the capacity of the plant from 1000 to 4000 horse-power, there being a big call for current.

AMERICAN TRADE PRESS ASSOCIATION held its annual meeting and dinner at the Hardware Club, New York City, on November 14. An unusually l rge number of technical and trade papers were represented. Papers were read on the function of such journals by Mr. Franklin Ford, the economist, and by Mr. E. C. Brown, on the general aspects of trade paper advertising. Comptroller Coler took an effective part in the discussions. The association was reported in flourishing condition as to finances, membership and influence. The following ticket was elected for 1901-2: President, F. P. Burt, *Engineering News;* first vice-president, J. M. Wakeman, ELECTRICAL WORLD AND ENGINEER; second vice-president, C. R. Clifford, *The Upholsterer;* third vice-president, J. D. Crary, *New York Lumber Trade Journal;* secretary-treasurer, E. C. Brown, *Progressive Age;* director for four years, F. F. Cutler, *Shoe and Leather Reporter;* director for two years, J. H. McGraw, *Street Railway Journal.*

ELECTRICITY IN ECUADOR.—The Consul-General of the United States at Guayaquil reports that that city has recently granted a syndicate a charter authorizing the construction of an electric tramway system. The charter permits the use of any of the streets of the city (whose inhabitants now number about 50,000), and also authorizes the use of electricity for lighting and power. It also provides for the construction of a new race course, including a bicycle track in the suburbs. The concession is for 35 years, the tramway and race course reverting to the city at the close of that period. At present Guayaquil tramways are operated by mule power. They have paid an annual dividend of 25 per cent for several years. The principal streets are lighted by gas lamps and the side streets by kerosene lamps. The new company is seeking capital in the United States.

THE AMERICAN BRIDGE COMPANY, of New York, is about to make shipment from its Pencoyd works of about 500 tons of structural material, which is intended to be utilized in the construction of the new Bank of Australasia building at Sydney, New South Wales. A shipment of 250 tons of railroad bridge material has just been forwarded from the Pennsylvania plant to the same Antipodean port. The American Bridge Company has also obtained a contract for the construction of 20 steel bridges along the line of the Uganda Railroad in East Africa. The amount of the contract is about $1,000,000. Several English and Continental firms offered bids, but that of the Philadelphia company was not only the lowest, but guaranteed the completion of the work in a shorter space of time than its competitors. The new bridges will replace wooden structures, which were built several months ago and found to be inadequate.

WESTINGHOUSE EQUIPMENT FOR DE BEERS MINES.—The De Beers Consolidated Diamond Mines of Kimberley, South Africa, are to be equipped with some $135,000 worth of electrical machinery, which is to be manufactured at the Westinghouse plants, East Pittsburg. One contract calls for the shipment of two Westinghouse-Parsons steam turbines, having a capacity of 1000 kilowatts each. This contract, which is the first export order received for Westinghouse-Parsons turbines, was secured through Westinghouse, Church, Kerr & Co. Another contract requisitioned for the supply of two alternating-current direct-connected generators. This order was received by the Westinghouse Electric & Manufacturing Company. The equipment will be utilized for general power purposes in the De Beers mines.

PLANTS FOR NEW JERSEY MANUFACTURING CONCERNS.—The Edward P. Hampson Company, Havemeyer Building, 26 Cortlandt Street, has secured a contract from the Hillson Cigar Company, for the electric light and power plant, which is to be installed in its new plant about to be constructed at Elizabeth, N. J. The contract, valued at about $8,000, calls for engine and boiler to be built by the Atlas Engineering Works, of Indianapolis, while the generator will be manufactured by the General Electric Company. The Hampson people have also received a contract from the American Sanitary Company, of Elizabeth, N. J., for an electric light and power plant to include a 200-hp boiler and a 150-hp engine, both of Atlas build. The electrical portion of the plant will be manufactured by the General Electric Company and the C & C Electric Company.

TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has been very busy on power work of various kinds. It is now finishing up a large equipment of generators, motors, etc., for the new Globe-Wernicke bookcase factory, and has now in hand another similarly extensive contract for the Krell French Piano Company, of Springfield, Ohio. The plant in the latter instance will consist of a generator and some 56 motors, which will be used in various parts of the factory in driving the different tools employed in the manufacture of pianos. Some will be back geared, some operated vertically, and others direct connected. It will make one of the most important installations of the kind in the country.

ORDERS FOR WESTINGHOUSE EQUIPMENT.—Westinghouse, Church, Kerr & Co., of New York City, have secured an order for a 300-hp vertical cross-compound engine, which is to be utilized for electrical power purposes in the plant of the Dominion Bridge Company, Montreal, Canada. A contract calling for ten 25-hp direct-connected lighting sets has just been received from the Pullman Palace Car Company for use in its cars.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The American Telephone & Telegraph Company has been incorporated with a capital stock of $250,000. Percy T. Wilden and Guy M. Lovejoy, of Bessemer and Jos. J. Dixon, of Birmingham, are among the incorporators.

SANTA MARIA, CALIF.—A telephone line is being constructed from Santa Maria to Carey, a small town ten miles up the valley.

SAN FRANCISCO, CALIF.—The Wheatville Telephone Company was recently incorporated, with Caruthers, Fresno County, Calif., as the principal place of business. Directors: F. M. Miller, H. A. Monson, W. G. Grove, J. W. Downing and H. A. Adams. Capital stock, $5,000; subscribed, $2,014.

JACKSONVILLE, FLA.—The Florida Long Distance Telephone Company will be incorporated. Charles F. Speed is president; W. N. Shine, vice-president, and C. J. M. Shine, secretary.

ATLANTA, GA.—The purchasing department of the Southern Bell Telephone & Telegraph Company, heretofore located at New York, has been moved to Atlanta, and M. O. Jackson, head of the department, together with a large force of clerks, have arrived from New York.

JACKSONVILLE, ILL.—The Illinois Telephone Company has moved its headquarters from Bluffs to Jacksonville.

MURPHYSBORO, ILL.—The American Telephone & Telegraph Company will ask for a franchise to establish a long distance telephone service in this city.

MT. VERNON, ILL.—Talbot & Frost, of Dix, were granted a city franchise for a long-distance telephone line to be constructed through Mount Vernon to Central and thence to Carlyle.

CARBONDALE, ILL.—The County Board of Supervisors has granted a franchise for a telephone system to the Farmers' Economic Union, including the use of all public highways of the county.

CHICAGO, ILL.—The rooms of the Auditorium and Great Northern hotels are being put on a branch exchange of the Chicago Telephone Company. There are 450 telephones in the Great Northern and 1059 in the Auditorium and Auditorium Annex.

SAYBROOK, ILL.—The telephone system here, owned by Mr. A. T. Wood, extends into the country among the farmers. There are 57 telephones in the village and 110 in the country, and the number of subscribers in both sections are being rapidly increased. The farmers own and control their lines, paying Mr. Wood a certain amount per year for exchange services.

CHICAGO, ILL.—Chas. H. Beers, as a minority stockholder of the Central Union Telephone Company, has petitioned the court for a receiver for that company to have the rights of the minority stockholders adjudicated. He charges that contracts have been entered into with the American Telephone & Telegraph Company, whereby exorbitant instrument rentals are paid by the Central Union Telephone Company.

INDIANAPOLIS, IND.—The Brown's Chapel Telephone Company, of Brown's Chapel Schoolhouse, has been incorporated. The directors are Eli Parish, L. C. Crider and C. E. Sipe.

SEYMOUR, IND.—Right of way has been granted Charles Leininger for the construction of a telephone line from Seymour to Crothersville. The line will be an extension of the Leininger system of this place.

LIBERTY, IND.—The Bell Telephone Company has been granted a franchise to put in an exchange here. Announcement has been made by the company that party lines will be put in along the principal highways of Union County and the service extended to any community of farm residences.

SOUTHPORT, IND.—Party line telephone service is in disfavor here. Some time ago the farmers and business men of this community constructed a party line system. Some of the farmers' wives are prone to gossip about their neighbors, and a particular slanderous conversation was listened to by the women talked about. They told their husbands, and the result is half a dozen families have become entangled in a row likely to go to the court for settlement in damages. Others threaten to have their telephones taken out, and it is likely the company will disband.

INDIANAPOLIS, IND.—The New Telephone Company has spent $37,000 for new copper wire on old lines within forty miles of this city. It built a new line to Spencer to connect with the coal fields of Southern Indiana, and is now constructing a line from this city to Terre Haute. The company is also preparing to build lines from Kokomo to Logansport, from Kokomo to Peru and from Peru to Wabash. Material is purchased to extend the line from Columbus to Louisville, Ky., to connect with the new independent plant in that city. The company says it is adding 100 telephones a month and has upwards of 5500 telephones in use in Indianapolis. Sub-stations are to be constructed, the materials for which will cost $97,000, to take care of the business on the outskirts of the city.

ELWOOD, IND.—The City Council, after considering the proposition for almost a year, has granted a franchise to George W. Beers and associates of the Anderson Telephone Company to establish and operate a telephone system in this city. By the terms of the franchise the company is to furnish a single line for each patron, doing away entirely with the party lines, and make a maximum charge of $1.50 and $2.50 a month for residences and business houses respectively. Long-distance communication with all cities and towns in Madison County is to be furnished at a rate not to exceed 10 cents for a five-minute conversation. The Beers Company has filed a written acceptance of the franchise, and will begin work at once, agreeing to have the exchange and city lines completed in four months.

INDIANAPOLIS, IND.—The New Telephone Company has arranged to give its long-distance operators lessons in elocution and distinct enunciation at the expense of the company. As far as known here this is an entirely new departure in the telephone world. The company's manager says that its long-distance patronage is such that the greatest efficiency and expedition is necessary to take care of the business. One-fourth of the calls for long-distance service have to be refused for want of time and capacity and the loss of a few minutes each hour amounts to something. A long-distance operator has considerable conversation in making appointments, etc., and frequently is asked to take the place of inexperienced patrons and do the talking for them. A clear, distinct enunciation is a valuable acquirement, while a poor speaking operator can lose much time and money for the company.

NEW HAMPTON, IA.—A company is being organized in Greene County to be known as the Greene County Farmers' Telephone Company.

SHELL ROCK, IA.—H. E. Eckles, of Tama County, has made arrangements for the purchase of the lines of the Cedar Valley Telephone Company at this place and he will improve and extend the system.

TINGLEY, IA.—The Tingley & Mount Ayr Telephone Company, capital stock $1,540, has been incorporated by D. C. Tidrick, president; R. H. Morey, secretary, and Wm. Fife, treasurer.

DOWNS, KAN.—Between twenty and thirty farmers in Corinth and Bloom townships are having a rural telephone system constructed.

LOUISVILLE, KY.—The linemen who are building the plant of the Home Telephone Company have struck for a nine-hour day and 25 cents increase in wages.

JEFFERSONVILLE, KY.—The Cumberland Telephone & Telegraph Company is negotiating for a lot on Spring Street with a view to putting up a building for an exchange.

ELKTON, MD.—The Diamond State Telephone Company is completing the construction of a new line from Port Deposit to Farmington, via Colora, Conowingo and Nottingham, where it will connect with the Elkton & Rising Sun line.

SALISBURY, MD.—The Salisbury Telephone Company has disposed of its charter, franchises, and properties to the Diamond State Telephone Company. The price paid by the Diamond State Company for the properties was $20,000.

BOSTON, MASS.—The Erie Telegraph & Telephone system made a net gain of 2369 subscribers in October, and since Jan. 1 15,968 subscribers.

DETROIT, MICH.—The Livingston County Telephone Company has been granted a permit to erect poles and wire at Brighton.

WAYNE, MICH.—The annual meeting of the People's Telephone Company of this place, held at Carleton Nov. 14, resulted in the election of Joseph Waltz, president; Frank L. Edwards, secretary and treasurer. The company was organized five years ago with a capital of $6,000, and is out of debt.

HATTIESBURG, MISS.—The People's Telephone Company has been incorporated with a capital stock of $30,000, by A. U. Montgomery, T. E. Ross, W. A. Dozier and others.

HELENA, MONT.—A new line has been completed by the Rocky Mountain Bell Telephone Company, giving much better connection between Helena and Spokane.

FAYETTEVILLE, N. C.—A combination is reported of all the telephone companies from Fayetteville to Washington, N. C., to be known as the Carolina system, with Howard F. Jones, of Wilson, N. C., as general superintendent. The exchanges included are: Wilson, with toll lines; Fayetteville, Tarboro, Scotland Neck, Greenville, Kinston, Goldsboro and Washington. Henderson and Rocky Mount are said to be the only towns not included.

WOODSTOWN, N. J.—The Borough Council has granted a franchise to the Interstate Telephone Company to erect its lines through the borough.

CLAYTON, N. J.—The Interstate Telephone Company has applied for permission to the Clayton Borough Council to operate its line in the borough.

HADDONFIELD, N. J.—The Township Committee has granted permission to the Delaware & Atlantic Telephone & Telegraph Company to lay underground conduits for its telephone system.

FLEMINGTON, N. J.—The Cherryville Telephone Company has elected the following officers: President, Samuel K. Everitt; secretary, Rev. A. E. Finn; treasurer, Andrew J. Pierson. The company has twenty-four members, all of whom are assessed $1 per year in lieu of the exchange service to Flemington.

TROY, N. Y.—The Rensselaer Telephone & Telegraph Company will erect a three-story brick building for its exchange and offices.

LESTERSHIRE, N. Y.—The new telephone company has about fifty subscribers in this village and will establish a local exchange.

NEW YORK, N. Y.—A special telegram from Aurora, Ill., says: "The Inter-State Independent Telephone & Telegraph Company was incorporated in New Jersey Thursday, Nov. 7, with an authorized capital of $3,000,000 and bond limit of $9,000,000, and the main office in New Jersey and branches in Chicago and Aurora. The first active operations will be in the States of Iowa, Illinois, Wisconsin, Michigan, and Indiana. The incorporators were men who are at the head of the Independent Telephone Company of Illinois. The board of directors and officers have not been chosen. The purpose of the Inter-State Independent Telephone Company is the unification of the independent telephone companies of the country, beginning in Illinois and including the independent projects which are on foot in Chicago. As the men who organized the Northwestern Telephone Company are the chief promoters of the Inter-State, into which the former will be merged, the history of the Northwestern is interesting. It is about a year old, but has 3200 telephones in its service, and links the Fox River Valley with the Mississippi. It has 634 miles of poles and 3600 miles of wire, covers Joliet, Aurora, and Elgin with a conduit system, and has a service in half a hundred towns in its territory." The incorporators are, it would appear, C. N. King, W. M. Greene and N. R. Vanderhoof, all of Jersey City.

JACKSON, OHIO.—The Jackson County Telephone Company increased its capital stock from $50,000 to $75,000.

XENIA, OHIO.—The Xenia Citizens' Telephone Company and the Clinton Telephone Company of Wilmington have completed a line between the two towns.

HILLSBORO, OHIO.—Citizens of this place have organized a Home Telephone Company and announce that the plant will be in operation before Christmas.

BELLVILLE, OHIO.—The Central Union Telephone Company is installing an exchange at Bellville and building new lines to New Washington and other towns in the vicinity of Mansfield.

SPRINGFIELD, OHIO.—The Miami Telephone Company is preparing to build two new direct toll lines, one of them to Washington Courthouse, by way of Jamestown and the other to Wilmington.

JACKSON, OHIO.—The Jackson County Home Telephone Company has increased its capital stock from $50,000 to $75,000. W. A. Sternberger is president and W. D. Jones secretary of the company.

DEFIANCE, OHIO.—The Northwestern Telephone Company, of Defiance, has increased its capital stock from $50,000 to $60,000. W. A. Sternberger is president and W. D. Jones, secretary of the company.

TOLEDO, OHIO.—Work has been started on the new exchange building of the Toledo Home Telephone Company located at the corner of Main and Fourth streets. The building will be of pressed brick and will cost $6,000.

NORTH RIDGEVILLE, OHIO.—The North Ridgeville Telephone Company of Lorain County, has increased its capital stock from $2,000 to $5,000, and will make improvements. J. P. Reidinger is president and C. P. Smith secretary of the company.

AKRON, OHIO.—A deal has been closed by which the Hartman Steel Company of New Castle, Pa., purchased the Cuyahoga Telephone & Wire Company, of Cuyahoga Falls. The price paid was $500,000. The new owners have already given orders for the improvement and enlargement of the plant.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has leased an office room at Rocky River and will install a branch exchange to take care of the service in that section of the county. Another new exchange is being opened up at Dover Center. Subscriptions from the urban district are coming in faster than they can be taken care of.

SOUTH CHARLESTON, OHIO.—A fight of several months' duration between the Central Union Telephone Company and the Citizens' Telephone Company at South Charleston, has resulted in a victory for the independent company. The Citizens' Company secured 280 subscribers and the Bell less than 30. The latter has taken out its system and sent the equipment elsewhere.

GENEVA, OHIO.—The Madison Telephone Company, with headquarters at Geneva, has completed extensive improvements to the Geneva exchange, among the improvements being the installation of a 300-drop North switchboard. At a meeting of the directors held a few days ago it was decided to make still further improvements, chief among them to be a new switchboard for the Madison exchange. New lines will be constructed between Geneva and Madison.

OTTAWA, ONT.—Application is to be made for the incorporation of the St. Lawrence Telephone Company. The company proposes to build a line between Sorel and Nicolet.

COTTAGE GROVE, ORE.—The Bohemia Telephone Company has been incorporated, with capital stock of $5,000 by P. J. Jennings, W. F. Morphy and J. W. Cook.

PITTSBURG, PA.—A deal for the merger of the Federal and Pittsburg & Allegheny Telephone companies of this city is understood to have fallen through. It may, however, be taken up again, under new terms. It is said that the hitch in the deal was in relation to the Maryland Telephone Company, of Baltimore, an affiliated corporation of the Pittsburg & Allegheny. The Baltimore and Pittsburg & Allegheny interests are said to have insisted on the Baltimore property being included in the deal, at terms which the Federal syndicate would not consider.

ORANGEBURG, S. C.—The Orangeburg & St. Matthews Telephone Company has been commissioned to construct a telephone line between these two points. The capital is said to be $1,000. Wm. C. Wolfe is interested.

DEADWOOD, S. D.—H. D. Maize, of Chicago, has purchased the franchises, etc., of the Harrison Telephone Company of this city.

MANKATO, S. D.—The Mankato Citizens' Telephone Company has completed its toll line between this city and the village of Good Thunder, Mapleton and Garden City.

PIKEVILLE, TENN.—The Gainsboro Telephone Company will put in an exchange at this place.

NASHVILLE, TENN.—Several gentlemen from Memphis who are interested in the Memphis Telephone Company were here conferring with local attorneys and others relative to establishing an independent telephone exchange in this city.

HILLSBORO, TEX.—J. S. Davis, of Blooming Grove, has purchased the Itasca telephone exchange.

FORT WORTH, TEX.—Fort Worth Telephone Company, composed of John C. Harrison, John Bardon, Martin Casey, of Fort Worth and Scott Johnson, of Chicago, has applied for a franchise for the construction of a $300,000 telephone system.

SALT LAKE CITY, UTAH.—The work on the installation of the new switchboard for the Rocky Mountain Bell Telephone Company will be commenced at once. This will be the fourth board since 1883. The new one will cost, with its battery plant, $75,000. It will be operated from a central energy plant.

RICHMOND, VA.—Southern Bell Telephone Company will expend $250,000 in improving and rehabilitating its plant.

SEATTLE, WASH.—A permit was taken out by the Independent Telephone Company for a one-story sub-station building to cost $35,000.

SEATTLE, WASH.—The Automatic Telephone Company, which is constructing an independent system in Seattle, is making good progress and expects to have its exchange in operation by April 15 next, giving service in the business districts.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Riverside Light & Fuel Company was recently incorporated, with Riverside, Calif., as the principal place of business. Directors: G. H. Dole, W. W. Wilson, F. B. Braden, F. O. Johnson and W. F. Jordan. Capital stock, $150,000, subscribed in full.

WASHINGTON, D. C.—A charter has been granted to the Shenandoah River Electric Power & Light Company, with headquarters at Charlestown, Jefferson County, W. Va., to equip and operate an electric power plant on the Shenandoah River at Millville, to furnish electric power and light. The company has been organized by electing the following officers: Ex-Governor Lloyd Lowndes, president; Lloyd Lowndes, David Sloan and Daniel Annan, of Cumberland, Md., and Col. R. P. Chew and George S. Eyster, as directors. W. O. Norris was elected secretary and general manager.

AUGUSTA, GA.—A bill has been introduced in the Georgia House to amend the Augusta charter so as to give that city the power to regulate the price and quality of gas, electric light and power.

BLOOMINGTON, IND.—Trouble between the City Council and the People's Electric Light Company has reached a climax by the Council refusing to allow a claim of over $800 for light furnished by the company. The Council also took steps to annul the company's contract, on the ground that the agreement is not being complied with, in that the lights failed to be of 2000 candle-power. Litigation will follow.

LAFAYETTE, IND.—Capitalists of this city have purchased 55 acres of land on the Tippecanoe River, where they propose building a dam and race for a 2000-horse-power electric power plant. The river at this point makes a bend of six miles, while it is only a half mile across the land purchased, and it is across the bend the race will be constructed obtaining a fall of forty feet. Power from this plant will be furnished to all the surrounding towns and cities.

LOUISVILLE, KY.—The city will receive $17,650 for the franchise to furnish electric light, power and heat in the district bounded by Chestnut, Third, Fifth and Green Streets for ten years. The privilege was knocked down to McWilliams & Company.

BALTIMORE, MD.—The Patapsco Electric & Manufacturing Company, Ellicott City, Md., is developing power from the Patapsco River, for the purpose of supplying light and power for that city and surrounding districts. The construction of the power house and dam is about completed.

BOSTON, MASS.—The Charlestown Gas & Electric Company has entered into a contract with the Edison Electric Illuminating Company, of Boston, for a supply of current for lighting purposes. It is expected that the Charlestown Neck plant, owned by the Charlestown Company, will be abandoned.

DETROIT, MICH.—The Western Michigan Electric Light & Power Company has been incorporated, with a capital stock of $100,000. The incorporators are: Wallace Franklin, of Detroit; H. J. Conant and W. W. Churchill, of New York; Thomas F. Carroll and J. D. Hawkes, of Detroit. The officers are: President, J. D. Hawkes; Vice-President, T. F. Carroll; Secretary, Wallace Franklin; Treasurer, H. J. Conant.

ST. LOUIS, MO.—It is rumored here that the consolidation of the electric and gas lighting plants of St. Louis will be effected within the next thirty days.

BEVIER, MO.—At a regular meeting of the City Council, a bill was submitted to vote on a proposition to issue $10,000 bonds to put in electric light plant for the city.

ST. CHARLES, MO.—The St. Charles Electric Light & Power Company has been incorporated with a capital of $30,000 by J. D. Henseman, F. E. Niesen and W. J. Murray. Apparatus for the new plant has been bought.

CHARLOTTE, N. C.—Ten thousand dollars will be expended on improvements at the 4 C's Company's power plant.

ASHEVILLE, N. C.—The Sumner Son's Company has been chartered, with $50,000 capital, to establish, among other things, an electric light plant. Frank A. Sumner and others are incorporators.

PRINCETON, N. J.—The Hopewell Electric Light & Power Company, of Princeton, N. J., is preparing to erect a new plant.

JERSEY CITY, N. J.—The Inter-Ocean Electric Construction Company has been incorporated, to supply light, heat and power; capital, $3,000.

ALBANY, N. Y.—The Castile Electric Light & Power Company, of Castile, Wyoming County, capital $800, has been incorporated. Directors: G. S. Vangorder, of Pike; M. H. Olin, of Perry, and J. M. Duncan, of Silver Springs.

ST. CLAIRESVILLE, OHIO.—A proposition to issue bonds to the amount of $25,000 to improve the municipal lighting plant has been carried by St. Clairesville citizens.

CINCINNATI, OHIO.—The Cincinnati Suburban Light, Gas & Electric Company, of Cincinnati, has been incorporated, with $10,000 capital stock, by Fred. W. Keam, Peter Keam, L. R. Keam and Henry Otterman.

YOUNGSTOWN, OHIO.—The John Smith Son's Brewing Company will make extensive improvements to its establishment. A large power plant will be erected and the refrigerating plant will be enlarged. L. R. Whyte, of Pittsburg, is engineer.

SHELBY, OHIO.—The City Council of Shelby has decided to dispose of the municipal lighting plant, which has been pronounced a failure, havign lost about $12,000 in the past year. The original cost of the institution was $25,000 and $18,000 has since been spent in repairs.

NORTH AMHERST, OHIO.—The Village Council of North Amherst is considering a proposition to build a combined municipal lighting and power plant. The plan is to furnish current to the proposed electric railway to South Amherst, which is being promoted by local people.

CLEVELAND, OHIO.—In connection with several large apartment houses and power buildings to be erected in Cleveland by John Hartness Brown, there will be a central power plant sufficiently large to furnish steam heat, power and electric light to the entire group of buildings, which will cover the block between Euclid, Murison, Chestnut and Erie Streets.

DELPHOS, OHIO.—A proposition to bond the town of Delphos for $25,000 to erect a municipal lighting plant has been defeated. The town is paying a private company $82 per year for 42 arc lamps, under a five-year contract, which expires June, 1903. A number of local citizens are organizing a company and will ask for a franchise to build another plant.

HUBBARD, OHIO.—At the recent election the citizens of the village of Hubbard voted down a proposition to bond the village in the sum of $8,000 for the purpose of rebuilding the municipal lighting plant which was burned early in the year. The situation is a peculiar one. Early last summer the Council declared in favor of a special election to decide on the matter. The election was held and the proposition carried, but when the sale of bonds was attempted it was found that the election had been held too soon after the passage of the resolution by the Council. A proposition has been made to furnish light by the Youngstown & Sharon Railway & Light Company, but its figures have been declared too high.

TOLEDO, OHIO.—The State Board of Public Works has granted permission to A. K. Detwiler, of Toledo, to build a pole line along the canal banks from Toledo to Maumee. Detwiler was the chief owner of the Toledo & Maumee Valley Railway which was recently sold to the Everett-Moore syndicate. The sale, however, did not include a 10,000-horse-power water plant operated by a 60 foot fall in the canal at Maumee. By stringing the wires to Toledo, Detwiler will enter into competition for city lighting with the local lighting plant. At present Toledo pays $90 per year for arc lights, and it is claimed Detwiler can furnish light at $30 per lamp, with private lighting, heat and power at correspondingly low prices.

PORTLAND, ORE.—A mining company composed of Portland capitalists, including Charles E. Ladd and Jonathan Bourne, is developing a great copper mining industry in Skamania County, Wash. There will be an extensive electric power transmission in connection with the company's operations. The company has secured water rights, giving it the control of large water powers on the upper tributaries of the Lewis and Washougal rivers. At one of the locations on the main Washougal River, it is estimated that 3000 horse-power can be developed for electric transmission to both the mines and mills.

ALLEGHENY CITY, PA.—The West Penn Light, Heat & Power Company, of this city, has been chartered, with a capital of $1,000.

GEORGETOWN, S. C.—The Georgetown Electric Company has been chartered by H. L. Chandler, president, and others. The company is capitalized at $50,000.

YORKVILLE, S. C.—A. & C. Wright, contractors for the dam for the Catawba Power Company, near Yorkville, have relinquished their contract after nearly a year's work. The water has overflowed the coffer dam 44 times since work began and between $10,000 and $15,000 has been lost by the contractors. The company will continue the work.

AUSTIN, TEX.—Several weeks ago the City Council purchased the plant of the Austin Water, Light & Power Company for $175,000. Following the purchase, ex-Mayor John D. McCall secured a temporary injunction enjoining purchase. Judge Morris, who granted the temporary injunction, has perpetuated the same, thus effectually preventing the purchase.

SALT LAKE CITY, UTAH.—Mr. F. M. Woods, of Victor, Colo., states that electric hoists are now being put in place on the properties of the Cripple Creek Gold Exploration & Battle Mountain Consolidated mining properties. The wires from the Pike's Peak power plant are already strung and the power is ready to be turned on as soon as the hoists are placed.

RUTLAND, VT.—With the exception of the extensive electric system to be installed, all the contracts for the equipment and building for the immense marble mill to be erected at Pittsfield, Vt., by the Rutland-Florence Marble Company of Rutland have been let. The plant will cost about $200,000.

LAMBERT'S POINT, VA.—The Norfolk & Western Railroad will place a new dynamo in its shops to increase the lighting capacity and furnish light for the recently completed coal pier.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The boilers in the power-house of the Oakland, San Leandro & Haywards division of the Oakland Transit Company's system at Elmhurst exploded recently, wrecking the power-house.

SAN FRANCISCO, CALIF.—Announcement is made of the incorporation in California of the Pacific Electric Railway, with $10,000,000 capital, to maintain 452 miles of interurban electric railway in Southern California.

SAN FRANCISCO, CALIF.—The Market Street Railway Company, San Francisco, has been bonded for $250,000 until Feb. 28 by a Baltimore syndicate represented by Geo. R. Webb. Three-fourths of the stock is to be bought for cash at a par value of $100 a share, if the system proves on examination by experts to be what it is claimed to be. The syndicate will spend $4,000,000 in improvements besides building interurban lines.

SAN FRANCISCO, CALIF.—Publicity was recently given to the plans of an Eastern syndicate, promoted by R. G. Hanford, of San Francisco, for an immense water supply and electric power transmission system. The water supply is to be found in the watershed back of Mt. Hamilton, Santa Clara County, Calif. On Isabel Creek, an impounding dam is to be built with a capacity of 1,000,000,000 gallons of water, giving a daily flow of 15,000,000 gallons. From the dam the water is to be conducted to the Calaveras Valley through flumes and piping. At the point selected for the electric generating station there will be an available head of 1200 feet and 3000 horse-power can be thus developed. Thence the water can be piped to various towns and cities about San Francisco Bay. It is claimed that all of the electric power that can be developed has been contracted for, for delivery to San Francisco, the distance of transmission being 47 miles.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company, has increased its capital stock from $100,000 to $750,000.

INDIANAPOLIS, IND.—Plans have been made for the building of an electric railway from Indianapolis to Lafayette, by way of Thorntown. Lebanon, Colfax, Stockwell and Dayton. The Lafayette & Indianapolis Rapid Railway, capital $250,000, has been incorporated by George P. Haywood, Henry A. Taylor, William C. Mitchell, C. E. Ruger and Adam O. Behm, of Lafayette.

LEXINGTON, KY.—A $7,000,000 syndicate to build interurban electric roads between Lexington and other cities of the central blue grass region has been organized here. The syndicate is backed by New York, Chicago and Detroit capital, and the following board of directors has been selected: Senator George D. Davis, chairman; Blaine Cavett, Edward E. Davis, Harold C. Beatty and Elliott G. Stevenson, of Detroit; Colonel W. F. Darwin, Chicago; M. C. Alford, W. J. Loughbridge and H. P. Headley, of Lexington. The chief office of the corporation will be at Lexington, and the main power plant, to be erected at a cost of $800,000, will be located here. The company's charter gives it the right to construct electric lines to Georgetown, Nicholasville, Winchester, Mt. Sterling, Versailles, Frankfort, Paris, Richmond and South Elkhorn.

LAUREL, MD.—The Berwyn and Laurel Electric Railway Company has been incorporated. The incorporators are Messrs. Frank Gosnell, Jesse Slingluff, George Weems Williams, Carroll T. Bond, and Ernest S. McElroy, of Baltimore. The capital stock is to be $500,000.

BOSTON, MASS.—The Railroad Commissioners have issued an order approving an issue of stock to the amount of $455,000 by the Springfield & Eastern (formerly Palmer & Monson) Street Railway Company, for purposes of paying and capitalizing the floating indebtedness from the cost of constructing and equipping the road, and the purchase of real and personal property.

ST. LOUIS, MO.—The St. Louis, Kirkwood & Manchester Railway Company, capitalized at $250,000, applied to the St. Louis County Court last week for a franchise to construct and operate an electric railway from St. Louis to Manchester, St. Louis County.

ST. LOUIS, MO.—It is said on excellent authority that the long-expected absorption of the suburban system by the Transit Company will be announced as a fact within the next two weeks. Negotiations are in progress between the representatives looking toward a consolidation.

MOUNT HOLLY, N. J.—A new plant is required by the Mount Holly & Burlington Traction Railway of Mount Holly, N. J., recently destroyed by fire. The property is owned by the Pennsylvania Railroad.

ELIZABETH, N. J.—There is a plan on foot for extending a trolley line from this city to Paterson, the route to be through Irvington, Vailsburg, East Orange and Bloomfield. A number of wealthy citizens of East Orange are behind the project.

AUBURN, N. Y.—Plans are being prepared for a 1500-horse-power plant to be erected by the Auburn Interurban Electric Power Company.

BROCKTON, N. Y.—At a public meeting in Brockton a franchise was voted W. J. Connors, of the *Buffalo Courier*, through Brockton, fifty miles from Buffalo, for his trolley line from Buffalo westward along the shore of Lake Erie.

NIAGARA FALLS, N. Y.—A dispatch from Niagara Falls of Nov. 17 says: "A fire at the Hydraulic Power Manufacturing Company's plant this afternoon destroyed the tower in which the wires are carried from the gorge to the top of the cliff. The Gorge Railway was without power to-day, and to-night many of the hotels are using lamps. Several large industries operated by power from the hydraulic plant will be interrupted in their business for a week. The property loss is about $5,000.

NEW YORK CITY.—One of the chief improvements incident to the installment of electricity on the Manhattan Elevated Railroad's system will be the new 110th Street station, which will be at Manhattan Avenue, on the great curve from Columbus Avenue and 109th Street to Eighth Avenue and 111th Street. The construction has already been begun, an excavation for the foundations of the station being now in evidence, as well as some of the steel frames and girders for the structure. One hundred thousand dollars will be the cost of the station, which is to be the finest as to equipment and convenience in the city. Electric elevators, eight in number and of large size, will take the passengers up to the waiting rooms. In the building erected along with the station will be one of the sub-power stations of the line, but it will be only a distributing station, with no smoke or noise.

SIDNEY, OHIO.—The Western Ohio Railway Company has secured a franchise in Sidney after a controversy lasting several months.

CLEVELAND, OHIO.—The passenger receipts of the London (Ont.) Street Railway for the month of October were $10,102.69, a gain of $845.87.

CLEVELAND, OHIO.—The passenger earnings of the Northern Ohio Traction Company for the month of October were $42,706.51, a gain of $4,972.21.

CLEVELAND, OHIO.—The receipts of the Detroit & Port Huron Shore Line for the month of October were $25,352.68, a gain of $710.25 over the same month last year.

CLEVELAND, OHIO.—The passenger receipts of the Toledo Railways & Light Company for the month of October were $79,605.05, a gain of $7,543.80 over the same month last year.

WATERVILLE, OHIO.—The Toledo, Waterville & Southern Railway Company has brought condemnation proceedings against the village of Waterville to secure a right of way through the town.

CLEVELAND, OHIO.—The Everett-Moore syndicate has formally taken possession of the Canton-Akron Railway, despite the statements of the Canton and Akron directors of the company that the road would not be sold.

CLEVELAND, OHIO.—It is stated in Youngstown that the Salem Railway (steam) a coal road which is owned largely by Myron T. Herrick, of Cleveland, is to be used as a nucleus for a traction line which will extend from Youngstown to East Liverpool.

WAPAKONETA, OHIO.—The Schaffer Construction Company, of Wapakoneta has been incorporated, with $25,000 capital stock, by S. A. Hoskins, W. S. Rogers, A. E. Chaffer, C. T. Kolter, and J. A. Wertz. It will take up electric railway construction.

CLEVELAND, OHIO.—The Council at Monroe, Mich., has refused to grant a franchise for an extension of the Toledo & Monroe Railway, thereby making it impossible for the present to connect this line with the Detroit & Toledo Shore Line, which will be part of the same system.

RAVENNA, OHIO.—Judge Robinson at Ravenna has dissolved an injunction brought by the Pennsylvania Railway restraining the Northern Ohio Traction Company from crossing its tracks near Ravenna. This is the last of several litigations which have barred the completion of the Kent-Ravenna extension.

CLEVELAND, OHIO.—The passenger earnings of the Detroit United Railways for the month of October were $260,098.96, a gain of $33,524.21 over the same month last year. The receipts were divided between city and suburban lines as follows: City, $227,698.49, a gain of $25,402.26; suburban, $32,400.47, a gain of $8,121.95.

CLEVELAND, OHIO.—The Everett-Moore syndicate will build a feeder line for the Detroit & Toledo Shore line, extending from Monroe to Dundee, fourteen miles west. The syndicate has secured a right of way extending on both sides of the river valley, the most available route. Other parties have been figuring on a similar line, but the Cleveland people quietly secured the desired right of way.

AKRON, OHIO.—The directors of the Northern Ohio Traction Company will meet in Akron and arrange to take over the Canton-Akron Railway, which has recently been purchased by the Everett-Moore syndicate. It is probable that an extension to Canal Dover and New Philadelphia will be authorized, as rights of way and franchises for such a line were secured with the purchase of the Canton-Akron line. It is stated that the Akron-Massillon line will not be built this year, but the Canton-Akron will be pushed to completion. Negotiations are still under way for the purchase of Canton-Massillon Railway and the city lines of Canton and Massillon.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has secured from the Lorain County Commissioners at Elyria, a franchise for a railway from Wellington to the county line, being part of the proposed Cleveland, Ashland & Mansfield Railway. T. Y. McGrey, promoter of the Mansfield, Savannah & Wellington Railway, appeared before the Commissioners at the same time to secure an extension of a franchise over the same route, their franchise having expired some time ago from failure to commence work. When he heard of the grant made to the other company, he did not make application, which fact, it is said, will prevent the McGrey Company from securing entrance to Wellington. Mr. Pomeroy says he is somewhat mystified as to the intention of the other company in building a parallel line, but he claims his people are not worrying over the situation. The Pomeroy-Mandelbaum syndicate has thirty miles of road south of the disputed territory, practically in operation, while from Wellington to Cleveland the line has been in operation for more than a year. All right of way for the connecting link of thirty miles has been secured, and when this strip is placed in operation, the Cleveland syndicate will have undisputed entrance to Cleveland as well as control of the through business, leaving little for the other company, it is claimed.

TORONTO, ONT.—United States and Canadian capitalists have formed a company to build and operate an electric railway from Toronto to Cornwall, with a branch line from Brockville to Ottawa.

OTTAWA, ONT.—It is stated that Mr. Van Dyke, of Grimsby, Ont., is negotiating for the purchase of the Belleville street railway, with the object in view of extending that railway system to the town of Trenton, Ont.

THE AUTOMOBILE.

THE SALEM AUTOMOBILE COMPANY was recently incorporated in Salem, Oregon, by T. L. Davidson, F. N. Derby, Amos Strong and H. G. Guild; capital stock, $3,000. Among its objects is to operate automobiles in Salem and between Salem and the Morningside addition and other towns.

NEW AUTOMOBILE COMPANY.—Mr. Francis T. F. Lovejoy, late secretary of the Carnegie Steel Company, of Pittsburg, has established an automobile company under the name of the Banker Brothers Company. The company will manufacture and sell automobiles. Not much has been given out by those interested in the new concern, but it is believed that it will develop some of the French and German types of automobiles. The company has a nominal stock of $50,000.

AUTOMOBILE CLUB OF AMERICA.—Forty-four members of the Automobile Club of America attended its annual meeting on Nov. 18. The regular nominees for officers, approved by the Board of Governors, were elected without opposition as follows: Mr. Albert R. Shattuck, president; General George Moore Smith, first vice-president; Mr. Edwin Gould, second vice-president; Mr. Harry Payne Whitney, third vice-president; Mr. Jefferson Seligman, treasurer, and Mr. Albert C. Bostwick, Mr. Winthrop E. Scarritt and Mr. James L. Breese governors for three years. The governors will elect the secretary, and will choose Mr. S. M. Butler, the present incumbent. The secretary reported a total of 351 members, of whom 293 are active. The club is in a very prosperous condition.

STAGES FOR CHICAGO.—Electricity probably will supplant the omnibus horse in Chicago in the conveyance of persons to and from the railway stations and the hotels. Such is the belief following the announcement that a syndicate has been formed to purchase and take over the property and business of the Frank Parmelee Company, which does almost all the transfer business. The men behind the project are John J. Mitchell, president of the Illinois Trust & Savings Bank; Roger B. McMullen, C. H. Randle, president of the Gulf Company, and James B. Wilbur, president of the Royal Trust Company; Norman B. Ream and J. C. Schaffer. The Parmelee concern has been in existence for almost half a century. Frank Parmelee began business in Chicago in 1853, with three or four old omnibusses. The company at present is controlled largely by John W. and Charles K. Parmelee, sons of the founder of the system.

LEGAL.

ROENTGEN RAY DAMAGES.—Dr. John Weldon, of Willimantic, Conn., has won a heavy damage suit against Otis Clapp & Sons, of Boston, from whom he bought an X-ray outfit. Dr. Weldon asserted that the defendants guaranteed that their apparatus would not burn, but that during the first experiment he received a burn that laid him up for twenty-two months and nearly caused his death. A jury in the Federal Court, Boston, awarded him a verdict of $6,750.

CHICAGO FRANCHISE TAXES.—Mr. Henry Crawford, acting for the Union Traction Company and the Chicago Consolidated Traction Company, has filed in the United States Circuit Court at Springfield, Ill., an application for an injunction to restrain the State Board of Equalization from assessing the franchises of the corporations for the year 1900 as ordered by the writ of mandamus recently issued by Judge Thompson. The Union Traction Company and the Chicago Consolidated Company were among the public utility corporations affected by Judge Thompson's decision, whereby it was calculated millions of dollars in taxes would accrue to the State. Relief is sought by the corporations under the fourteenth amendment to the Constitution of the United States, which provides that private property shall not be taken without due process of law. The complaint alleges that the process which the Supreme Court of the State of Illinois outlined as legal is not lawful and, therefore, in violation of the fourteenth amendment.

OBITUARY.

MR. M. H. REDDING, Assistant Superintendent Western Union Telegraph Company's central cable office in New York City, died last week, after a sickness of two weeks.

MRS. S. E. MORSE.—Mrs. Sarah Elizabeth Morse died at the home of her daughter, Mrs. Franz Rummel, in Berlin, Germany, on Thursday, Nov. 14. She was the widow of Professor Samuel F. B. Morse, of telegraph fame. Mrs. Morse, who was a Miss Goodrich, was a deaf mute, but she was taught to articulate by the Rev. Dr. Gallaudet, whose wife was an intimate friend.

MR. OMAR J. AUGE, formerly lieutenant First United States Volunteer Engineers, died in the J. Hood Wright Hospital, New York, on Nov. 10, from diseases contracted in Porto Rico while in the military service in 1898. He was in the employ of the Central Cable office in New York. He was an exceptionally fine operator and a man of great refinement and of sterling character. He spoke several languages fluently.

CHARLES H. L. KNIGHT died last week in New York City, after an illness of four months. He had been employed by Tiffany & Company since January, 1897, as chief engineer, in charge of the steam and electric plant. For six years prior to his engaging with Tiffany & Company he was in charge of the electric lighting plant of the *New York Herald*. He had also been attached in a like capacity to James Gordon Bennett's steam yacht Namouna.

PERSONAL.

MR. G. A. NISBET, formerly of the Electrical Appliance Company, 39 Cortland Street, New York, has joined the selling forces of the General Incandescent Arc Light Company.

MR. E. B. BAKER, long time general superintendent of the Southern New England Telephone Company, has resigned, but it is said that the resignation does not take effect until next May.

MR. B. H. KROGER, a Cincinnati wholesale grocer, is credited with the intention of establishing big electrical bread bakeries there and selling bread at three cents a loaf. He has been in New York city the past week looking for bakery sites in the metropolis.

MR. SAMUEL INSULL, president of the Chicago Edison Company, is again in New York, and reports favorably on conditions. The demand for current in Chicago far outruns any previous season, and Mr. Insull has had to do some hard work preparing for the winter season.

PROF. RICHARD O. HEINRICH, general manager of the European Weston Electrical Instrument Company, Limited, of Berlin, is now in this country on a trip for consultation, etc., with Mr. Edward Weston, but expects to return to Germany this week. He and a host of old American friends have found his stay on this side altogether too short.

PROF. W. F. STRATTON.—At the Manufacturers' Club of Philadelphia on Nov. 18 Prof. W. F. Stratton, president of the National Bureau of Standards, explained the advantages of the new bureau to business men. He advocated the adoption of the metric system, and, after a discussion, the club directed its Legislative Committee to prepare a memorial to Congress endorsing the system.

MR. E. B. OVERSHINER, president and treasurer of the Swedish-American Telephone Company, of Chicago, has been a visitor to New York during the past week, taking in the Horse Show with his wife, while attending also to various business matters. While here in the East he has also visited Philadelphia and Pittsburg. He reports an active telephone trade, the field now expanding more rapidly than ever before.

MR. SAMUEL W. GLOVER, president and treasurer of the Post-Glover Electric Company, Cincinnati, Ohio, has surprised his many friends by slipping away and taking unto himself a wife. The young lady who is now Mrs. Glover was Miss Mary Grace Herbert, of Asbury Park, N. J. The wedding took place on Nov. 20, and Mr. and Mrs. Glover are now settled at home in Avondale. Mr. Glover's friends extend their hearty congratulations.

MR. C. T. YERKES has sailed from Southampton for New York. He stated that he was going to the United States for two months on business connected with underground transit construction in London. He expects that the decision of the Arbitration Commission concerning the electrical system will be announced shortly, and it is understood that he is ready to place his contracts for equipment at once. He has been subjected to many vexatious delays in his business in London. Should the Arbitration Commission decide against the direct current system—the system advocated by Mr. Yerkes—the latter will withdraw altogether from the field, according to a statement made by a director of the Charing Cross, Euston & Hampstead Company.

MR. G. H. McKIBBIN.—The appointment of George N. McKibbin as first lieutenant in the First Signal Corps, National Guard, N. Y., to fill the vacancy caused by the resignation of First Lieutenant Chas. F. Lembke, Jr., was recommended recently by Major General Chas. F. Roe, commanding National Guard, New York. Lieutenant McKibbin was thereupon examined, in accordance with the recent regulations, by the board for the examination of signal officers consisting of Major Frederick T. Leigh, Signal Officer; Captain Oscar Erlandsen, First Signal Corps, and Captain Chas. B. Baldwin, Second Signal Corps, and passed brilliantly, especially in the technical subjects—electricity, telephony, telegraphy, etc., and soon afterward received his commission and took the oath of office.

MR. A. J. WURTS at the November meeting of the Electric Club of Cleveland, held Nov. 6, delivered an interesting and instructive address on the Nernst lamp. The meeting was held for convenience in the Electricity Building of Case School of Applied Science and was attended by fully 300 members of the club and students of the school. The principles and construction of the lamp were fully explained and illustrated with parts of lamps. Mr. Wurts stated that the newly organized Nernst Lamp Company will make both indoor and outdoor lamps in one, two, four and six glower sizes. At present they are constructed only for parallel work, but it is expected that before long series lamps will be produced. Many technical questions were asked regarding the action of the lamp under various conditions. In a number of instances Mr. Wurts admitted that he was unable to give information on different points, since the experiments of those who have developed the lamp have been along commercial lines and purely with a view to bringing out in the shortest time a lamp which would be practical and economical for commercial purposes.

Trade Notes.

THE LAWTON-BEATTIE ELECTRIC COMPANY, Cincinnati, Ohio, has recently taken a contract for the electric equipment of the Wiborg & Hanna lumber plant.

VAN CHOATE.—The plant of the old Van Choate Company at Foxboro, Mass., is being sold. The company made great protestations, but never did anything. Down Boston way it is regarded as a rank big swindle.

THE FORT WAYNE ELECTRIC WORKS has recently installed two 300-kw 550-volt belted generators in the plant of the Rapid Transit Company, Chattanooga, Tenn. The contract was taken by the Cincinnati office.

THE PORTLAND COMPANY, Portland, Me., is overwhelmed with orders just now. The company has in course of erection a new three-story brick building which has been found necessary to accommodate its electrical work.

LIGHT READING.—The second of the series of leaflets on "Light Reading" has been issued by the New York & Ohio Company, Warren, Ohio. Some pointed facts about Packard incandescent lamps are given, and the light-giving qualities of these lamps are humorously illustrated.

WATER has always given more or less trouble in the filtering of waste oil. The Burt Manufacturing Company, of Akron, Ohio, has perfected an attachment for its Cross oil filter which successfully overcomes this difficulty—an improvement which makes an already good filter better.

U. S. METAL POLISH.—Mr. George W. Hoffman, Indianapolis, Ind., manufacturer of "U. S." infallible metal polish paste, reports that business is steadily improving and good reports are coming in from his branch houses in New York, Chicago and San Francisco, and from foreign agents.

KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill., has recently issued a variety of excellent trade literature relative to its telephone apparatus. It includes Bulletin No. 4 relative to small switchboards for central battery work, and No. 5, devoted to Kellogg transmitters and receivers.

MACHINE TOOLS.—The Garvin Machine Company, New York, has issued a leaflet containing an up-to-date list of good modern second-hand machine tools in stock. It also has on hand over 400 new machine tools of every description ready for immediate delivery. The company is always ready to trade, or buy.

OKONITE.—The use of Okonite wire for telephone work has been increasing steadily, and has now reached such proportions that in order to supply the demand the Central Electric Company is compelled to carry in Chicago a large stock of this grade of wire as well as Okonite wires and cables for lighting purposes.

COAL HANDLING APPARATUS.—An interesting pamphlet has been issued by the C. W. Hunt Company, New York, describing the means of handling coal from ship to furnace at the Lincoln power station of the Boston Elevated Railway. Hunt equipment is used in this work. The pamphlet is illustrated with views of the apparatus.

MICANITE PATENTS.—The Mica Insulator Company, of 218 Water Street, New York City, has lately been directing attention to its long list of patents secured in the United States, Great Britain and Germany, protecting its special processes, etc., with regard to the article known as "Micanite" and the manufacture of electrical insulation from mica sheets.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, 436 Broome Street, New York, announces that its new forty-eight page catalogue is now ready for distribution. The Chicago branch of this company, at 254 Madison Street, was destroyed by fire on Nov. 14, in consequence of which all orders are being filled direct from the New York factory.

THE VIADUCT MANUFACTURING COMPANY, of Baltimore, Md., has lately brought out a new district call box for the Postal Telegraph Commercial Cable Company. This box is finished in blue enamel with white lettering, and is one of the most attractive call boxes on the market. The Viaduct Company is thoroughly up to date with its apparatus, as an examination of its catalogue will show.

THE KEYSTONE ELECTRIC COMPANY, Erie, Pa., is making a line of high grade dynamos and motors. Its line of belted dynamos ranges from 1½ to 300 kilowatts and its motors from 1¾ to 400 horse-power in standard machines. The capacity of the direct connected generators range from 5½ kilowatts at 450 r. p. m. to 900 kilowatts at 95 r. p. m. The company is prepared to build larger belted machines for special purposes.

SALES ORGANIZATION.—The W. W. Whitehead Company, Chicago, Ill., has just effected a sales organization and opened sales offices at 541 Marquette Building, Chicago. The sales heretofore have been handled through the company's main office at Davenport, Iowa, where the company's engine and boiler building shops are also located. The Chicago office will undoubtedly prove a great convenience to the company's customers.

T. H. SYMINGTON & COMPANY.—Pending the completion of many tests of their specialties in various parts of the country, the business of T. H. Symington & Company, of Baltimore, Md., will be conducted as heretofore from their Baltimore office under the direct supervision of Mr. Harvey Middleton, managing director. Mr. W. R. Bean has been appointed general inspector of the company, and will look after these tests.

BELT CONVEYORS.—The Robins Conveying Belt Company, 15 Park Row, New York City, has just issued a new catalogue descriptive of its belt conveying machinery. It consists of 72 pages, printed in two colors on heavy paper. The illustrations are mostly half-tone reproductions of photographs of typical installations, there being seventy-six of these, as well as a large number of other illustrations of parts and arrangements of the system.

DISSOLUTION OF PARTNERSHIP.—The partnership at Saginaw, Mich., conducted under the firm name of the Porter-Morse Company, was dissolved on Nov. 1 by mutual consent. The business will be continued at the same place by Mr. Wellington S. Morse, under the firm name of the Morse Cedar Company. This concern manufactures cedar products, including ties of cedar, hemlock and oak for steam and electric railways, telephone and telegraph poles, etc. It has four distributing yards.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., reports the sales of its lava insulators for the month of October to be the largest in its business experience of thirty years. The foreign sales have increased one-third and orders have just been received from the General Electric Company and the Western Electric Company, the largest ever received from these two concerns. Mr. R. B. Steward, the vice-president of the company, looks after the Eastern branch of the business, with offices at 107 Chambers Street, New York.

CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY.—In the item in last week's issue regarding the installation in Providence, R. I., of an intercommunicating telephone system in the Commercial National Bank in that city, by the Clark Automatic Telephone Switchboard Company, the types effected a curious transformation of a part of the company's title. It was rendered "The Clark Automobile Telephone Switchboard Company," the word "automobile" having been evolved from the word "automatic" by some mysterious process.

OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York City, whose new "Flexduct" conduit for interior wiring was recently illustrated and described in these pages, has issued a very neat and tasteful brochure devoted to this new material in the art. The conduit is shown in detail, each part being brought out clearly in the cuts and text, and the "argument" is well presented. A copy of this interesting trade pamphlet should be in the hands of every one of our readers, and can be obtained on application. The company reports a rush of inquiries and orders, and is already very busy at its Hoboken factory.

UNITED TELPHERAGE COMPANY, 20 Broad Street, New York City, have added to their excellent trade literature two new pamphlets illustrative of the practical uses of ærial electric transportation. No. 17 is largely devoted to their telphers, particularly those of the center bearing type, and to their electric hoist attachment, for which they are receiving many inquiries and orders. No. 18 has as its theme telpherage as applied to docks, piersheds, freight stations, etc., and shows by means of admirable diagrams and outline sketches how a telpher line, dispensing with a track along the floor, so often blocked and encumbered with merchandise, will handle large quantities of freight with wonderful economy and dispatch. Indeed, it is impossible to study these circulars and not realize that a great revolution in such work has been begun by this concern.

SHOW CASE LIGHTING.—The proper illumination of goods in show cases means much to the dealer, and gives such advantage, that its importance is now generally recognized. The lighting fixture for show cases manufactured by Thomas E. Clark, manager Electric Service & Appliance Company, 166 Randolph Street, Detroit, Mich., has several meritorious features. It is portable and applicable to any show case, and it brilliantly lights the goods in the case, at the same time the source of light is screened from the eyes of the observer. The reflector is of metallic construction and the fixtures and wiring meet the requirements of the highest grade of material required by the rules of the National Board of Fire Underwriters. The lamps used have a long, narrow cylindrical bulb, formed to take the least space vertically, but to give the most horizontal illuminating surface. A circular in colors issued by Mr. Clark tells all about this fixture.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOVEMBER 12, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

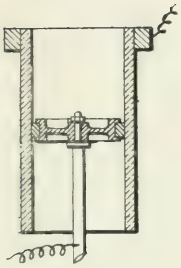
686,245. ELECTRICAL RESISTANCE; J. F. Bachmann and A. Vogt, Vienna, Austria-Hungary. App. filed Nov. 22, 1898. The resistance material is in the form of a tube through which the contact passes in the form of a piston.

686,246. ELECTRICAL RESISTANCE; J. F. Bachmann and A. Vogt, Vienna, Austria-Hungary. App. filed Dec. 12, 1899. A graduated resistance comprising a number of divisions each of a different specific resistance and all of the same cross-section and composed of mixtures of a conductive and non-conductive material.

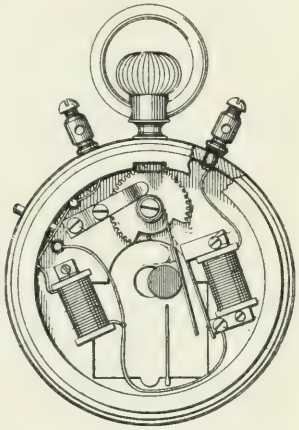
686,288. ELECTRICAL STEAM BOILER; C. E. Griffing, Hamilton, Ohio. App. filed April 2, 1900. Electrical heating coils extend through the boiler parallel with the tubes.

686,295. LIQUID INTERRUPTER FOR ELECTRIC CURRENTS; John O. Heinze, Jr., Revere, Mass. App. filed April 24, 1901. A tube at one end is drawn out to a small bore and submerged in an electrolyte within a lead cylinder. The cylinder serves as one electrode and a platinum wire within the tube as the second electrode. By means of a crank an up-and-down motion is imparted to the platinum wire. As the platinum wire is pulled up into the glass tube it is insulated from the liquid by the gas which is formed through the electrolysis in the small part of the tube, and the current is broken. A commutating device on the crank shaft may be utilized for changing the relative positions of the insulating means and the electrode, and thus to control the circuit interruption.

686,330. ELECTRIC TRANSFER APPARATUS; H. H. Porter, Jr., Chicago, Ill. App. filed April 1, 1901. An elevator cage adapted to carry a car from one floor to another and equipped with a trolley conductor above, and a conducting floor below, so that when the cage reaches a landing, the two conductors will join corresponding conductors on the floor and the car will be able to propel itself out onto the floor.



686,245.—Electrical Resistance.



686,561.—Battery Gage.

686,349. ELECTRIC CONTROLLER; G. J. Scott, Philadelphia, Pa. App. filed Jan. 22, 1901. The contact brush is carried by an endless chain and is moved successively over pairs of contacts.

686,350. STRONG CURRENT PROTECTOR; A. A. Seeley and C. Silet, Chicago, Ill. App. filed Feb. 4, 1901. A tripping circuit breaker controlled by a magnet.

686,395. APPARATUS FOR ELECTROCOPPERING METALS; E. L. Dessolle, Levallois-Perret, France. App. filed March 6, 1900. (See Current News and Notes.)

686,402. MAGNETIC SEPARATOR; T. J. Greenway, East Adelaide, South Australia. App. filed Oct. 12, 1899. The crushed ore is caused to travel from the center of a rotating horizontal disk to the edge, the magnetic particles being meanwhile retarded by an electro-magnet, so that the said particles will be thrown from the edge of the disk at a different point from that which the non-magnetic particles leave it.

686,416. ALTERNATE CURRENT TRANSMISSION; W. M. Mordey, Westminster, Eng. App. filed March 16, 1900. (See Current News and Notes.)

686,419. CONDUIT FOR ELECTRIC WIRES; E. D. Page, Brooklyn, N. Y. App. filed April 2, 1901. A conduit the cover of which is corrugated crosswise, so that it will be strong and at the same time permit the cover to bend to suit the shape of the conduit.

686,434. DISTRIBUTION OF ELECTRIC CURRENTS; E. Arnold, O. S. Bragstad and J. L. La Cour, Carlsruhe, Germany. App. filed Jan. 26, 1901. (See Current News and Notes.)

686,443. ROSETTE FOR ELECTRIC WIRING; J. H. Cramphorn, Medford, Mass. App. filed June 14, 1901. Passages are arranged to lead the wires from the binding posts at the side to the central orifice.

686,459. ELECTRIC CUT OFF FOR EMERGENCIES; J. H. Johnson, Newark, N. J. App. filed April 25, 1901. A cam standing beneath the handle of a switch can be pulled in either direction by a rope to open the circuit in case of emergency.

686,507. ELECTRIC METER; J. Cauderay, Lausanne, Switzerland. App. filed Sept. 17, 1900. Details.

686,525. ELECTRIC FURNACE; J. H. Morley, Springfield, Mass. App. filed June 18, 1900. (See Current News and Notes.)

686,526. ELECTRIC BELL; J. J. Mossop, Philadelphia, Pa. App. filed Feb. 20, 1901. The mechanism is confined within the gong, the hammer being a reciprocating bar attached to the armature.

686,541. THIRD RAIL SAFETY SYSTEM FOR ELECTRIC RAILROADS; C. Schlechtiger, Nantasket, Mass., and R. Bingham, Philadelphia, Pa. App. filed March 19, 1898. The switches controlling the current to the feeder section, are moved mechanically by the car.

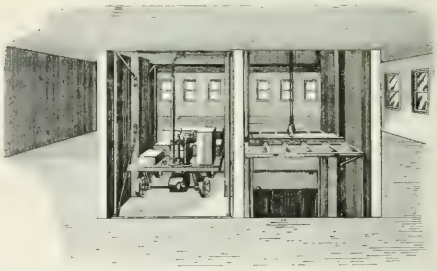
686,551. ELECTRIC FURNACE; A. Simon, Bordeaux, France. App. filed Feb. 27, 1901. (See Current News and Notes.)

686,558. APPARATUS FOR MANUFACTURING TUBES, PIPES, ETC.; E. Thomson, Swampscott, Mass. App. filed Feb. 15, 1897. The seam in the tube is welded by laying a strip of welding material along the abutting edges of the tube, then applying a current to heat the parts to a welding temperature and then pressing them together.

686,561. BATTERY GAGE; C. R. Underhill, Montclair, N. J. App. filed Feb. 19, 1901. A pocket device by which the voltage, amperage and resistance of a battery can be calculated from the readings obtained from it.

686,583. ELECTRIC CIGAR LIGHTING APPARATUS; C. J. Brosnan, Springfield, Mass. App. filed Dec. 3, 1900. Details.

686,605. AUTOMATIC TENSION COUPLING AND SOUND DEADENER; E. L. Grauel and S. H. Gallagher, Carthage, N. Y. App. filed June 24, 1901. At ends of a conductor are attached to caps fixed to the respective ends of a coil-spring, the wires leading through the spring in opposite directions. The spring thus acts as a tension device and the whole



686,330.—Electric Transfer Apparatus.

thing is embedded in fibrous material to deaden the vibration of the wire.

686,609. INSULATING SUPPORT FOR ELECTRIC WIRES; R. G. Heringray, Muncie, Ind. App. filed March 11, 1901. A pin threaded at each end carries at one end an insulator for the wire, and at the other end an overhanging, water-shedding petticoat insulator.

686,632. APPARATUS FOR LOCATING METALS, MINERALS, ORES, ETC.; Augustus F. McClatchey, Chicago, Ill. App. filed Dec. 26, 1900. Apparatus for a method consisting in establishing an alternating current circuit through a definite distance of the earth and measuring its resistance, then establishing similar circuits through the same distance at various other points, and comparing the measurements.

686,644. ELECTRIC RAILWAY; L. Woods, New York, N. Y. App. filed Nov. 3, 1900. Electro-magnetic appliances for making the switch-action positive in sectional railway systems.

686,645. ELECTRIC RAILWAY; L. Woods, New York, N. Y. App. filed Feb. 1, 1901. A modification of the preceding.

686,651. TROLLEY WIRE HANGER; G. W. Gurten, Piqua, Ohio. App. filed March 21, 1901. Details.

686,668. ENGINE STOP MECHANISM; J. H. Cary, Providence, R. I. App. filed March 5, 1901. The movement of the governor is used to close circuits for controlling the engine.

686,671. ALARM GAGE; E. Fortier, Kankakee, Ill. App. filed Jan. 19, 1901. The device closes a circuit for the maximum and minimum pressures.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, NOVEMBER 30, 1901. No. 22.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10
In requesting your address changed give OLD as well as new address.

Copyright, 1901, by Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 30, 1901.

CONTENTS.

	PAGE
Editorial	877
The Philadelphia Meeting of the National Academy of Sciences	880
Electrical Engineers of the Day—XXII; Cummings C. Chesney	880
Debt of Electrical Engineering to C. E. L. Brown—III; by B. A. Behrend	881
Air-Gap Induction, by F. W. Carter	884
Changes in Arc Lighting, by Alton D. Adams	888
Power Transmission on the Susquehanna, by O. P. Waters	890
"Distribution." Discussion by the American Institute of Electrical Engineers	890
Reciprocity Resolution Adopted at Washington	892
The Morton Current	893
Supervision of Electrical Circuits in Cities	894
Marconi Stations for Newfoundland	894
An Anglo-American Building for England	894
Electric Furnace with Magnetic Field	895
New Telephone Patents	895
The Edison Storage Battery	896
The Institute Meeting and New Members	896
Current News and Notes	897
LETTERS TO THE EDITORS:	
Modified Three-Wire System, by L. J. B. Wall	898
Electrical Engineering in England, by A. C Shaw	898
Digest of Current Electrical Literature	899
New Books	903
Motor-Driven Tools	903
Bullock Railway Generators	905
The Regulation of Electric Light	906
Reliance Dynamo and Motor	907
Coal Handling Machinery for a Small Plant	907
DEPARTMENTS:	
Financial Intelligence	908
Commercial Intelligence	909
General News	911
Trade Notes	915
Illustrated Record of Electrical Patents	915

SUBMARINE BOATS.

The performance of the "Fulton" in staying under water for 15 hours at Peconic Bay, L. I., is a notable feat, and, we presume, constitutes a "record." It has naturally attracted considerable attention, but will soon be surpassed, if not here then in Europe. Mr. Loubet, who has done so much in submarine boats in France, has just been awarded a prize in recognition of his work, and he and his fellow countrymen are hardly likely to leave Mr. Holland in undisturbed peace. It will be interesting to get the official report of the two Navy officers on board, and learn their views, for the Navy has been very conservative as to this submarine boat development, and the same is true of the English Navy. Such a test as this, while praiseworthy, leaves much to be proved. That clams will not sing has never been urged very warmly as an argument in their favor, and a submarine boat that simply lay motionless in its oozy bed would be of little use to anybody. The next tests, therefore, of any validity must be those bearing on the utility of such craft in battle, or at least in the supreme qualities of activity, agility, dirigibility and offense. But even as they are, these craft would cause the admiral of a foreign fleet off Sandy Hook some little anxiety and worry, for in actual warfare, brave Merrimac crews would be plentifully forthcoming, ready for any dash or forlorn hope. The rest of the demonstration, that of the "offensive" kind, is now in order.

THE INSTITUTE MEETING.

President Steinmetz, who is no *roi faineant,* is to be heartily congratulated upon the success attending his work in co-operation with that of the Institute papers' committee to secure better meetings. Indeed it is rather curious that one who has become associated in the mind of the average member of the Institute with very dry and abstruse mathematical papers, tending to somnolence and empty seats, should now be foremost in presenting matter-of-fact, everyday, bread-and-butter programmes. Just what subject Mr. Steinmetz proposes to leave for his successor after these grand round-ups is not quite clear, but probably if the future presidents only go over the same hackneyed ground again, they will still be able to muster excellent papers and large audiences. The great problems are ever with us, in engineering as in religion, and the Institute management does wisely and well to recognize this very patent fact. Even if it be regarded as somewhat of a concession to the mere wants of daily human nature, to leave more material for the *Journal of Mathematics,* there is consolation in the thought of the French philosopher that after all to satisfy the multitude, a high level of mediocrity must be achieved.

The papers presented last Friday night, as our abstract shows, were in reality an unusually strong batch, and form a welcome addition to current data and discussion. They provoked quite naturally a brisk and interesting discussion, to which and the papers we hope to pay specific attention. It was no harm that the perennial controversy between "direct" and "alternating" should pop up. It would be hard to keep away from the theme, with so many men still around who would find it even in a proposal to put the Gospels into modern Greek. But so long as these discussions help to elucidate a topic and add in ever so slight a degree to the sum of human knowledge, they do good, while at the very worst a symposium presided over by Steinmetz becomes at once an enjoyable and memorable function.

BALLOON TELEGRAPHY.

The utilization of balloons in connection with wireless telegraphy is not altogether a new idea, and there is extant an interesting report by Dr. Slaby of his work in that branch of the art in Germany. Mr. Tesla, with his wonted daring, has proposed and patented schemes not only for conveying intelligence but for transmitting power by the same aerostatic agencies. We now note in our columns the plans of Mr. Marconi for some wireless telegraphic balloon work on the dangerous coast of Newfoundland. The efforts and the success of this inventor have already proved so valuable we should be sorry to see him run any unnecessary risk in the higher altitudes of the air. Probably the balloons will not go up on windy days—like those of the present week; but even then there are the fogs to be reckoned with, although here again Mr. Marconi will be disappointed if he does not get typical Newfoundland weather. From what we know, London is the ideal area for fog experimentation, and being well inland a balloonist who goes up from Highgate Hill may count upon landing on a Surrey common or in the Lincolnshire marshes, instead of in the open sea. But to go ballooning around St. Johns is a little like going over Niagara in a barrel, and we can only hope that Mr. Marconi and his associates may be able to combine success with safety. Doubless there is more in their plans than is given out, for while the answering steamer is not expected to get an offing of more than two or three hundred miles, why should she not, with favoring circumstances, keep on until she finds herself in Vigo Bay, or in the lower reaches of the Tagus at Lisbon, still whispering cohererently with the far Atlantic shore? That is a consummation devoutly to be striven for, and no longer needs an effort of the imagination.

THE EVOLUTION OF STREET-LIGHTING.

The statistical examination of arc lighting in Massachusetts to be found elsewhere in our columns, gives a very clear impression of the changes that have taken place in the art of street lighting since the first introduction of electricity into this particular service. Beyond doubt there have been few changes more sudden and complete than those due to the introduction of the series enclosed arc lamp. The passage from open to enclosed arcs was not, however, quite as violent as Mr. Adams' figures on their face would show. From 1895 on enclosed arcs were making rapid and steady headway on commercial circuits worked at constant potential; in fact, it would not be putting the case too strongly to say that the growth of constant-potential arc lighting in this country has been largely due to the successful introduction of enclosed arc lamps. The first enclosed lamps were of the constant potential form and the series lamps were rather slow in coming to the front because of the high voltage required per lamp. By the middle of 1897, however, series enclosed lamps were successfully introduced on commercial circuits in Boston, and once the first step was taken further progress was very rapid, so that at the present time more than half the arc lights in Massachusetts are enclosed; and it is safe to assert that the other half are retained solely by reason of the cost of changing. But the figures under discussion tell only half the story of changes in the art, for in passing from open to enclosed arcs, it is of late very common practice to install the latter for operation in series from alternating circuits.

Another stage of evolution in street lighting is the decrease in the use of series incandescent lamps, either on arc circuits or on series alternating circuits, especially for street lighting. The incandescent lamp for arc circuits has been for years the pet abomination of the station manager. It has very often been demanded by lighting committees stricken with a fever of petty economy, and has sometimes been used on a considerable scale. But the lamps possible to use on an ordinary constant-current circuits are almost always of low economy and poor life, especially if reckoned in candle-hours. As a matter of experience, lamp renewals are generally so considerable as to make such lights costlier to maintain than arcs of corresponding power, unless the lamps are allowed to burn until they break. The special alternating incandescent circuits are a little better in this respect, but broadly the objection to street lighting by incandescent lamps is that they are generally allowed to burn until they are little better than red-hot hairpins. The same divining process is the reason why, as a rule, Welsbach street lights prove highly unsatisfactory. If an inspector with a long club were authorized to patrol the circuits and smash every bulb or mantle that had grown dim, it might be possible to obtain from incandescent lights the results indicated by the beautiful curves which have played a conspicuous part in some recent papers on street lighting; in fact, a street lighted by incandescent lamps, electric or gas, is nearly always a poorly lighted street, far less effectively lighted than if the same appropriation were expended on arc lights. In theory the arc is too powerful for economical use in the illumination of streets if minimum or even average illumination is to be the criterion of good lighting, but in practice the incandescent lamp is not powerful enough, for its initial brilliance is one thing and its average or final brilliance quite another. When a street is filled with trees so that lights must be near together and hung rather low to avoid shadows, incandescents can and do give excellent results, but if kept rigidly up to the standard power the renewals become a serious matter.

Within a short time there has been considerable interest in arc lamps of low power as substitutes for incandescents. Such arcs hold their brilliancy well with ordinary care in keeping the globes clean, but they have troubles of their own. No arc lamp in commercial use has quite equaled the old 2000-cp open arc when burned with high-grade carbons and kept in perfect order. Its light was white and powerful, and the resulting illumination was highly satisfactory. But these lamps were seldom kept in perfect order, and carbons of the grade employed in enclosed arcs, or in open arcs abroad, have rarely been in use in them so that practically the modern series enclosed arc operated with 6.5 to 7 amperes of continuous current gives an all-around result better than our old friend of the 2000 alleged candle power. The enclosed arc is somewhat bluish in color, but it gives a steady, clear and well distributed light. The alternating-current enclosed arc when pushed to about 7.5 amperes gives an equivalently good result. But when it comes to small units the enclosed arc as generally installed is at a disadvantage. Whether for alternating or continuous current, its light is blue as a signal torch when the amperes fall to five or thereabouts, so that in street lighting the 5-ampere enclosed arc is by no means the equivalent of the old 1200-cp open arc. Of late some interesting experiments have been tried with carbons of small diameter giving an increased current density in the arc. These have been, we believe, fairly successful, but be this as it may, the fact is that if arcs of moderate power are to be adapted to street lighting for which they possess conspicuous advantages something must be done to obviate the blue or violet color due to the long, thin arc of the enclosed lamp. Possibly the Nernst lamp may serve a useful purpose as a substitute, but the Nernst lamp has both a globe to be cleaned and a glower to deteriorate, to say nothing of the trouble of adapting it to series circuits, so that the small arc had better come in for a thorough overhauling. At present it is far from being in a satisfactory state for street lighting. The limitation most likely to be incurred is that of voltage in case of arcs used in the series connection, and it would not surprise us to see in the future much more street lighting from constant-potential circuits than has been the custom in the past.

Long-Distance Transmission.

According to recent advices from California the power of falling water is now being electrically transmitted a distance of over 200 miles from Colgate on the Yuba River, through Oakland to Redwood City, and thence by secondary distribution to Burlingame, 20 miles south of San Francisco. It is stated that in January next this power will be carried into San Francisco, making a total distance of transmission of 222 miles. This is just about double the distance of the celebrated Lauffen-Frankfort transmission of 1891 (110 miles) in which the pressure was usually about 8 kilovolts, raised occasionally to 14 kilovolts, and in which the power transmission was a little over 100 kilowatts. In 10 years, therefore, the pressure has been greatly raised, and the actual distance of transmission has been practically doubled. The reason why California is the center of these long-distance transmission plants is mainly owing to the high price of fuel in that region, and partly owing to the fine climate and the facility which exists for employing high electric pressures. It would seem as if 60 kilovolts may become a standard commercial pressure in California.

We have already presented our readers with very full accounts of the interesting work of the Bay Counties Power Company, upon which this notable transmission is based. The articles were written by a staff editor, who has been over much of the ground, and we need only refer our readers to his reports and to that by Mr. Sterling on the line itself, for a very complete idea of the difficulties and the manner in which they were met. It would be hasty to infer from the work in California that it will soon be repeated elsewhere under as favorable conditions; but the example will be hard to resist. Indeed, similar plans are now being realized in India and are discussed for other regions where fuel is scarce and water power is abundant. Meantime, Niagara transmission halts at twenty miles.

Air-Gap Induction.

Mr. F. W. Carter's communication in this number is an important contribution to the intricate subject of the distribution of magnetic flux over the surface of a tooth-cored armature. Dynamo designers usually employ empirical rules for dealing with the effect of the slots in an armature upon the magnetic reluctance of the air-gap. The accurate determination of the magnetic flux distribution over a dynamo armature is a hopelessly complex problem, which even if completely analyzed and resolved for any theoretically assignable case, would probably be much too laborious to compute in the practical design of dynamos. At the same time, every step in the process of analysis is an advance in the direction of electromagnetics, and is a valuable addition to the stock of technical knowlege. The solution presented by Mr. Carter does not purport to be a complete solution of the practical problem, but is a solution of an ideal case approximating to that of the practical problem.

The ideal case worked out is the flux distribution accompanying the presentation of a rectangular pole, whose entire surface is at one magnetic potential, to a flat parallel armature surface, all of which is also at another magnetic potential, which may conveniently be called zero. In other words, the solution presented does not take into account the difference of potential by magnetic "drop" in the iron of the field or armature, and, moreover, does not take into account the gradual rise of magnetic potential from the yoke end to the armature end of each pole-piece. Neither does it consider the influence of the conformal bending of pole face and armature, rendered necessary by the cylindrical shape of the armature. Nevertheless, these reservations have in ordinary practice much less influence upon the magnetic distribution, than the presence of the teeth and of the polar edges, so that within reasonable limitations the results reached and tabulated in Mr. Carter's curve sheets cannot fail to be of service as a basis for the correcting of the empirical formulæ of the designers and engineers. Thus, Fig. 6 representing the equivalent increase of air-gap length for different dimensions of teeth shows, for example, that when the teeth and slots have equal breadth, the air-gap is virtually increased 50 per cent in length, or in reluctance, when the slots have a width of 10 times the actual air-gap. Assuming that the computation is correct, this shows the superiority, in point of air-gap reluctance, of tunnel armatures over slotted armatures.

The method which is used by Mr. Carter for the solution is based on the now well-known rectangular transformation operator in connection with conjugate functions, and forms a powerful weapon of analysis. A few cases of the application of this operation are worked out in J. J. Thomson's "Recent Researches in Electricity." With the aid of this theorem, the direct solution is obtained of a problem which has been attacked by Professor Goldsborough in a different but simpler and indirect manner. In the device represented at Fig. 8 Mr. Carter introduces a very beautiful principle, which we do not remember to have seen previously suggested for any practical purpose; but which, whether new or not, promises to be of considerable value in dealing experimentally with this difficult class of problems in magnetic flux distribution. The principle depends upon the fact that when any system of equipotential lines and flow lines have been correctly mapped out in two-dimensional space, we may set up a working model of the system in a sheet by laying off thereon the system of curves and impressing a suitable electrical difference of potential between any pair of flux lines. In the limited space within the plate, the system of potentials and flux will be the same as in the wider area of the complete diagram. Also, because flux paths and equipotential lines are everywhere mutually perpendicular, we may conversely apply the impressed difference of potential along any suitable pair of flux lines in the plate, and the *equipotential* lines in the plate will then correspond to the *flux* lines of the original diagram. Moreover, in the latter case the difference of electric potential between any two points in the plate will measure the total flux passing between the same points in the original system. Mr. Carter proposes to cut out a model of the pole-piece and opposing armature surface from a uniform metal plate, and to apply a constant difference of potential to two boundaries corresponding as nearly as may be to flux paths in the actual system; the difference of electric potential measured along the surface of the armature in the plate model will then be a measure of the total magnetic flux entering the armature in the real machine.

This very interesting inverted electric model of the magnetic distribution enables the actual flux lines and equivalent surfaces to be mapped out for all shapes of pole-pieces and slotted armatures, no matter how complex, but subject, however, to the assumptions that there is no magnetic drop in the iron, and that the entire surface of the pole has one and the same magnetic potential. This will entail some deviation between the inverted electric model and the magnetic distribution in the corresponding actual machine. Moreover, the electric model is in two dimensions, whereas certain disturbance of the purely cylindrical distribution occurs in the actual machine of three dimensions at the ends of the armature cylinder. In spite of these disturbing influences, the plan suggested is a promising one, and would form an excellent practical research for the thesis of a graduating student. A number of inverted electric models, cut out of German silver sheet, could be prepared for slotted armatures covered by poles of different angular spread. The flux distribution and equivalent air-gap or polar fringe could be studied in these models with the aid of a storage cell and a potentiometer, with great detail.

The Philadelphia Meeting of National Academy of Sciences.

The fall meeting of the National Academy of Sciences was held at Houston Hall, University of Pennsylvania, Nov. 12-14, President Ira Remson, of Johns Hopkins University presiding in the absence of both president and vice-president.

Twenty-three papers were read, including several of much interest, notably that of Professor George F. Barker on the monatomic elements, illustrated by a complete set of these elements, argon, helium, neon, krypton and xenon, in glass tubes from the laboratories of Dewar and Ramsay, being the only collection of the kind in America. They give very brilliant colors when the electrical current is passed through them. Argon gives two distinct colors, one with direct, another with alternating current.

There was, however, a dearth of papers on electrical subjects. Professor Barker lectured on the newer forms of incandescent electric lamps, including the Nernst lamp, in a popular and interesting way. Dr. Barker also explained the osmium filament now controlled by the Welsbach people, which he says give even better results than the Nernst lamp, being far less expensive.

The programme included only two other electrical papers, both by Dr. Carl Barus, and read by title only, as they relate to preliminary investigations which Professor Barus is not willing to publish yet. They were (1) "On Quadrant Electrometry with a Free Light Needle Highly Charged Through a Conductor of Ionized Air," and (2) "On Nuclear Condensation in the Vapor of Non-Electrolytes like Benzene, and On Graded Condensation."

Among other papers read were the following: "Observations on Tungsten," by Edgar F. Smith; "A New Gauge for the Direct Measurement of Small Pressures," and "Transmission of Heat Through Vapor of Water at Small Pressures," both by Edward W. Morley and Charles F. Brush. Professor Cyrus B. Comstock presented a biographical memoir of the late General John Newton, and the work of the International Association of Academies was sketched by Professor Henry L. Bowditch.

Electrical Engineers of the Day—XXII.

CUMMINGS C. CHESNEY.

Cummings C. Chesney, who is a Pennsylvanian by birth, entered the Pennsylvania State College in 1881, and was graduated therefrom as a chemist four years later. For some years after leaving college Mr. Chesney was greatly handicaped by an injured foot that made it impossible for him to follow any pursuit necessitating great physical activity, and in consequence he spent three years in teaching mathematics and chemistry at the Doylestown Seminary and Pennsylvania State College.

In 1888 he joined Mr. William Stanley's laboratory force in Great Barrington, Mass., where he devoted himself particularly to experimental chemistry and to electro-dynamics. The following year he went with the United States Electric Lighting Company, in Newark, where he designed and developed for this company its small direct-current motor and generator work, at the same time following various lines of investigation in applied electricity. In the fall of 1890 he removed to Pittsfield, Mass., where he was one of he original incorporators of the Stanley Electric Manufacturing Company. He was also one of the members of the Stanley Laboratory Company.

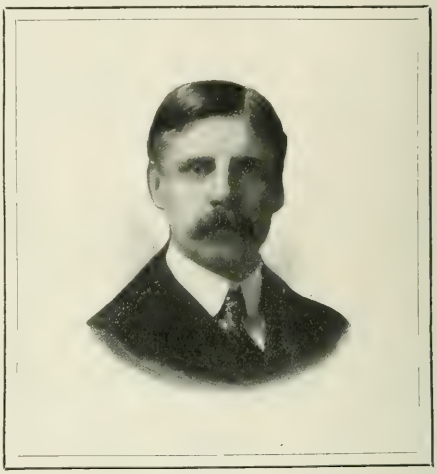
After the incorporation of the Stanley Electric Manufacturing Company, it soon became apparent to those associated with Mr. Chesney that his broad general knowledge and clear conservative judgment indicated him as the man to guide the electrical departments of the manufacturing establishment, and the future demonstrated that this estimation was not at fault.

With his associates and staff of assistants, Mr. Chesney early perfected the inductor type of alternator to a point far beyond anything before reached in this country and not surpassed in the world. To him is due the credit of having laid out the first polyphase power transmission plant to be put into successful operation in America. This plant is at the present day supplying light and power for use in the towns of Housatonic and Great Barrington, Mass.

When Mr. Chesney and those around him contended that alternating-current generators could be run in parallel under conditions prevailing in practical operation, they were opposed by almost all American engineers of standing, yet the fight proved a winning one. When others were ready to prove that the winding of 10,000 to 12,000-volt generators was an impracticability, Mr. Chesney designed alternating-current generators for such voltages with great success. It might be added that for even lower voltages Mr. Chesney was the pioneer, as the first 6000-volt generators built and successfully operated in America are of his design and are still furnishing alternating-current power to Quebec.

When it became apparent that transformers of large capacities would be a valuable addition to the electrical plants of the time, notwithstanding predictions to the contrary by those presumably in a position to know, he with his associates again realized their convictions in a most satisfactory manner, and to him is due the design of the first commercial 100-light transformer ever used in this country, which was made by the Stanley Electric Manufacturing Company in 1891.

A long list might be given of electrical developments in which Mr. Chesney has been a pioneer. Among other work, switchboard instruments, high-tension arc-breaking devices, frequency indicators, indicating wattmeters, lightning protection for high and low-tension circuits and many other appliances, have all had a share of attention and always with satisfactory results. One of the most striking and practical exhibits at the Pan-American Exposition was the "S. K. C." phase and frequency-changer, which transformed the three-phase 25-cycle Niagara currents to two-phase, 50-cycle currents for



lighting and power purposes in the Electricity Building. This is one of Mr. Chesney's more recent inventions.

Mr. Chesney is seldom idle, and an idea of value his little chance of escaping him, as is shown in some degree by the numerous patents issued to him, and by the many unique and valuable details to be found in the "S. K. C." apparatus. His friends like to think of him not only as the man of resource and energy, always ready to seize the best that can be found and incorporate it into his work, but they also remember his enthusiasm for athletic sports and the time when he was one of the most clear-minded college baseball catchers and coaches in the country. His control over his fellow students was remarkable at all times, and he had an intuitive knowledge of their strong points. When it was a question of organizing a champion baseball team, he saw quickly how to use the available material at hand. This characteristic of prompt thought and the ability to make the most of men and things about him has remained with him through all of his engineering and research work, and has been one of the potent factors in placing that work in the rank of highest order. He has, in short, always been a man of action rather than of words, but when the latter prove necessary they are forcible and cogent.

In addition to being chief engineer of the Stanley Electric Manufacturing Company, Mr. Chesney holds the position of consulting engineer for the Northern Electrical Manufacturing Company, of Madison, Wis. He is a member of the American Institute of Electrical Engineers and a director in a number of electric lighting and power companies throughout the country.

The Debt of Electrical Engineering to C. E. L. Brown.—III.

BY B. A. BEHREND.

ALTERNATING-CURRENT MACHINERY.

WE have described briefly in the preceding articles the designs and work of Mr. Brown in the development of the direct-current dynamo in its adaptation to the transmission of power and to electrolytic purposes. But while we consider this work which was done in the latter half of the eighties of great interest and importance, we must admit that it is in large measure eclipsed by Mr. Brown's work in alternating-current machinery. Here his ability and genius, his enterprise and boldness, found a wide and congenial sphere of activity. In 1889, still connected with the Oerlikon Company, Mr. Brown took up the design of transformers and of alternators for single-phase currents. One of the first machines built by him is illustrated in Fig. 11. The alternator is of the Kapp type, for about 80 kilowatts at 2000 volts. An entirely novel and original feature is the direct-connected exciter, a construction which Mr. Brown has consistently adhered to for the past 12 years. With these machines Mr. Brown operated in Kassel, Germany, one of the first single-phase power transmission plants worthy of the name. There are two 100-hp generators operating in parallel, producing current at 2000 volts and transmitting it over five miles through a Siemens concentric cable. The two motors are driving direct-current generators which are operating in parallel with a storage battery, from which current is taken to start the motors and to synchronize them. The plant has operated for years proving the excellence of the workmanship and mechanical design of the machines, features which always marked machines manufactured at Oerlikon. The satisfactory parallel operation of these machines without "hunting" is worthy of notice.

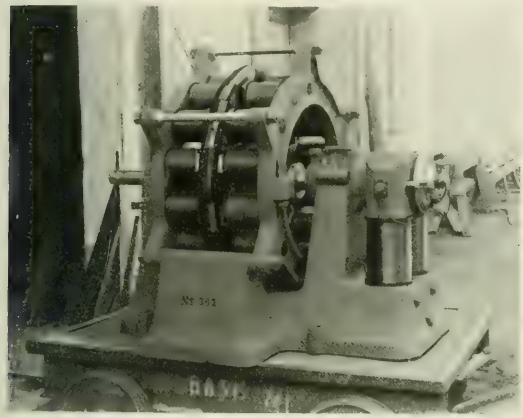


FIG. 11.—ONE OF BROWN'S SINGLE-PHASE ALTERNATORS OF THE KAPP TYPE, WITH DIRECT-CONNECTED EXCITER, 1889.

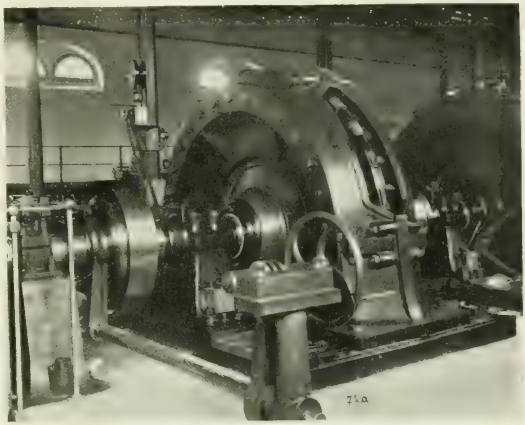


FIG. 12.—BROWN'S KAPP ALTERNATORS AT THE ZURICH CENTRAL STATION.

The Kapp type of single-phase alternator was also adopted by Mr. Brown for the Zurich station, where four 300-hp generators at 50 cycles and 2000 volts were installed in 1890, and have been running since. They are all connected to the same shaft by clutches clearly visible in Fig. 12. The station has been greatly enlarged, and these generators, which are driven by turbines, are now operating in parallel with steam-driven inductor generators of the Oerlikon Company.

THE ADVENT OF POLYPHASE CURRENTS.

Before the introduction of polyphase currents for driving motors, the direct current had hardly any rival. Attempts had been made to make a motor for single-phase alternating currents, and Professor Elihu Thomson had taken out some patents in 1887 on some self-starting single-phase motors embodying the principle of induction, i. e., the armature and field were not *connected* with each other as in direct-current motors, but the rotary effect was produced by currents *induced* by the field in the short-circuited coils of the revolving armature. The basis of the induction motor, though for single-phase circuits, was thus laid for the first time. That this motor was not for a long time properly dimensioned and designed was the reason that it had almost sunk into oblivion. We may here remark that we owe to Mr. Brown's skill the first successful single-phase motors embodying Thomson's principle of induction.

In 1888, through the labors of Tesla and Ferraris, the principle of induction became most fertile through their applying it in connection with two independent single-phase currents of different phase. But the Tesla motor was not an economical machine, and the labor was not small that had to be expended on it to make the modern induction motor. To throw some light on that phase in the history of the application of electricity to industrial ends, we wish to cite Professor Elihu Thomson who wrote in 1900:

"These long-distance power transmission plants are generally spoken of as 'two-phase,' 'three-phase,' or 'polyphase' systems. Before 1890 no such plants existed. A large number of such installations are now working over distances of a few miles up to 100 miles. They differ from what are known as single-phase alternating systems in employing, instead of a single alternating current, two, three or more, which are sent over separate lines, and in which the electric impulses are not simultaneous, but follow each other in regular succession, overlapping each other's dead points, so to speak. Early suggestions of such a plan, about 1880, and thereafter, by Bailey, Deprez and others, bore no fruit, and not until Tesla's announcement of his polyphase system in 1888, was much attention given to the subject. A widespread interest in Tesla's work was invoked, but several years elapsed before engineering difficulties were overcome. This work was done mainly by the technical staffs of the large manufacturing companies, and it was necessary to be done before any notable power transmission on the polyphase system could be established. After 1892 the growth became very rapid."

This is Professor Elihu Thomson's presentation of the development of the polyphase system, and a more accurate and correct version could hardly be given. Generators for polyphase currents were not new in 1888, the principle of induction had been explained and demonstrated a year before by Thomson, but Tesla's combination of them was a great step in advance. The somewhat erratic nature of Mr. Tesla and the popular applause that he has received—entirely uncoveted as it may be—have of late done a good deal to discredit the man and his work. But while the younger generation, presumptuous in their criticism, ignore a man's good work, it is unbecoming to thoughtful people to follow their example. Mr. Tesla's paper was read in May, 1888, before the American Institute of Electrical Engineers, and it had excited a good deal of comment. But singular though it may be, the changes, which we are now tempted to call slight, but without which the system was not workable, were slow to come.

Strange to say, the working ground seemed to have gone from America, where it had taken its start, to Europe. Adverse circumstances seem to have prevented the Westinghouse Company who had

acquired the Tesla patents in 1888, from developing the system for which they have done so much in later years. Mr. Lewis B. Stillwell, then connected with the Westinghouse Company, says that "Mr. Tesla came to Pittsburg in the summer of 1888. He brought with him a number of his motors, an induction regulator, and other devices pertaining to the system. The work of developing a variety of sizes of the motor to meet the commercial demand which had begun to make itself felt almost as soon as the Westinghouse Company began the introduction of alternating-current apparatus, was prosecuted in the shops of the company under the direction of Mr. Tesla, and during the next two years a number of generators and motors were sold and put into commercial service. Among these plants was one sold to the Hercules Mining Machine Company, of Pittsburg, which consisted of a 60-hp, two-phase generator, and the number of motors of the sizes required by the Hercules Company for the operation of their machines. The majority of these motors were of the 3 horse-power size. During the latter part of 1889 and in 1890 and 1891 the commercial introduction of the system was seriously hindered by financial difficulties in which the company had become involved. In 1892 the company began to vigorously push the commercial introduction of the system upon a very large scale, and in October, 1893, the Cataract Construction Company awarded to the Westinghouse Company the contract for a 15,000-hp generating plant."

The conditions here referred to by Mr. Stillwell in connection with the tremendous development of electric traction work that directed the torrent of activity in this country from the alternating current, account in large measure for the shifting of the working ground in the latter field above referred to. America can well afford, in the consciousness of her great work in the field of electric traction, and of her great work in power transmission of more recent date, to give credit to some of Europe's best engineers for the development of much that made the polyphase system what it is to-day. After these introductory remarks we will return to our subject.

The two-phase system of Tesla was simplified and improved by Michael von Dolivo-Dobrovolsky through the introduction of the interlinked three-phase system which has almost entirely supplanted the two-phase system for power transmission. When Mr. Brown in 1890 entered the field of polyphase currents, he found a perfect sea of ideas, and an almost infinite number of mostly useless patents referring to motors, generators, transformers and transmission lines. But with the keen insight of genius he sifted the wheat from the chaff and set to work to design a suitable generator for three-phase currents, to make the induction motor an economical machine, and to construct transformers for high-tension work. In regard to the use of high tensions Mr. Brown writes:

"When I hit upon the idea that probably a properly insulated ordinary overhead line could carry without considerable loss higher tension than had yet been dreamed of, I set about designing (middle of 1890) a transformer for producing these high tensions. As there was at this time a good deal of talk about the Brooks' oil-insulated cables, I thought it would be good to use oil also for transformers,[1] and introduced it for this case with such success that now all over the world oil is used when it is a question of making a transformer for durability or to meet the requirements of high-tension work."

Fig. 13 is a photograph of the high-tension testing set in Oerlikon, where, in 1890, Mr. Brown showed the German technical commission the possibility and feasibility of even 40,000 volts for the transmission on oil insulators over long distances. A direct current, with starting resistances, is seen on the right driving a small alternator, which is shown with its field resistance. The current was sent through a fuse, a switch and an ammeter to the step-up transformer. The secondary tension of this transformer was measured by a Kelvin electrostatic balance, and it was connected to an overhead line consisting of 100 fluid insulators outside the room, re-entering the room again to connect with the high-tension side of the step-down transformer. In an adjoining dark room Mr. Brown observed the effects of the high tension on different types of insulators. "These testing transformers were run up to over 40,000 volts," writes Mr. Brown, "without the slightest hitch, and enabled me to carry out the series of experiments which terminated in the Lauffen-Frankfort experimental plant."

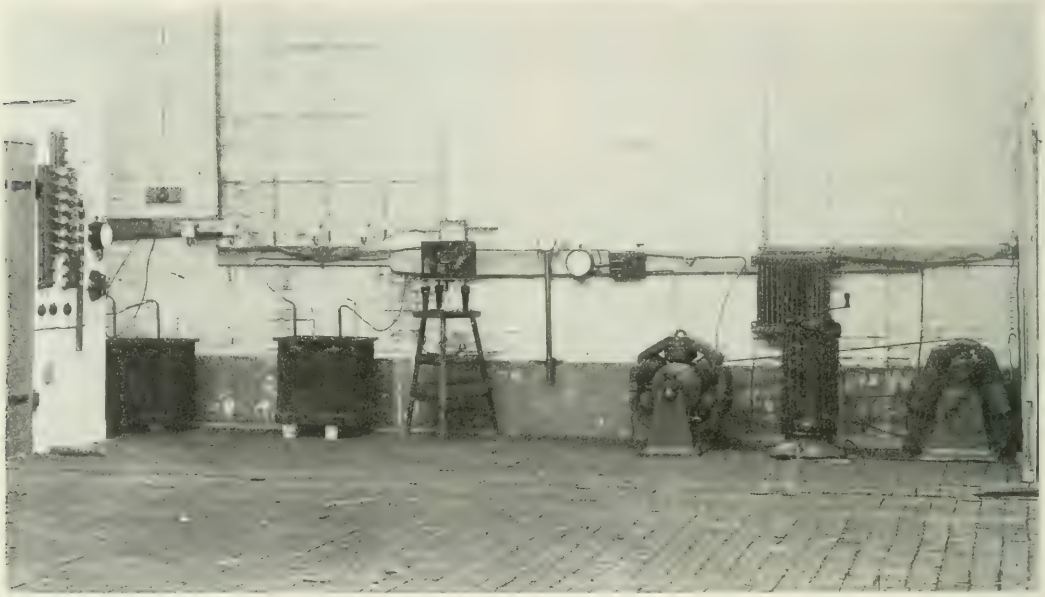


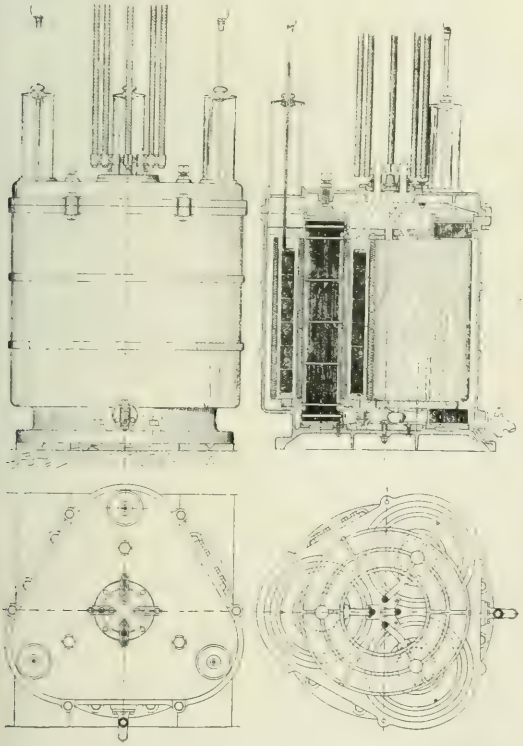
FIG. 13.—BROWN'S 40,000-VOLT HIGH-POTENTIAL TESTING SET IN OERLIKON, 1890.

In regard to the Lauffen-Frankfort experiment we content ourselves with quoting Professor S. P. Thompson:

"Great skepticism prevailed at first as to the probable result of transmission under the novel conditions of using such very high voltages over so long a line, and with polyphase currents. It was anticipated by some that the efficiency would be greatly reduced by possible disturbances due to the capacity of the lines acting as condensers or to leakage over the 10,000 insulators on which the line was supported. In private, some who were very closely connected

[1] "The first application of oil for insulating purposes was made by Brooks for his underground conductors, by putting ordinary insulated wires into tubes which were filled with oil." Lecture of C. E. L. Brown, "On High Pressure, Its Generation, Transmission and Application," Frankfort, February, 1891.

with the enterprise expressed their fears that the efficiency should fall below 50 per cent, and at one time there was some apprehension that the jury would not be allowed to make full tests. However, as experience was gained these fears were found to be empty. The elaborate tests carried out by the commission in the autumn months, mostly at about 8000 volts pressure, showed that the energy given out electrically at Frankfort was as much (on the average) as 74 per cent of the energy given by the turbines at Lauffen to the generator.



FIGS. 15 AND 16.—200-KW HIGH-POTENTIAL THREE-PHASE LAUFFEN TRANSFORMER.

"The Lauffen-Frankfort transmission was much more than a mere experiment. It was a daring and successful demonstration not only of the utility of high voltages in the transmission of power, but of the success of polyphase currents. As such it marked an epoch in the commercial development of electricity. It evoked an extraordinary interest throughout the continent of Europe and in Germany in particular."

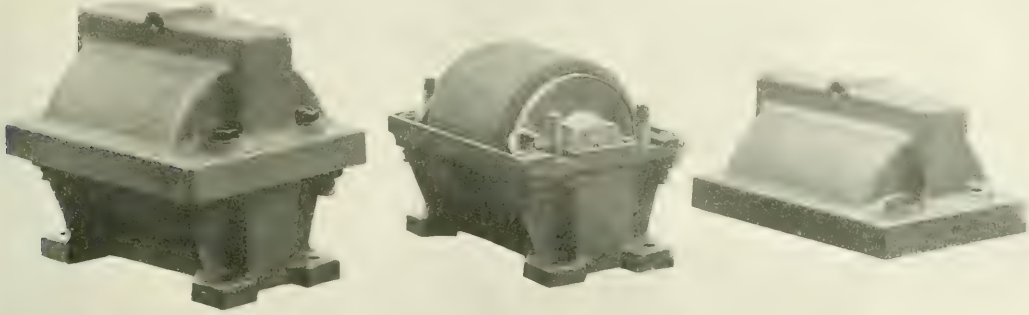


Fig. 14.—Brown Single-Phase Transformers, 1889.

It will be of interest to give some good illustrations of some transformers of Mr. Brown's designed about twelve years ago. The transformer represented in Fig. 14 is a small core transformer, the coils being cylindrical and easily removable. The core has no bolts or rivets, the plates being forced into the cast iron frame, a very ingenious construction. Fig. 16 represents the 200-kw, three-phase transformer for the Lauffen-Frankfort experiment. It was designed for 15,000 volts at 50 cycles, and shows the ring-shaped yoke designed by Mr. Brown for the purpose of making three-phase transformers. Fig. 15 shows the transformer in its cast iron case.

In 1898 Mr. Brown adopted another way of connecting the three cores of a three-phase transformer. Fig. 17 shows this transformer. Other constructions of transformers will be described later on.

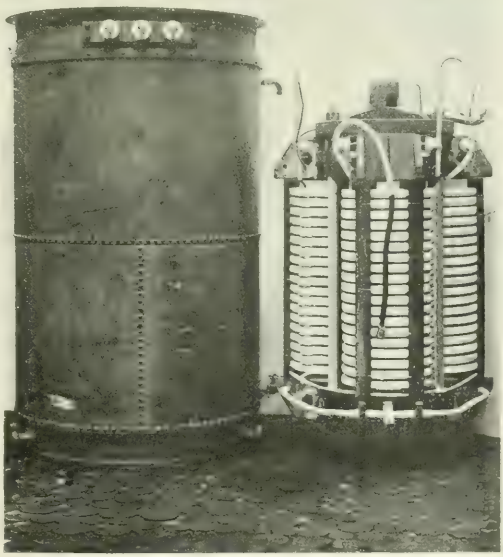


FIG. 17.—HEILBRONN TYPE OF THREE-PHASE TRANSFORMER.

Air-Gap Induction.

By F. W. Carter.

So much has been written on the theoretical determination of the magnetic field occurring in various parts of the dynamo, that the average person may be excused if he supposes that a mathematician who investigated the subject could predetermine the force at any point with accuracy. This, however, is so far from being the case that no process with which we are acquainted will so much as touch so complicated a magnetic problem as is presented by the dynamo. Some few of the formulæ which have been developed are capable of giving approximately correct information concerning the field in limited regions, and so have a correspondingly limited use, but many have neither practical nor theoretical value, and serve only to mislead the user with their pretensions to accuracy. One having some acquaintance with the subject would do better to trust his native wit than use such formulæ to guide his judgment in investigating the variations of the field. He at least will not corncern himself then about that third significant figure.

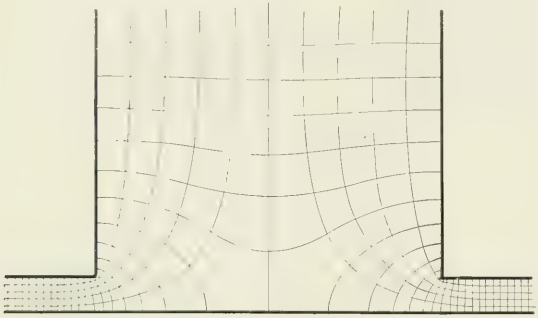


FIG. 1.—LINES OF FORCE BETWEEN TWO POLES.

In a communication made to the British Institution of Electrical Engineers[1] the writer gave a complete solution of an ideal magnetic problem, devised to resemble as nearly as practicable that of the field of force in the air-gap and interpolar space of a dynamo having a smooth core armature. The armature was supposed straight in section and the pole pieces rectangular, as in Fig. 1, which shows the system of lines of force and equipotential surfaces deduced from the solution referred to, though given here for the first time. The armature and poles are equipotential surfaces, the potential of the armature being a mean between that of the two poles. In this figure the distance between the poles (2c), is 10 times the air-gap (g). Such a diagram really gives all information about the field at every point, for not only do the lines represent the direction of the force, but their density shows its magnitude, which varies inversely as the distance between consecutive lines. This is another way of saying that the strength of the field is the number of lines of force which cross a line of unit length drawn at right angles to the direction of the force. The lines of force and equipotential lines cut one another at right angles, and divide the diagram into a system of curvilinear squares.

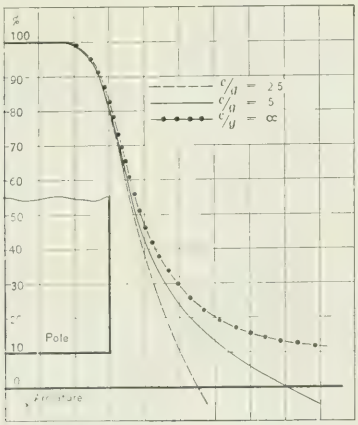


FIG. 2.—VARIATION OF FLUX DENSITY AT ARMATURE FACE.

Fig. 2 gives curves of field strength at the armature face for certain values of the ratio (2 c/g) between the distance apart of the poles and the air-gap, whilst Fig. 3 gives the fraction of the air-gap that must be added to the pole face in order to correct for the fringes at the two sides of the pole face. If this fraction be added to the width of the pole and the field under the pole face so increased be taken the same as that in the gap, the total number of lines of force will be the same as actually passes between the pole and armature.

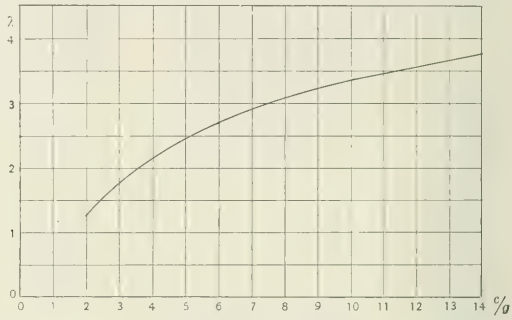


FIG. 3.—FRINGING COEFFICIENT.

The method used to deduce these results is that of conjugate functions about which something will be said later. It is not exactly an easy method, but it is the only one we have that will attack such problems at all.

The particular purpose of this article is to introduce the solution of another ideal problem so devised as to resemble very nearly that of the magnetic flux between a smooth pole face and a toothed armature. The diagram of lines of force and equipotential lines is given in Fig. 4, in which the width of the slot is taken at three times the air-gap. We should expect this ideal solution to approximate closely to the usual practical cases, for, in the first place the dimensions of the slot are small compared with the diameter of the armature, so that we are not making a violent assumption in supposing the armature to be straight instead of circular over the small portion considered. Again the slot is not unusually rectangular, as in the ideal case. Furthermore, at a distance under the tooth equal to the air-gap the lines of force are practically straight across. If they had been perfectly straight across, we could have used one as bounding the space considered in the problem, and have introduced another slot at an equal distance on the other side of this line. This would have been a true and perfect solution for a succession of slots and teeth; but as it is, we get a solution which is, in this respect, practically perfect, but not mathematically so. Fig. 4 shows that few lines of force penetrate far into the slot, so that unless this is very shallow, which is not the usual case, the depth has practically no effect. The case of a slot, square at the bottom, instead of indefinite, could be worked out,

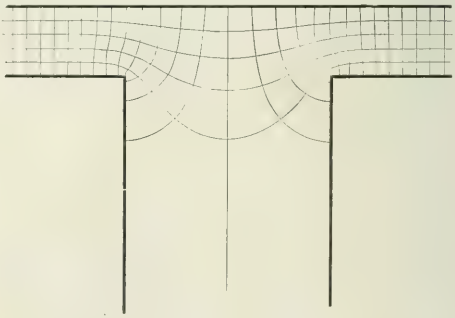


FIG. 4.—LINES OF FORCE ABOUT A SLOT.

[1] See *Journal of Proceedings* of the Institution of Electrical Engineers, 1900, Part 146, Vol. XXIX.

but, as the solution involves elliptic functions of complex quantities, it is not worth the very much greater labor of calculation, since the present solution fills the needs of practical cases.

Having determined the magnetic field about the slot, it is an easy matter to find an expression giving the effect of the slot. If we determine the total magnetic flux between two points, one at some distance to the left of the slot and the other at some distance to its right, we shall find that this flux is less than it would have been had there been no slot there, by an amount which we may conveniently express as occupying a certain length on the armature or pole face, which length we shall write as a fraction, σ, of the breadth of the slot, b. In other words, if d be the distance between the two points considered, and F_0 the magnetic force well under the tooth, the total flux

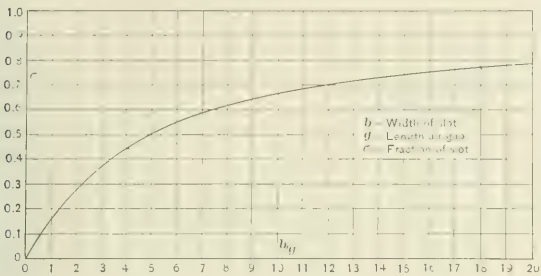


FIG. 5.—CORRECTION FOR SLOT.

beween the two points, instead of being dF_0, as it would have been had the distance d not included a slot, is $(d - \sigma b)\, F_0$, so we may represent the effect of the slot as diminishing the flux by an amount $\sigma\, b\, F_0$. Here σ is given by the equation

$$\sigma = \frac{1}{90} \tan^{-1} \frac{b}{2\,g} - 1.466 \frac{g}{b} \log \left(1 + \frac{1}{4} \frac{b^2}{g^2}\right)$$

where the angle is expressed in degrees and the logarithm is a common one. Fig. 5 gives σ for different values of $\frac{b}{g}$. Thus, if a be the breadth of a tooth, b being that of the slot, we may, in calculating the total flux suppose it has the same value as at the crown of the tooth over an amount of tooth-face, $a + b - \sigma\, b$, and is zero elsewhere. We may say, then, in finding the reluctance of the gap, that

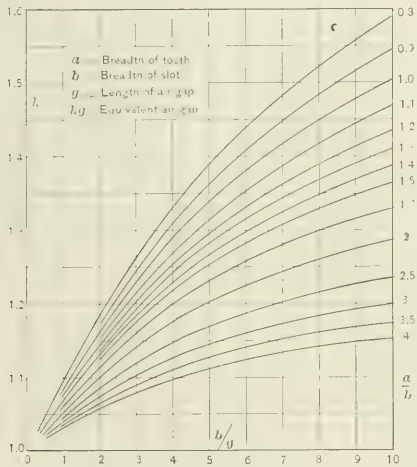


FIG. 6.—EQUIVALENT AIR-GAP.

the total flux is equal to what it would be if the induction had throughout the same value as at the crown of the tooth, and the pole face were diminished in the ratio of

$$a + b - \sigma\, b \text{ to } a + b \text{ or } 1 - \frac{\sigma\, b}{a + b} \text{ to } 1$$

or, what is better, we may say that the induction has its actual mean value, but the gap is increased in the ratio of 1 to $1 - \frac{\sigma\, b}{a + b}$; meaning by "the gap" the shortest gap or the distance between the pole face and crown of the tooth. This puts the results in a workable form for those requiring the equivalent air-gap. The value of the coefficient k by which the shortest gap must be multiplied to get the equivalent air-gap, is plotted in Fig. 6 for some of the more usual values of the quantities involved.

We notice that Fig. 5 can be used immediately to determine the effect of an internal ventilating duct. We have merely to take b as the width of the duct instead of that of the slot, and the curve gives the fraction of the duct that must be annihilated, in order to find an equivalent gap area without ducts, having the same reluctance as the actual gap has. It is convenient and natural to consider the ducts and fringes as affecting the equivalent area of the gap; and the slots—being distributed throughout the area—as affecting the equivalent length of the gap.

Fig. 4 shows that the magnetic induction at the pole face is variable. Of course, the variation does not penetrate far into the iron, being rapidly damped out by eddy currents. We can calculate approximately the amount of energy lost due to these eddy currents in the pole face, when we know the amplitude of the variation. Fig. 7

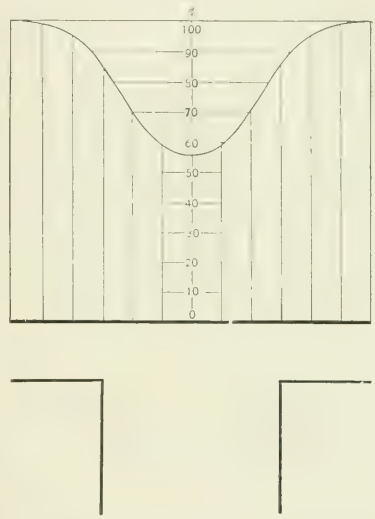


FIG. 7.—VARIATION OF FLUX DENSITY AT POLE FACE.

shows the variation corresponding to the case of Fig. 4. Here the minimum field is 0.555 of the maximum, so that the total variation is 1-0.555, or 0.445 of the maximum field. Thus the amplitude of the variation is 0.222 of the maximum field, or 0.222k of the mean field. In general, the amplitude of the variation is $k \left(\frac{1}{2} - \frac{1}{1 + b^2/g^2}\right)$ times the mean field. Calling this amplitude B lines per square inch, the energy lost in this way is, for a solid pole face,

$$8\, B^2\, D^2\, n^{\frac{3}{2}}\, \mu^{-\frac{1}{2}}\, s^{-\frac{1}{2}}\, 10^{-13}$$

watts per square inch of pole face, where D is the diameter of the armature in inches, n the speed in r. p. m., s the number of slots in the armature, and μ the permeability of the iron of the pole face, for the induction at which it is being worked.

The problem we have to face when we attempt to obtain a genuine mathematical solution of a magnetic problem of this nature, is that of finding a potential function which shall have prescribed values at certain definite boundaries. Having found this function we can get everything. Had a definite boundary distribution of attracting matter been prescribed instead of the potential at the boundary, we could

have found the force at any point by direct integration; but as it is we cannot find the density of the layer of matter which will make the boundary take the prescribed potential until the whole problem is solved. This is the chief difference between a problem in gravitational attraction and a problem in electricity or anything of the flux kind—the law of force is the same, but nature has arranged that the boundary conditions we have to satisfy are different. Having solved a problem of the flux kind, we can generally express it in the language of another subject of the same kind. Thus, in the foregoing we have only to change magnetic force into electric force, magnetic potential into electric potential, and magnetic induction into electric displacement, to get a problem in electrostatics, to which the same solution applies. Again the solution of the problem of the slot will do for that of the flow of a perfect fluid in a straight canal past the slot shaped opening. Here the lines of flow are the magnetic equipotential lines and the equipotential lines of the fluid motion are the lines of magnetic force of the figure.

In particular the perfect fluid might be electricity flowing in uniform sheet metal of the shape of the canal. I mention this because, the problems being mathematically identical, if we can get a practical solution of one by any means, we can translate it immediately into the language of another subject.

Now, it is not difficult to trace the equipotential lines on a plate through which a current is flowing, and so we may, with sufficient precision, investigate practically problems that we could not touch mathematically. I have not had an opportunity of experimenting in this direction, but the arrangement shown in Fig. 8 should be capable of giving the required result. *A, B, C, D, E, F* is a thin, uniform plate, cut to the shape of the section of the air-gap and interpolar space. Thick electrodes are soldered on along *A-B* and *C-D*, lying, as nearly as we can guess, along what corresponds to the lines of magnetic force. Current is led in at these electrodes, and a potentiometer is put in parallel with the plate. The line on the plate having the same potential as a point (*P*) on the potentiometer, is found by connecting *P*, through a galvanometer, *G*, to a pointer which is brought into contact with the plate. If *E* and *F* represent the mid-points of the interpolar spaces, the drop of volts between *E* and *F* is proportional to the total flux between the corresponding two points on the machine, and if we find what length of strip cut from the same sheet,

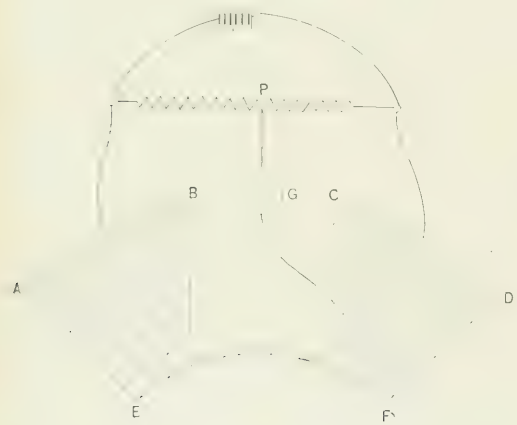


FIG. 8.—METHOD OF DETERMINING LINES OF FORCE, EXPERIMENTALLY.

and of width equal to the uniform part of the air-gap, produces the same drop with the same current, we can find an expression for the fringing immediately. In this way we could investigate the effect on the reluctance of the air-gap of chamfering the poles or other such practical point.

When we say that something is of the nature of a flux, we mean that as much of the something enters any particular space as leaves it, as much current enters a particular area on the plate of Fig. 8 as flows out of that area, or as many lines of magnetic force enter a particular volume as leave that same volume. Considering the leaving flux as entering negatively we may say that the total flux entering any space is zero. The flux is supposedly produced by a force derivable from a potential function, ϕ, so that the force parallel to the axis of x is $-\frac{\delta\phi}{\delta x}$, and that parallel to the axis of y is $-\frac{\delta\phi}{\delta y}$

In Fig. 9 suppose the area *A, B, C, D* is bounded by small elements of length dx and dy. The force parallel to the x axis across the line $A\ B$ is $-\frac{\delta\phi}{\delta x}$. The flux across $A\ B$ is, then

$$\frac{\delta\phi}{\delta x} \times \mu \times A\ B \text{ or, } \quad \mu\frac{\delta\phi}{\delta x}\,dy$$

The flux across $C\ D$ is

$$-\mu\frac{\delta\phi}{\delta x}\,dy \quad \frac{\delta}{\delta x}\left(\mu\frac{\delta\phi}{\delta x}\,dy\right)dy$$

Thus the total flux entering the area *A, B, C, D* parallel to the x axis is

$$\mu\frac{\delta\phi}{\delta x}\,dy - \left\{\mu\frac{\delta\phi}{\delta x}\,dy - \frac{\delta}{\delta x}\left(\mu\frac{\delta\phi}{\delta x}\,dy\right)dx\right\}$$

$$\text{or, } \frac{\delta}{\delta x}\left(\mu\frac{\delta\phi}{\delta x}\right)dx\,dy$$

Similarly, the total flux entering parallel to the y axis is

$$\frac{\delta}{\delta y}\left(\mu\frac{\delta\phi}{\delta y}\right)dx\,dy$$

Thus the total flux entering the area is

$$\left\{\frac{\delta}{\delta x}\left(\mu\frac{\delta\phi}{\delta x}\right) + \frac{\delta}{\delta y}\left(\mu\frac{\delta\phi}{\delta y}\right)\right\}dx\,dy,$$

and this is zero. Thus, since the permeability μ is unity for air, we have

$$\frac{\delta^2\phi}{\delta x^2} + \frac{\delta^2\phi}{\delta y^2} = 0$$

as the equation satisfied by ϕ. This is called Laplace's equation, and is often written

$$\nabla^2\phi = 0.$$

Now, if $i = \sqrt{-1}$, any function of $x + iy$ will satisfy this equation; for if

$$z = x + iy \text{ and } \phi = F(z)$$

$$\frac{\delta\phi}{\delta x} = \frac{\delta\phi}{\delta z} = F'(z) \text{ say, } \quad \frac{\delta^2\phi}{\delta x^2} = \frac{\delta F'(z)}{\delta z} = F''(z) \text{ say,}$$

$$\frac{\delta\phi}{\delta y} = i\frac{\delta\phi}{\delta z} = iF'(z), \quad \frac{\delta^2\phi}{\delta y^2} = i^2\frac{\delta F'(z)}{\delta z} = i^2F''(z) = -F''(z),$$

$$\therefore \frac{\delta^2\phi}{\delta x^2} + \frac{\delta^2\phi}{\delta y^2} = F''(z) - F''(z) = 0$$

Since a real quantity cannot be equal to an imaginary one, it follows that both the real and imaginary parts of $F(z)$ satisfy the equation separately. Thus, if $\phi + i\psi = F(x + iy)$, where ϕ and ψ are real, ϕ and ψ each satisfy Laplace's equation, and are called conjugate functions of x and y. The system of curves $\phi =$ constant, and $\psi =$ constant, for different values of the constant, always cut one another at right angles, and, if the constants change by equal small increments, divide the space into a system of curvilinear squares. This is easily proved, and is given in all books treating the subject. These two systems form our lines of force and equipotential lines.

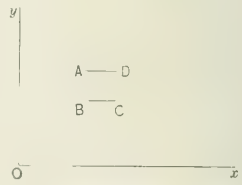


FIG. 9.—DETERMINATION OF FLUX.

Now, if $\phi + i\psi = F(x + iy)$ and x, y, are conjugate functions of x', y', say, $x + iy = f(x' + iy')$, then $\phi + i\psi = F[f(x' + iy')]$ is a function of $x' + iy'$, and, therefore, ϕ and ψ are conjugate functions of x' and y'. If, accordingly, $\phi + i\psi = F(x + iy)$ solves a known problem in the plane of x y, making perhaps ϕ constant on some boundaries, and ψ constant on others, and if we are able, by

means of the transformation $x+iy=f(x'+iy')$ to convert these boundaries into certain required boundaries in the plane of $x'\ y'$, we are able to solve a problem in the plane of $x'\ y'$,—ϕ and ψ taking the same values on these boundaries as on the corresponding ones in the plane of $x\ y$.

To take a particular case:

$$\phi + i\psi = -\frac{i\varphi_0}{\pi} \log(\xi + i\eta)$$

represents in the plane of $\xi\ \eta$ (Fig. 10), a system of radial lines from the origin ($\phi =$ constant), and a system of circles about the origin ($\psi =$ constant). We may say it represents the effect of a small source, situated at the origin, discharging on the infinite half plane. Here,

$$\phi = \frac{\varphi_0}{\pi}\theta, \quad \psi = -\frac{\varphi_0}{\pi}\log r,$$

where $\xi = r\cos\theta$, $\eta = r\sin\theta$, and therefore, $\xi + i\eta = re^{i\theta}$, where "$e$" is the base of the natural logarithms. Hence, $\phi = 0$ when $\theta = 0$, that is, along the positive part of the ξ axis, $(0, \xi)$, and $\phi = \varphi_0$ when $\theta = \pi$, that is, along the negative portion of the ξ axis, $(0, -\xi)$.

Now, if we can express ζ, $(\xi + i\eta)$ as a function of z, $(x+iy)$, such that the positive axis of ξ is transformed into the armature face, and the negative axis of ξ into the pole face, we shall be able to solve a problem with the armature and pole face as equipotential surfaces, the pole face being at potential ϕ_0 and the armature at potential zero. For our purpose, we can do as well, and, in fact, better, if we can express z as a function of ζ.

Now, the transformation

$$z = \frac{g}{\pi}\left\{\log\left[\frac{(1-\lambda)^2}{2\lambda}\zeta - \left(1\zeta + \frac{1}{1\zeta}\right)\sqrt{\zeta + \frac{1}{\zeta} - \left(\lambda + \frac{1}{\lambda}\right)}\right]\right.$$

$$\left. - i\frac{1}{\sqrt{\lambda}}\log\left[\frac{2\sqrt{\lambda}}{1+\lambda}\sqrt{\zeta + \frac{1}{\zeta} - \left(\lambda + \frac{1}{\lambda}\right)} + i\frac{1-\lambda}{2\sqrt{\lambda}}\left(1\zeta + \frac{1}{1\zeta}\right)\right]\right\}$$

converts the half plane of ζ (Fig. 10) into the air-gap space, containing a slot, of Fig. 11, making the range of points, $-\xi\ O\ A\ B\ C\ \xi$ of Fig. 10, into the points so marked in Fig. 11.

For, if ζ is negative and real, the first logarithm in z is real, and the second one reduces to

$$i\tan^{-1}\left(\frac{1-\lambda}{2\sqrt{\lambda}}\right) \cdot \frac{1+\zeta}{\sqrt{(\zeta-\lambda)\left(\zeta - \frac{1}{\lambda}\right)}}$$

which, multiplied by $-i\frac{1}{\sqrt{\lambda}}$ is real. Thus, the negative axis of ξ becomes the real axis of x. When ζ is very small, the variable part of the first logarithm becomes $\log(-\zeta)$. In passing through zero, ζ changes from $r\,e^{i\pi}$ to re^0, or the first logarithm changes from a real quantity to a real quantity, $-i\pi$. Thus, when ζ is between 0 and λ, the imaginary part of z is $\frac{g}{\pi}\times -i\pi$ or $-gi$, that is, the armature face lies a distance g below the pole face.

When

$$\zeta = \lambda,\ z = -\frac{g}{\pi}\left[\log\frac{(1+\lambda)^2}{2\sqrt{\lambda}} + \frac{1}{\sqrt{\lambda}}\frac{\sqrt{\lambda}}{2}\right] - ig$$

When ζ is between λ and 1, the first logarithm has the value

$$\log\frac{(1+\lambda)^2}{2\sqrt{\lambda}} - ig + i\tan^{-1}\left\{\left[-\left(1\zeta + \frac{1}{1\zeta}\right)\right.\right.$$

$$\left.\left.\sqrt{\lambda + \frac{1}{\lambda} - \zeta - \frac{1}{\zeta}}\right] \Big/ \left(\frac{(1-\lambda)^2}{2\sqrt{\lambda}}\zeta - \frac{1}{1\zeta}\right)\right\}$$

and the second reduces to

$$\log\left[\frac{2\sqrt{\lambda}}{1+\lambda}\sqrt{\lambda + \frac{1}{\lambda} - \zeta - \frac{1}{\zeta}} + \frac{1-\lambda}{2\sqrt{\lambda}}\left(1\zeta + \frac{1}{1\zeta}\right)\right] + i\frac{\pi}{2}$$

$$\frac{1}{1\zeta} - \sqrt{\zeta}$$

Thus the real part of z remains constant, and the line $A\ B$ of Fig. 10 represents the line AB, parallel to the imaginary axis, of Fig. 11.

When ζ passes through 1, the first logarithm remains unaltered, and the second one changes its imaginary part to $-i\frac{\pi}{2}$. Hence, the line $B\ C$ of Fig. 10 becomes the other side of the slot. When ζ is between C and ∞, the form of z is the same as when ζ is between O and A.

FIG. 10.—PLANE OF ζ.

The change in the real part of z between the two sides of the slot is

$$-i\frac{1-\lambda}{1\sqrt{\lambda}}\frac{g}{\pi} \cdot \pi = g\frac{1-\lambda}{1\sqrt{\lambda}}i,$$

the breadth of the slot.

If we write $\frac{b}{g} = p$, the transformation from ζ to z will then become

$$z = \frac{g}{\pi}\left\{\log\left[\frac{p^2}{2}\zeta - \zeta^{-1} - \left(\frac{1}{\zeta^2} - \zeta^{-2}\right)\sqrt{\zeta + \zeta^{-1} - p^2 - 2}\right]\right.$$

$$\left. - ip\log\left[\frac{2}{1(p^2+4)}\sqrt{\zeta + \zeta^{-1} - p^2 - 2} + i\frac{p}{2}\left(\frac{1}{\zeta^2} - \zeta^{-2}\right)\right]\right\}.$$

Now, $\phi + i\psi = -i\frac{\varphi_0}{\pi}\log\zeta$, which we can write

$$\zeta = e^{-\frac{\phi + i\psi}{\varphi_0}\pi} = e^{X + iY} \quad \text{say.}$$

Substituting this in the equation for z, we get

$$z = \frac{g}{\pi}\left\{\log\left[\frac{p^2}{2}e^{X+iY} - e^{-(X+iY)}\left(e^{(X+iY)} - e^{-2(X+iY)}\right)\sqrt{e^{X+iY} + e^{-(X+iY)} - p^2 - 2}\right]\right.$$

$$\left. - ip\log\left[\frac{2}{1(p^2+4)}\sqrt{e^{X+iY} + e^{-(X+iY)} - p^2 - 2} + i\frac{p}{2}\left[e^{2(X+iY)} - e^{-2(X+iY)}\right]\right]\right\}$$

Thus, if we give values to ϕ and ψ in this equation, we find the coordinates $(x\ y)$ of the point where the equipotential line on which the potential has the value given to ϕ, crosses the line of force where the flux function takes the value given to ψ. In this way the system of lines of force and equipotential lines shown in Fig. 10 is transformed into a system similar to Fig. 4, the chief difference being that, for convenience of representation, the constant λ is chosen as ½ in Fig. 10, giving $b/g = 1/\sqrt{2}$, whilst in Fig. 4, $b/g = 3$, or λ is approximately 1/11. In fact, Fig. 10 transforms into the slot shown in Fig. 11, and the system of lines of force and equipotential lines of Fig. 10 transforms into the system appropriate to this slot, but will be denser than in Fig. 4, for which the corresponding radial lines would be 36 degs. apart instead of 15 degs., the circles being spaced to suit.

Having obtained a diagram of lines of force, all information about

the magnetic field follows. For instance, the equivalent layer of attracting matter required to produce the field has a surface density $\frac{1}{4\pi}$ times the force at the surface over which it is spread, being positive when the force is inward, and thus it varies in a complicated manner over both the armature and pole face.

It will be seen that even an ideal case is not an easy subject for calculation, while an exact solution of the usual practical cases is quite beyond us. In order that theory may be any use to us at all in

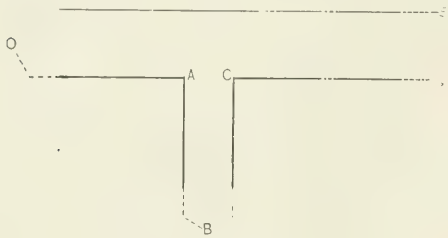


FIG. 11.—PLANE OF Z.

this connection, we must arrange that any problem we solve really resembles in some part, a practical problem, and then take care that whatever deductions we make from our solution for actual use are so expressed as to depend on that portion of the solution which resembles the practical case.

Changes in Arc Lighting.

By Alton D. Adams.

ARC lighting for streets and private service is now done by not less than seven distinct varieties of lamps. Five of these varieties operating with direct current are single open series arc, single open multiple arcs, single enclosed series arcs, single enclosed multiple arcs, and double open series arcs. Alternating currents operate single enclosed series arcs, and single enclosed multiple arcs. As to costs of operation and methods of distribution these lamps differ widely. Because of this some of the varieties have largely displaced others in the past, and like changes are still going on. Single open arcs, distributed by series circuits from constant, direct-current dynamos were the first to enter the lighting field, a little more than two decades ago. This type of lamp usually operates with current of 6 to 10 amperes, according to the degree of illumination desired, and 45 to 50 volts at the arc. A very large per cent of the energy delivered to these lamps is available at the arcs, as the coils of the regulating magnets consume only trifling amounts. In most instances it has not been found desirable to increase the pressure of series arc circuits beyond about 3500 volts, thus providing for approximately 60 open arcs and a considerable line loss. The pressure last named with 10 amperes flowing represents only 35,000 watts, which is thus a common limit to the individual capacity of arc dynamos. Such a limit is exceeded in some cases by operating more lamps per circuit, or by the construction of dynamos intended to operate several independent circuits each.

Street lighting has been a very large part of arc lamp service from its inception, and the expense of operation for single open arcs is especially heavy for this line of work. During a large part of each year street lighting must be done for 10 to 12 hours per night. As a single pair of carbons is consumed in 6 to 8 hours of operation, the single open arc must usually be trimmed during the night for street service. The use of double instead of single open arcs for streets saves fully one-half the labor of trimming, because much more time is required to go to each lamp than to fix the carbons when there, and the work cannot be done as rapidly at night when there is energy on the line, as during the daytime when the circuits are dead. For commercial service the advantage of double over single open arcs is much less, because such service seldom requires more than one pair of carbons per lamp per night, and a trimmer must usually make the rounds daily in any event. While arcs on series circuits are available for both street and commercial service, they are especially adapted to the former, because of the ease with which they may be distributed over wide areas. On the other hand, arcs in multiple are subject to the limits of low pressure circuits, but may be operated from the same supply with incandescent lamps, and are thus well suited to the requirements of commercial service. As multiple arcs of either the direct or alternating type may be operated by large generators that also supply incandescent lamps and motors, they are a much more desirable load than series arcs. With multiple arcs 15 to 25 per cent of the energy taken from supply lines must be expended in resistances connected with each lamp because of the pressures at which incandescent lamps and motors are operated. Such resistances must in any event consume 10 to 15 per cent of the energy delivered for multiple arcs, in order to insure steady working of the lamps.

The most important differences between open and enclosed arcs, whether of the alternating or direct current variety, are the increased voltage of the latter, and their longer service with a single pair of carbons. Enclosed arcs require 75 to 95 volts between the carbon points of each lamp, or nearly twice the pressure necessary for the open variety. One pair of carbons in the enclosed arc lamp lasts roughly fifteen times as long as in an open arc. For distribution on series circuits the higher voltage of enclosed arcs is a decided disadvantage, because little more than one-half as many lamps can be operated on a single circuit as is possible with open arcs. On the other hand, the higher voltage of enclosed arcs is often an advantage where they are operated on circuits of constant pressure, because a single lamp can be supplied from 110-volt mains with much greater economy than is possible with open arcs. The great advantage of enclosed arcs that more than offsets any disadvantages they may have is the saving which they effect in the cost of carbons and labor for trimming.

The several classes of arc lamps have come upon the scene one after another, and the effect of each type in displacing previous sorts has been due much more to possible economies of operation than to capacities for superior service, though this latter has not been lacking.

With the qualities of the several classes of arc lamps in mind it is possible to detect the reasons that have determined the numbers of each type in use for streets and commercial purposes since the inception of the industry. Beginning with 1888 the number of each kind of arc lamps operated by electric lighting stations in Massachusetts has been recorded for each fiscal year in the public records of that State, and the figures here presented are derived from this source. From the table it appears that the total number of arc lamps supplied from lighting stations has constantly increased for each of the 12 years from 1888 to 1900. In the former year the number operated was 6579, and in 1900, 23,355, a gain of 255 per cent. Commercial arcs have fallen behind the rate of gain made by the total for all purposes, their number having been 3258 in 1888, and 9893 in 1900, an increase of 200 per cent for the period.

Arc lamps operated by electric stations.

Year ending June 30.	Total arc lamps.	Commercial arc lamps.	Arc street lamps.
1888	6,579	3,258	3,321
1889	8,827	3,928	4,899
1890	9,999	4,492	5,507
1891	11,868	5,004	6,864
1892	14,097	5,600	8,497
1893	15,583	5,846	9,737
1894	16,602	6,593	10,009
1895	17,313	6,653	10,660
1896	18,714	7,614	11,100
1897	19,529	7,834	11,695
1898	19,847	7,743	12,104
1899	21,253	8,161	13,092
1900	23,355	9,893	13,462

Arc street lamps, on the other hand, have increased in numbers at a greater rate than the total for all purposes, having stood at 3321 in 1888 and at 13,462 in 1900, a gain of more than 300 per cent.

For each year the number of arc street lamps has been divided by the total number of arc lamps to determine the per cent in street service.

Year ending June 30.	Per cent street lamps.	Year ending June 30.	Per cent street lamps.
1888	50.4	1895	61.5
1889	55.5	1896	58.8
1890	55.0	1897	59.8
1891	57.8	1898	60.9
1892	60.2	1899	61.6
1893	62.4	1900	57.9
1894	60.2		

From these results it appears that the per cent of street lamps to the total arcs in use increased from 50.4 in 1888 to 61.6 in 1899. During these eleven years the rise in the proportion of street lamps suffered two checks—one in 1894 and another in 1896.

From 1899 to 1900 the relative number of street arcs fell rapidly and stood at 57.9 per cent in the latter year. Before the reasons for these changes can be traced, the number of each type of lamp operated in different years must be considered. The table presents the numbers of single and double open and of enclosed arcs in use each year, for both street lighting and commercial purposes.

The single open arcs present a striking illustration of rise and decline. Starting with 4392 in 1888 the number of this type of lamp reached 7056 in 1893, was at 7485 in 1898, and dropped to 2915 by 1900.

Types of arc lamps operated by electric stations.

Year ending June 30.	Single open arcs.	Double open arcs.	Enclosed arcs.
1888	4,392	2,187	.....
1889	5,452	3,375	.....
1890	5,364	4,635	.....
1891	5,753	6,115	.....
1892	6,574	7,523	.....
1893	7,056	8,527	.....
1894	7,286	9,316	.....
1895	6,929	10,384	.....
1896	7,159	11,555	.....
1897	7,385	12,144	.....
1898	7,485	12,362	.....
1899	5,096	11,857	4,300
1900	2,915	8,452	11,988

For the year of 1888 the number of double was less than the number of single open arcs, because the former came into the market later. The rise of the double arcs was the more rapid and the maximum number greater, but attained in the same year as that of the single open arcs. In 1888 the double arcs numbered 2187, and the maximum of 12,362 was reached in 1898. After this later year the number of double arcs declined, though not as rapidly as the single type and stood at 8452 in 1900. Enclosed arcs began to be used about 1897, but their numbers do not appear in the records until 1899, when the total was 4300. By 1900 this total had more than doubled, and stood at 11,988 in that year.

Increase in the number of arc lamps for each year.

Year ending June 30.	Commercial arc lamps.	Arc street lamps.	Single open arc lamps.	Double open arc lamps.
1889	670	1,578	1,060	1,188
1890	564	608	*88	1,260
1891	512	1,357	389	1,480
1892	596	1,633	821	1,408
1893	246	1,240	482	1,004
1894	747	272	230	789
1895	60	651	*357	1,068
1896	961	440	230	1,171
1897	220	595	226	589
1898	*91	409	100	218
1899	418	988	*2,389	*505
1900	1,732	370	*2,181	*3,405

*Decrease.

To bring out more clearly the reasons for the increase or decrease in the number of each type of lamp, the additions to commercial, street, single open and double open arc lamps are given in the table for each year. From 1888 to 1898 the number of commercial arcs increased 4485, but during the same period only 3093 single arcs were put into use, so that 1392 double arcs must have been required for commercial purposes, even if no single arcs were used in the streets. During the decade just considered 8783 street lamps were put into operation throughout the State, and the number of double arcs added for all purposes was 10,175. This leaves an excess of 1392 double arcs above the requirements for street lamps, or just enough to make up the difference between the numbers of commercial and of single arc lamps. As a matter of fact, while the demands of street lighting were mainly supplied by double arcs, it is probable that a few of the single lamps were used for this purpose. In only four years, between 1889 and 1900, was the number of single open arcs put into operation sufficient to meet the demands of commercial service. The largest additions of single arcs during this period were made from 1891 to 1897, when single multiple arcs were being applied rapidly to commercial service. The figures for the yearly increase of arc lamps show only the net additions. The decade from 1890 to 1900 saw a large displacement of series by multiple open arcs in commercial service, but this movement is not indicated in the table.

In each of five years between 1889 and 1897 the addition of double arcs was greater than the requirements for street lighting, and in the three years where demands for street lamps exceeded the additions of double arcs these excesses were relatively small. The year 1898 saw a great decline in the addition to the numbers of both single and double open arcs, less than one-half of the usual number of the former and less than one-quarter of the usual number of the latter being put into service during the year. For each year up to and including that last named the sum of street and commercial arc lamps is just equal to the sum of single and double open arcs, because the number of street lamps in each case is found by the subtraction of the number of commercial lamps from the sum of single and double open arcs. It is possible that the numbers of street lamps for the years 1897 and 1898 are less than they should be, because the state reports do not show the numbers of enclosed arcs separately for these years, and it is not clear that they were included in the numbers of open arcs.

The year 1899 evidently marks a new era in the applications of arc lighting. For that year there was an increase of 1406 in the total number of arc lamps used for all purposes, and at the same time the open arc lamp declined by 2894. The demands for increased service as well as the falling off of the single and double open lamps was met by an addition of 4300 enclosed arcs. Changes for the year of 1900 were even more radical than those just described. In this year the arc lamps added for street lighting and commercial service numbered 2102, while the decrease of single and double open arcs was 5586. Enclosed arcs to the number of 7688 were put into service meantime to replace the open arcs thrown out of use and meet the new demand. During the two fiscal years just considered 4570 single and 3910 double open lamps were replaced by enclosed arcs. In the absence of any other reasonable cause it seems certain that the enclosed arcs have largely increased the demand for arc lighting. During the four years from 1894 to 1898 the number of arc lamps in use for all purposes increased by 3245, but in the two years from 1898 to 1900 the like increase was 3508 arc lamps, making the yearly rate twice as great on an average in the later as in the earlier period. For the year of 1900 the number of arc lamps in use for all purposes increased by 2102, a number equaled by additions in previous years only by those for 1889 and 1892. In these two earlier years street lighting was making rapid advances by means of double arcs, and more than 70 per cent of the lamps added in each year were devoted to this purpose. On the other hand, for 1899 and 1900, only 38 per cent of the added arcs were street lamps. From this it seems that the especial influence of enclosed arcs has been to stimulate commercial service. Six years between 1892 and 1898 saw an increase of 2143 in the number of commercial arc lamps, and the two following years gave a further increase of 2150 arcs in the same service. Evidently the enclosed arc stands a much better chance than the open type in competition with incandescent lamps for interior illumination.

The substitution of enclosed for open arcs has a strong tendency to modify distribution lines and generating stations. With enclosed arcs the number of series lines may be double, or the maximum voltage of each line twice that necessary for an equal number of open arcs. This makes it more desirable to supply street as well as commercial arcs from constant pressure circuits wherever possible than was the case with open arcs. In the supply of private consumers the change from open arcs on series circuits to enclosed arcs on constant pressure circuits is already far advanced.

Even where series distribution is retained for enclosed arcs in

street service, there is a tendency to shift them from direct to alternating current. This tendency is stronger with the enclosed than with open arcs, because the illumination from the former is satisfactory, where the alternating current is used. The movement of arcs from series to multiple circuits, and from constant direct to constant alternating current lines retarded the increase in capacity of constant current dynamos throughout the decade from 1890 to 1900. Exact figures cannot be given on this point, but it is a matter of general knowledge that multiple have largely displaced series arcs in commercial service, and the per cent of arc street lamps to the total reached its highest point at 62.4 in 1893. For the year of 1900 the total capacity of arc dynamos throughout the stations of the State declined 193 kilowatts. Of the 4300 enclosed arcs reported for 1899, 3313 were in use at Boston, leaving 987 for the remainder of the State. In 1900 the number of these lamps at Boston was 6682, and the rest of the State had 5304. Thus while the enclosed arcs in use at Boston were doubled in number, those outside were multiplied by six.

Power Transmission on the Susquehanna.

By O. P. Waters.

THE largest plant of the kind in Pennsylvania which has ever gone in, and perhaps second only in importance to the great Niagara power plant, is now in the course of construction at York Haven, on the Susquehanna River, about 16 miles from Harrisburg, and 11 miles from York, Pa. The work began June 17, 1901, and will likely be completed in the fall of 1902. The operation consists in the development of an immense electrical power plant, gained by impounding and utilizing the entire body of water at the Falls, a point on the Susquehanna River, just a short distance above the plant.

There will be built a power house 478 ft. long and 51 ft. wide, in which there will be 40 turbine waterwheels of 600 horse-power each, operating twenty 750-kw generators, together with two turbines of

VIEW OF FALLS ON SUSQUEHANNA RIVER.

250 horse-power each to drive machines for excitation. A contract for the generators has been awarded to the Stanley Electric Manufacturing Company, and for the turbines to Robert Poole, Sons & Co., of Baltimore.

From this building there is being built a granite wall 3500 ft. long, and from 26 to 38 ft. high, 16 ft. at the top and 19 ft. at the bottom. This will enclose a race 375 ft. in width, 16 ft. in depth, connecting with the dam at the head of the Falls. The construction of the wall will require 100,000 cubic yards of masonry. A cofferdam has been erected 550 ft. in length and 240 ft. in width, in the construction of which 45,000 bags of sand, 250,000 ft. of timber and 10,000 cubic yards of stone were used. Inside of this cofferdam the foundation for the power house has been excavated in solid rock, and the work of laying masonry is being pushed with all possible energy. Twelve derricks, with the latest improvements in hoisting apparatus, have been placed, and a portable railway laid reaching all points at which masonry work is in progress, comprising a length of nearly two miles, and supplied with complete equipment for transportaion of material and supplies used in the work.

The promoters and principal owners of this company are Mr. Henry L. Carter, of New York, and Judge W. F. Bay Stewart, York, Pa. In addition to the lands required by them for the proposed development they have purchased 450 acres lying contiguous to the developing property and to the Northern Central Railway, on which it is expected a large portion of the current generated will be used to drive large industries which are already negotiating the power.

The company has been capitalized at $3,000,000 and a bond issue has been made of $1,500,000. It will take all of this latter sum to complete the work. The plans have been laid out by Major George S. Burbank, consulting engineer, who was connected with the Niagara power plant. Contractor Thomas Green, of York Haven, is superintending the work of construction, while H. B. Montgomery is the business manager.

An exceptionally favorable feature in connection with this construction is the fact that all of the granite used in the erection of the building, etc., will be taken from a quarry located but a few yards from the place. It is of excellent, durable quality.

"Distribution" Discussion by the American Institute of Electrical Engineers.

THE November meeting of the American Institute of Electrical Engineers was held last Friday simultaneously in New York and Chicago, and no less than eight papers were presented. As the amount of matter contained in the papers would cover about 15 of these pages, it is only possible within the space at our disposal to give a brief summary of the more salient features of the contents. The papers in the aggregate deal in a most thorough manner with the question of electrical distribution in cities, and to those particularly interested in this subject, their reading in full is to be recommended. The paper of Mr. W. L. R. Emmet on "The Distribution by the Three-Phase System and the Operation of Single-Phase Circuits by It," will be printed in a following issue.

A paper somewhat aside from the subjects discussed in the others read is a short one by Mr. Henry G. Stott on "Locating Faults in Underground Distribution Systems." Mr. Stott shows that with the large cables used in city distribution, the application of the resistance or loop method is impracticable. He then discusses three other methods which have been applied. One is denominated the "cut-and-try" method, which consists in cutting into as many sections as necessary until the fault is finally located. This is characterized as a slow, expensive and unscientific method which can only be used as a last resort. The second or "smoke" method consists of putting a current of sufficient magnitude into the cable to cause the insulation at the fault to burn and give out volumes of smoke, by means of which the location of the burned section may be discovered upon opening up the manholes. Mr. Stott considers this method also crude, since the flames may burn not only a great length of the cable itself, but also other cables, or cause explosions from the ignition of the gases ever present in city conduits.

The third, or compass method, Mr. Stott considers to be the only practicable and safe means of quickly and accurately locating a ground in cables of large cross-section. This method consists, briefly, in sending a direct current of about 10 amperes into the cable through the ground, the current first passing into an automatic reverser which changes the direction of the current flow every ten seconds. A manhole is then opened near the center of the cable length and a pocket compass is laid on the lead sheathing of the cable and observed for, say, half a minute. If the ground is further from the source of reversed current the compass needle will swing around approximately 180 degs. upon the reversal of flow at the end of each 10-second interval. The compass is then applied at another manhole, say, a mile further away, and if no motion of the compass needle occurs, then the fault has been passed and another manhole is opened between the first two positions, and so on until the fault is finally located in a section between two manholes.

The paper illustrates and describes a form of reverser used by the Manhattan Railway Company, which consists of a ¼-hp three-phase induction motor geared to a two-part commutator which revolves in oil in order to insure the quick reversal of current without danger of arcing across segments. Current may be obtained from an arc light machine preferably, or from a 500-volt circuit.

The paper by Mr. Emmet, which will be reprinted in full in a following issue, advocates the use of three-phase machines in general for alternating-current generation in central stations, even where the distribution is single-phase. Two-phase and single-phase machines he considers to have, in the great majority of cases, no good reason for existence. A three-phase machine, as ordinarily designed and with a star-winding, will carrying from 75 per cent to 85 per

cent of its rated load in single-phase current between two conductors with the same heating which would be produced by operation at its rated capacity with balanced three-phase current. If motors or rotary converters are connected to a three-phase generator which is operating with single-phase load, these motors or converters will tend to equalize the load between phases and thus may increase the capacity of the system. When a three-phaser is partly loaded with single-phase currents between two of its wires, the unused phases may naturally be loaded with other single-phase currents, thus giving various degrees of unbalancing between the three phases and, with normal heating, will vary from 75 per cent to 100 per cent of the total three-phase capacity. As to relative cost, a three-phase machine for a given single-phase output has about the same size and cost as the machine designed for single-phase alone, the apparent inconsistency lying in the fact that a three-phaser for a given output is cheaper and smaller than a single-phaser.

The paper enters into the details of single-phase distribution from three-phase machines, and contains diagrams of several types of distributing circuits.

A paper by Mr. Harold W. Buck describes the Buffalo high-tension distribution system. Three overhead circuits, each having a capacity of 10,000 horse-power at 7 per cent line loss, enter a terminal house in Buffalo, where the transmission voltage of 22,000 is cut down to 11,000. From here power is transmitted at 11,000 volts by cables drawn through tiled ducts under the street, to seven sub-stations. The methods are described which are employed in this part of the distribution for transferring from one cable to another, and for cutting out damaged sections of a cable by means of section switches, which latter are installed in vaults under the city streets. It is stated that these switches have proved a great convenience at times when repairs have been necessary on sections of the cables, and for locating faults without the necessity of cutting the cable.

Of the seven sub-stations, one receives 2000 horse-power for railway purposes with a current that is transformed by converters from 11,000 volts three-phase to 360 volts direct. This same sub-station also receives 1000 horse-power for general power distribution at 2200 volts. Four other sub-stations are for railway service, the amount of power received being 1500, 1000, 1500 and 1000, in each case the three-phase, 11,000-volt current being transformed by converters to 360-volt direct. The largest of the seven sub-stations receives 5000 horse-power, which is transformed from 11,000 volts three-phase to 360 direct, and fed to the plant of the Buffalo Lighting Company in an adjacent building. One thousand horse-power is also supplied from this station at 2200 volts, three-phase, for general power distribution. The remaining station receives 2000 horse-power, which is transformed to 2200 volts, three-phase, for power distribution.

As to the reason for distributing to sub-stations at 11,000 volts instead of at the transmission voltage of 22,000 volts, Mr. Buck says that while there have been examples of the successful operation of underground cables at voltages even higher than 22,000, nevertheless what can be done on a through direct line cannot be safely done on a network. The Buffalo underground system is essentially a network, and he believes that 11,000 volts is, in the present state of the art at least, the highest voltage which should be considered for this class of service. The success of the Buffalo distribution of 11,000 volts has, however, demonstrated the safety and feasibility of using a potential as high as this, and seems to show that there is no longer any reason for adhering to the prevailing voltage of 6600 for underground work. One of the advantages of the higher voltages is that in case of short circuits in the cables, practically no damage is done at 11,000 volts on account of the small current, while a similar short-circuit at 6600 volts would undoubtedly blow the cable to pieces on account of the greater current, the heat energy at the fault being nearly four times as great. Another advantage for changing from 22,000 to 11,000 volts at the city line is that it renders the 11,000-volt cable system independent of grounds and high-voltage disturbances which occur at times on the transmission line, since there is only an inductive connection between the two systems.

Mr. Buck considers that from a business as well as an engineering standpoint the division of power supply among three companies is desirable. In Buffalo there is a distributing company called the Cataract Power & Conduit Company, which purchases power generated by the Niagara Falls Power Company and delivered at the Buffalo city line, which it distributes as raw material to the railway and to the lighting and power company for redistribution to consumers.

In a paper entitled "Alternating Current as a Factor in General Distribution for Light and Power," Mr. Charles F. Scott considers the question whether for general distribution for lighting and power service, and where the current is generated in alternators, it is desirable to utilize the current as alternating current or to convert it into direct current. After considering the various factors that enter into the quesion, Mr. Scott concludes that all of the important classes of service for which current from a central station is used may be successfully undertaken either by the direct current or by the alternating current, sometimes equally well, sometimes with the advantage on one side and sometimes with the advantage on the other side. The most important difference is probably in the case of variable speed motors and the importance of this will depend quite largely on the proportion of this kind of service. Although the alternating-current motor cannot exactly replace the direct-current motor, so that there may be some inconvenience in changing from one system to the other, yet when a new plant is being laid out, it is probable that the cases are very rare in which it would not, on the whole, be practicable to utilize either alternating-current motors or direct-current motors.

Considering next the matter of apparatus, the greater simplicity of the alternating-current system is brought out in its several aspects. Referring to the storage battery as an element which is sometimes presented as a reason for adopting direct current, Mr. Scott points out that it may be readily added to the alternating-current system through the employment of a rotary converter for charging the battery, which latter in turn supplies current through the converter to the alternating circuit.

Mr. Scott concludes that the general comparison evidently favors the one which employs alternating current only. The introduction of converting apparatus, therefore, must be justified by the advantages accruing in connection with the utilization of the current which is sufficiently great to overbalance the extra cost and compensation. There are, however, some cases where combined service is advantageous, alternating current being supplied for certain districts and direct current for others. In cities a combined service for general distribution is sometimes applicable for furnishing direct current from sub-stations to districts which have previously been supplied by direct-current generating plants, while alternating current is furnished to the outlying parts. The same generators may be used for both classes of service and may supply them simultaneously. Quite similar results may be obtained from a direct-current generating plant, the alternating current being obtained from inverted rotary converters. In smaller towns in many cases the lighting and railway work can be operated from the same alternating-current busbars, an automatic compounding of the rotary converters being suggested so as to make the voltage upon the general system sufficiently constant for lighting service.

In conclusion Mr. Scott considers that probably the most pertinent conclusion to be drawn from a discussion of this kind is that there is no ideal system and no panacea plan which can be unanimously applied. Existing and local conditions, special requirements and the relative importance of the various classes of service to be rendered, must all be taken into account in determining what will be adequate in an individual case.

Mr. W. S. Barstow contributed a paper entitled, "Notes on the Alternating-Current System of Distribution." Among the reasons which Mr. Barstow introduces as to why the alternating-current system has not yet attained the status of a large distributing system for compact territory, are the indispensable part which the storage battery has come to play in the general system; the lack in the past of an alternating-current motor for general power purposes, and lack of standardization of alternating-current systems, and the difficulties that have been met in paralleling transformers. The alternating-current system, he considers, is, however, alone in its field of transmission and house-to-house supply in scattered territories, but even in entering these fields too much attention cannot be paid to the condition of future permanent supply, there being many cases where the system has been used only as a temporary expedient for developing territory.

In conclusion, Mr. Barstow states that if the alternating current, besides retaining its field of transmission and scattered distribution, where it is supreme, would enter the compact direct-current field of distribution, there are required: First, a standard type of motor which can be used for all classes of business demand, and will meet the same commercial requirements as the present direct-current motor. Second, a universal system of supply which does not re-

quire transformers or anything outside of the meter to be located on the premises of the customers. Third, some apparatus which, in connection with alternating current, will take the place of the storage battery supply on the direct current. With these requirements complied with he considers that alternating-current distibution can expect to take the place of many of the large direct-current systems, not only for the supply of light and power, but also for transportation.

In a paper entitled "Distribution of Electrical Energy in Large Cities," Mr. Louis Ferguson describes the system employed in Chicago, and also refers to similar systems now employed in Milan and Berlin. Mr. Ferguson recommends direct current for the lighting and power work in the strictly business and city residential districts, and alternating current for the less closely built residential districts, as well as for the actual suburban territory of the city. He gives an analysis of the lighting and power output of Chicago central station companies where this method of distribution is followed. Out of a total maximum output of 22,500 kilowatts, 23.4 per cent is by 60-cycle alternating distribution for a territory of approximately 58 square miles, and 79.5 by direct-current distribution over a territory of only 10 square miles. In the latter case a considerable part of the direct current is supplied by direct-current machines operated at 25 cycles. With the growth of the business of the company all direct-current generating apparatus will be superceded as it wears out or becomes obsolete, by 25-cycle rotary sub-station distribution in one low-tension district. As outlying residence districts become more general consumers of electricity they are changed over to low-tension direct-current, and all new development in the northern and western Chicago districts is supplied by motor-generator sets receiving 25-cycle current from a main generating station and delivering 60-cycle current to the distribution lines.

Mr. Ferguson considers that the feasibility of applying the direct-current motor to general power work is much superior to that of the alternating-current motor, and the disturbing effects of line pressures are less. The initial cost of the direct-current motors and their accompanying equipment is very much less, and he adds that at the present time the selling price of three-phase motors in America is far in excess of being reasonable. Direct current is also very much better adapted than alternating current, to electric elevator work, and to illustrate the importance of the electric elevator to the central station, the statement is made that in Chicago elevator motors alone take 12½ per cent of the total output of the companies. In connection with the advantage of direct current he refers to the great value of the storage battery on electrical distribution systems. The battery capacity of the Chicago Edison Company is distributed over the entire low-tension district, having a combined capacity at the eight-hour rate of 6600 ampere-hours, not including smaller batteries in three of the rotary sub-stations in residence districts.

Having determined that direct-current distribution is most desirable for the central district of Chicago, the system of generation for the principal stations was adopted which was considered the best adapted to direct-current distribution. This consists in the use of rotary converter sub-stations and the generation of 25-cycle, three-phase alternating current by double-current machines at 160 volts alternating, arranged for stepping-up to 4500 and 9000 volts. In one of these stations the largest double-current machine thus far built has been installed, having a normal capacity of 2500 kilowatts with an overload limit for peak work of 3200 kilowatts, and generating 300 volts direct current and 180 volts three-phase. This machine is run in parallel with the other double-current and direct-current machines in the station, and will also operate in parallel with a new 3500-kw. three-phase alternator now being located beside it to generate 9000 volts. It is stated that the limit of available space in the principal plants having been reached, it is probable that all additional generating plants will consist of 25-cycle, three-phase alternators generating 9000 volts. The efficiency of transmission and transformation between three-phase generators and rotary direct-current for the entire sub-station system, is 82.2 per cent.

Mr. Ferguson states that the method of generating all alternating current in one or two large stations and transmitting the energy at high voltage to sub-stations for conversion to direct current in thickly settled districts, is now being adopted in some of the large and most progressive cities of Europe, notably in Milan and Berlin. The paper gives an account of the recent plants installed on this system in these cities.

Mr. Philippo Torchio, in a paper entitled "250-500-Volt, Three-Phase Wire Distribution for Lighting and Power," advocates the use of the three-wire, 500-volt system, which he states has all the advantages of the original low-tension Edison three-wire system, and has greater capabilities of expansion in lightly loaded or scattered territories, as in the case of small cities or in large factories and in other places. Three points that have been urged against this system are the greater tendency to arc, thereby necessitating the use of special fittings and insulation; the lower efficiency of the 250-volt incandescent lamp, and the difficulty of operating 250-volt arc lamps.

As to the first point, this can be provided for by the use of proper insulation and the design of proper fittings. As to the lower efficiency of the lamp, this is only a matter of moment where low-voltage lamps are at present used, for outside of large cities the 3.6-watt lamp is quite common, and there will be thus an advantage in replacing it with a 3.4—3.5 high-voltage lamp. As to arc lamps, the difficulty has been overcome by connecting two ordinary enclosed arcs in series, and lately several types of double arc lamps have been used with entire success. In conclusion, Mr. Torchio considers that the difficulties to be overcome are not very serious, especially for new installations and where changes of distribution are contemplated.

A table is given, showing that the saving from the use of the high-voltage system will be very large for lightly loaded districts. With a 500-volt, three-wire system a sub-station can in each case supply for the same current density in the feeders and the same regulation, a territory four times as large as with a 250-volt, three-wire system. While thus no feeder saving is effected, a large saving will be made by the reduction of the number of sub-stations, and their operating expenses, of which estimate is given in the second table. This saving ranges from $100 per kilowatt maximum, where the load is 2.5 watts per foot of street covered by mains, to $14.40 for a load of 80 watts, no large motors being used; if large motors are used these figures become $162.50 and $19.40, respectively.

Professor W. L. Robb, in a paper entitled "Distribution of Electricity in Cities of Moderate Size," considers that in view of the conditions existing in business sections of the cities of this class, and the relatively high price charged at present for alternating-current arc lamps, motors, etc., it is desirable, at the present time, to supply the business section of a city of the class considered in the paper, with direct current, and he favors the three-wire, 220-volt system as against the high-voltage, three-wire system.

The power house should be situated with respect to the cheap production of electricity, and, therefore, not in the business district. Current for this district should, therefore, in general, be supplied from a rotary converter sub-station situated as near as possible to the center of distribution of the district. The main power house should generate only alternate current, which should have a frequency of 60 cycles, be a three-phase, four-wire system and have a pressure of approximately 2300 volts between each phase wire and the common wire. The feeder should be lead-covered cables drawn into conduits. Professor Robb considers that paper insulation is more satisfactory as well as cheaper for feeders than rubber insulation. In order that a system of alternating-current distribution of any size should be satisfactory, it is necessary that the arrangement of the generating plant be such that current can be supplied to the different feeders at different pressures, which may be accomplished by boosting transformers in each feeder circuit and by a system of pressure wires from the various centers of distribution, or by automatic devices such as originated by Mr. W. L. R. Emmet.

Reciprocity Resolution Adoped at Washington.

The net result of the proceedings of the National Reciprocity Convention held at Washington last week appears to be summed up in the following resolutions:

Whereas, The growth of manufactures in the United States, represented in values and in round numbers, has been as follows: 1850, $1,000,000,000; 1860, $2,000,000,000; 1870, $4,000,000,000; 1880, $5,000,000,000; 1890, $9,000,000,000; 1900, $15,000,000,000; and,

Whereas, These figures exhibit at the same time a splendid result for the past industrial policies of our Government, and a growing need for the development of larger markets in foreign countries; and,

Whereas, It would seem desirable not only to maintain policies under which such splendid results have been accomplished, but also devise means to develop increased markets for the increased and increasing manufactured products; therefore, be it

Resolved, That this convention recommends to Congress the main-

tenance of the principle of protection for the home market and to open up by reciprocity opportunities for increased foreign trade by special modifications of the tariff, in special cases, but only where it can be done without injury to any of our home interests of manufacturing, commerce or farming.

On the whole, it may be said that the protectionists captured the convention bodily. Before adjourning, the convention adopted resolutions in favor of the proposed Department of Commerce and Industries.

The Morton Current.

At the annual meeting last year of the American Electrotherapeutic Association, upon the motion of Dr. W. J. Morton, a committee was appointed, consisting of Dr. W. J. Herdman, of the University of Michigan, and Mr. W. J. Jenks, to report on a question of priority concerning a method of producing from static apparatus what has been claimed to be a new form of undulatory or oscillatory current, which sometimes has been referred to as the "Morton current."

It appears that Dr. A. D. Rockwell had in letters to a medical journal contested the priority of Dr. Morton in the discovery of a new so-called static induced current and means of producing the same. In his articles he said that in a book by Mauduyt published in Paris in 1783 is given "both in descriptive and illustrative detail what is now called the 'static induced current.'" Referring also to Tibbett's "Handbook of Medical Electricity," published in London in 1873, he says: "Dr. Morton has simply copied in its essential details this illustration, or some similar one from earlier French or English issues—Mauduyt, Wilkinson, Adams or Cavallo—and given to the current that these old fellows used the name of 'static induced.'" Again, referring to Adams' "Essay on Electricity," published in London in 1792, and to an illustration therein, he says: "These are nothing more nor less, could be nothing more nor less, than what Dr. Morton calls his wonderful discovery of 'static induced currents and physiological tetanus.'"

The report in considering the question of priority goes into considerable detail and includes three illustrations, of which reproductions are given herewith. Fig. 1 illustrates Cavallo's method of about 1780; Fig. 2, Duchenne's method of 1872, and Fig. 3 outlines Morton's method of 1880-81. Referring to Fig. 1, the circuit of discharge of the Leyden jar condenser is completed through the patient and the spark-gap, which are in simple series. Commenting on this arrangement, the report says that the patient thus receives the direct shock of the discharge and all of the current which causes the spark. A Lane electrometer is used to regulate the frequency and force of each shock. In this method the static generator is constantly revolved.

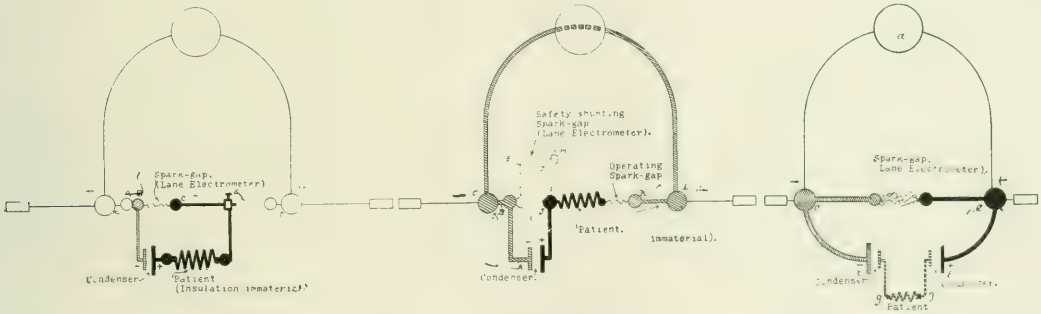
Fig. 2 indicates Duchenne's method of 1872. Here the circuit of the discharge of the Leyden jar condenser is completed through the spark-gap and the generator, all three of which are in simple series. Commenting on this arrangement, the report says that with it the patient receives the direct shock of the discharge and all of the current which causes the spark, as in the action of Cavallo's apparatus and method; but that in this case the regularity of the force and steadiness of the succession of shocks is less certain because the generator is turned a certain number of times to charge the condenser, after which the discharging rod is moved toward the patient until the spark jumps to his body, the generator then being again turned and the cycle repeated. A Lane electrometer is here used only as a safeguard to sidetrack a heavy charge which might be inadvertently stored in the condenser, and to discharge it before it could do any damage.

Fig. 3 outlines the Morton method. Two Leyden jar condensers are used, the inside terminal of one being connected to the positive prime conductor of the static generator, and the inside terminal of the other connected with the negative prime conductor. Commenting on this arrangement, it is stated that the two outside terminals of the two condensers are connected together through the patient so that the secondary or induced current which surges backward and forward is the only current the patient receives. The discharge between the two inside terminals is completed through the balls of the prime conductors, the adjustable discharge rods and the spark-gap. The direct shock thus traverses the spark-gap, but it does not traverse the patient, thus differing from the arrangements of Cavallo and Duchenne. The adjustable rods constitute the Lane electrometer used for the same purpose as that Cavallo described, viz., regulating the frequency and force of every spark. As in the Cavallo's method, the static machine is operated continuously.

The conclusion of this part of the report is that in Morton's apparatus the frequency and force of the spark determine, through the medium of the condensers, the frequency and force of the pulses in the secondary circuit (which, with reference to the generator, is in shunt with the primary), while the current thereby induced is radically different in its characteristics from the inducing disruptive discharges such as Cavallo and Duchenne had utilized.

The report states that the committee has not attempted to analyze the precise physical differences between the electric current which traverses the patient under the conditions of Cavallo and Duchenne (Figs. 1 and 2), and that which is applied by the Morton arrangement of Fig. 3. It is added that statements from several eminent medical electrical authorities which appeared in several French publications, and which are quoted, indicate their opinion that the high-frequency currents which Hertz secured and described several years later, were developed by Dr. Morton and medically applied in 1880, though he did not then clearly recognize or characterize them as such. The committee considers the fact has no force that Dr. Morton did not at the time of his discovery or invention of the static induced arrangement and method fully appreciate the nature of the electric pulses which he secured or all the accompanying phenomena, or foresee all of their features of utility. The committee considers it sufficient that the devices and methods be clearly described, in the best form and mode of application which the experimenter may have worked out (so that others skilled in the same art may follow him), to entitle him to the credit of their discovery and reduction to practice, and to a claim to the foundation on which others may subsequently build structures of which he has or may have no conception.

The final conclusions are that the evidence before the committee indicates that in 1880 or thereabouts Dr. W. J. Morton devised and used an arrangement of previously existing static electrical apparatus, and in its use practised a method of producing currents, which have been widely adopted and recognized as useful in subsequent medical work; that the arrangement and method had not theretofore been known or practised, and were not evident to those skilled in the art as the result of their prior knowledge and experience, and that Dr.



FIGS. 1, 2 AND 3.—THE MORTON CURRENT.

Morton's claims of priority as made by him are entitled to the recognition of the American Electrotherapeutic Association.

We understand that the above report was rendered at the meeting of the Association this September, and its recommendations adopted unanimously; also that a committee consisting of Mr. W. J. Jenks, Dr. S. Sheldon and Dr. A. E. Kennelly, has been appointed to investigate during the year 1901-2 the physical peculiarities of the "static induced," and similar currents, which constitute the results of the experiments of Morton since 1880.

Supervision of Electrical Circuits in Cities.

In connection with the meeting in New York next week, of the Underwriters' National Electrical Association, the following remarks of Mr. William H. Merrill, Jr., electrician of the electrical bureau of the National Board of Fire Underwriters, to the *Evening Post*, are of interest: "During the last five years some 85 cities in the central western district have adopted ordinances and created efficient inspection departments for the control of the electrical hazard, as compared with less than one-half that number of cities in the East. I do not think that electrical conditions have improved in the smaller towns as rapidly as they have in the cities, and as a means to reaching these towns, I believe State supervision is necessary. There has been from time to time criticism of municipal electrical departments by persons whose knowledge of the subject has been confined to the consideration of one, or possibly two, such departments in which political influences had created discord and which for that reason were not doing all that they could for public safety. I think, however, that no one can dispute the fact that the great majority of the 125 or more municipal departments at present in operation in the United States are credits to the municipalities in which they operate, and productive of splendid results in standing between unscrupulous contractors and the lives and property of people, who are, for the most part, profoundly ignorant in electrical matters. Electrical inspection to be competent must be comprehensive, and must not confine itself to original inspections. It must inspect and inspect and reinspect. There is hardly a mercantile establishment in the United States of any size having an electrical plant which makes no changes in its electrical equipment for an interval of 60 days. These municipal electrical inspection departments—many of them—inspect the large equipments every 30 days, and in Chicago the department maintains a corps of 10 to 12 men at an annual expense of about $12,000. The work is in charge of an electrical engineer, and it has been demonstrated that as far as that city was concerned the electrical interests, the insurance interests, and the commercial interests would not permit the control of the department to remain long in the hands of any one not thoroughly conversant with electrical matters. This bars out the politician.

"Conditions which prevail at Chicago exist also in a majority of the other cities governed by electrical ordinances. I venture to say that 90 per cent of the municipal departments of the country are as efficient as the departments maintained by the insurance interests. Boston and St. Paul have notably efficient departments, and I could name 40 or 50 of the smaller cities and towns in the central western district where similar standards of efficiency prevail. Insurance interests cannot maintain comprehensive electrical inspection unless they are prepared to increase rates so as to augment revenue for the maintenance of such departments to the extent of something like a million dollars a year. This being obviously out of the question, the the remedy lies in municipal and State control.

"Where to-day we have 125 cities exercising such control, we ought to have 500. Where such departments are inaugurated it becomes more or less the duty of the insurance interests to see that they are maintained in a competent manner and that the inspections are well made and the National Electrical Code enforced. Of course, the introduction of electricity has diminished the number of fires which might have been caused by the use of other means of illumination. As people are beginning to learn that they do not need to light a house by gas and electricity both, the number of fires caused by gas pipe being burned through by electricity and the ignition of escaping gas will be further restricted.

"I do not publish as an electrical fire anything other than well established and proven electrical losses. These, of course, while they reach a majority of the electrical fires probably do not cover 25 per cent of electrical losses. I know of no way in which we can get at the facts in an account of an accurate summary of the annual electrical fire waste. Any estimates made must be merely an estimate. We know that the annual electrical fire waste is more than $3,000,000, but how much more than this we do not know, and until we discover some means of identifying the cause of a fire which no one saw start and which leaves us as its only evidence a heap of ashes, I see no way of giving a correct and definite answer to the question. Electrical equipments are in the best conditions in those territories where inspection departments have been in operation the greatest length of time. From this it follows that the East is in advance of the West in its endeavor to comprehensively control the electrical hazard."

Marconi Stations for Newfoundland.

It is announced that Mr. Marconi has sailed for St. Johns, Newfoundland, to carry out some experiments in connection with his system. During four weeks following his arrival various localities on the Newfoundland coast will be utilized in turn as stations, as one of the main points which it is hoped will be solved by his experiments is the extent of the influence natural surroundings have upon wireless telegraphic transmission. Weather conditions along this coast are notoriously bad, and electrical disturbances frequent, so Mr. Marconi will in all probability be able to study all the difficulties which at present confront the development of wireless telegraphy. As it would be tedious and expensive work to erect a huge mast at each spot selected for an experimental station, Mr. Marconi takes with him two balloons of 20,000 cubic feet capacity. These balloons will be used to suspend the aerial wire forming the shore station. With balloons it is obvious the experimenter can work with a longer aerial wire than with poles, and it is probable, weather conditions being favorable, that attempts to extend to its greatest distance the working radius of wireless telegraphy by utilizing an additional height for the wire will be made. Ordinarily the balloons will be kept about 150 ft. in the air, but may be used up to 300 ft.

The sea station will be on a steamer, equipped with a pole 120 ft. high. This steamer will work off the coast, steaming out to sea as far as communication with the shore station can be maintained. The effect of rocky shores, enclosed bays and fogs will be studied. Electrical disturbances at present form one of the most aggravating obstacles to distinct and uninterrupted communication, as when electric strays come in on the aerial wire mixed up with Morse signals it is impossible to read the tape or sounder. To discover a remedy for this defect also is one of the objects of Mr. Marconi's experiments. The steamer "Lake Champlain," of the Beaver line, which is equipped with Marconi apparatus, will be communicated with at the longest distances possible during her trips in and out of the Gulf of St. Lawrence. Mr. Marconi speaks of trying to do 250 or 300 miles, but does not promise success.

The first spot where experiments will be made is in the vicinity of St. Johns, on the northern coast lower promontory. There is already a Marconi station at Cape Race, 80 miles from St. Johns, but in order to satisfy himself on these points Mr. Marconi will move his basis of experiments from place to place between Cape Race and St. Johns, at the same time testing the difference in altitudes by comparison with the results from balloons.

An Anglo-American Building for England.

The action of an Anglo-American syndicate in applying to the London County Council for a 999 years' lease of a site on the north side of the Strand, for the erection of an office building on American lines, has caused much comment and interest. More than half the capital for the building is to come from America. Frederic B. Esler, of New York, practically promoted the whole affair. Sir Michael Farrant will be chairman of the company. Among the financial interests concerned in the project are the British Electric Traction Company and the New York & Brooklyn Tube Company. The inclusion of young Lieutenant George Cornwallis West in the directorate of the company is explained by the fact that since his marriage he has become a director of the British Electric Traction Company. He has displayed marked ability. Moreover, his wife (formerly Lady Randolph Churchill), is much interested in the office building scheme.

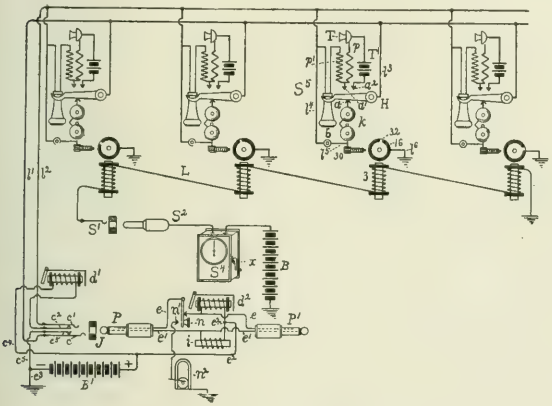
The project is discussed from various points of view. Many people share the views of William Waldorf Astor's *Pall Mall Gazette*, which throws cold water on the proposed "addition to that conglomeration of architectural chaos which is modern London." It fears that the mammoth building would deform the new thorough-

fare. The majority of the business community, however, share the views of *The Times*, which says: "We are far too slow in meeting the wants of the enormous population, and are far too much given to muddling along with timid extensions of methods essentially antiquated. The stay-at-home Englishman has a great deal to learn, and as his fine, insular superiority prevents him from learning by inspection what others are doing, the best thing possible for him is that others should come here and do things under his nose. Besides, the Americans owe us a good turn of this sort. We built many of their railroads and lost no small amount of money in the operation. It is only fair that they should energize our operations a little, though we have no desire that their experience here should be as unpleasant as that of many a British investor in wildcat lines over the water. They are really doing very well just now, setting up a magnificent electrical factory in the North, pushing the electrification of the underground roads, and interesting themselves in the 'tubes,' while American ideas and methods are largely recognized in the new telephone service."

New Telephone Patents.

Telephone patents of the issue of Nov. 19 number two only, but make up for lack of company in quantity of drawings and volume of specifications and claims. Both belong to the increasing class of inventions which aim to cheapen the use of the telephone by means of automatic devices to permit the economical use of plant and the saving of manual labor in operating.

A party-line selector system, invented by Thomas C. Drake, of Malta, Ohio, belongs to the family of party-line systems operated by selectors worked on a separate line from the telephone line proper. The system has been very thoroughly worked out, and so have others before it, but the cloven hoof of the extra line wire casts its blight on the commercial prospects of the genus. Mr. Drake provides a



PARTY-LINE SELECTOR SYSTEM.

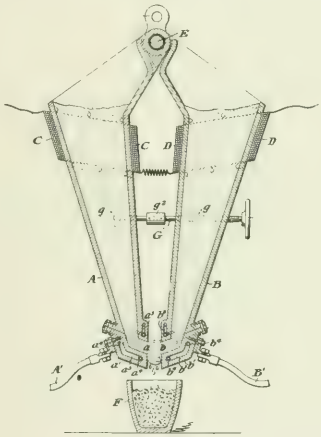
step-by-step selector designed so as to be operated for setting a contact by a "light" current, and to be released and returned to zero by a "heavy" current. The system does not provide for operation of the selectors by the stations on the line, but is operated by a central office.

In the normal state of the line the telephone circuits, both ringer and talking, are all open. A subscriber wishing to call the central office presses his push-button *b* and so closes the circuit through battery B^1, the line wires, his own bell and the line signal d^1. If no connection is already up he gets a single tap on his bell, which is normally held over by a light spring, so that a continuous current causes it to give a single stroke. When a connection is up the battery B^1 is cut out, and the subscriber on pressing his button gets no tap on his bell. He then knows that there is nothing doing, and that he must try again—or amuse himself by listening in. If the line is clear, however, he throws the line signal and the operator answers by inserting plug P^1 into the line jack *J* and pressing her listening key (not shown) in the usual manner.

To signal the station required she puts the selector plug S^3 into the selector line jack S^1 and operates the selector transmitter the required number of steps to bring the selector wheel 16 at the substation into contact with stop 30. This puts the bell at the substation to ground and the operator then inserts plug P^1 in the jack *J*, and rings the sub-station by means of ringing key *N*. The clearing-out signal d^2 shows when the called sub-station takes down and replaces his receiver, as it is energized by battery B^1 on a ground circuit which is made and broken by the closing and opening of the contact between the switch-hook *H* and the spring *A*. On receipt of the clearing-out signal the operator restores the selectors to zero by pressing a button, which throws the strong releasing current on the selector line.

Electric Furnace with Magnetic Field.

A patent has just been granted to Marcus Ruthenburg, of Philadelphia, Pa., for an electric furnace construction designed mainly for carrying into effect the inventor's method of agglomerating iron sand and similar magnetic ores, as described some two years ago. These ores, the purest source of iron at the command of the metallurgist, are exceedingly difficult of treatment, for their state of fine division not only checks the free passage through them of the furnace gases, but renders them liable to projection from the furnace by the intermittent bursting of the confined gases through the column. To agglomerate the sands into coherent but porous masses, capable of withstanding, until reduction occurs, not only the heat of the furnace but the unmeasured pressure of the supercumbent charge, is a difficult problem, and is further complicated by the necessity of avoiding, in the composition of the binding medium, any elements capable of affecting injuriously the quality of the separated metal. Mr. Ruthenburg's plan is to pass through a body of the magnetic sand an electric current of sufficient volume to weld together the contiguous edges of the grains, thus forming a porous mass of



ELECTRIC FURNACE WITH MAGNETIC FIELD.

pure ore without the use of any cementing medium or the introduction of any additional impurity.

The furnace is shown in the accompanying figure. Hoppers *A*, *B*, preferably of cast iron, pivotally suspended from a bar *E*, are provided with opposed delivery orifices *a*, *b*, the thrust-bar *G*, *g*, with an insulating section g^2, serving to bring the orifices into the desired relation. These hoppers constitute the opposed electrodes of the circuit *A′ B′*, and are magnetized by coils *C*, *D*, which may be connected in series with the fusing circuit or otherwise. The delivery end of each hopper is formed of a detachable shoe *a′ b′*, and means a^3, b^3, a^4, b^4, are provided for water cooling the parts adjacent to the heat zone.

The consequence of this disposition of apparatus is to constitute the hoppers and the magnetic ore contained therein the cores of opposed magnets, and the physical effect is to cause the magnetite to bridge the gap between the electrodes, there to be subjected to the maximum heating effect of the current, and to be fused or fritted, according to the temperature reached. A crucible *F* is suitably placed to receive the product. Other figures accompanying the patent show modified constructions, in which supporting devices co-operate with

the magnetic field to maintain the bridge, or in which means are provided for positively progressing the ore through the tubular magnets.

The patent affords no data regarding the strength of field necessary to maintain this bridge across the very heat zone of the furnace, nor does it discuss the question, vital as regards the practical operation of the method, of the relation between the critical temperature of the ore and the temperature at which the agglomeration occurs.

The Edison Storage Battery.

Ever since Dr. A. E. Kennelly read his admirable paper last May before the American Institute of Electrical Engineers, on the Edison iron-nickel storage battery, the keenest interest in the subject has been taken not alone by the electrical profession but by those engaged in many other fields of industrial application, notably that of automobilism. This interest has again been stimulated by the loan exhibit at the recent automobile show in Madison Square Garden of a complete cell of the battery. The cell was 12 inches high, 2 inches thick, 5 inches wide, and weighed 7½ lbs., giving 120 watt-hours, or 46 lbs. per horse-power-hour. The cell was also shown in its detail parts, and the steel plates excited much comment and surprise, being in sharp contrast to the familiar ones of lead.

The publicity given to Mr. Edison's work has led people to expect to buy the battery even now in the open market, and the disappointment expressed in many quarters is not fair to the distinguished inventor. The Kennelly paper was presented last spring against Mr. Edison's desire, but in compliance with an universal request that he would "show his hand" and tell the public what it was that he was working at in storage batteries. In the interval, Mr. Edison, who has always looked upon the Institute as the proper channel for these important communications, has maintained an absolute silence, but it would be the wildest mistake to suppose that he had also been idle. One thing can always be predicated about Mr. Edison, viz., that whether he talks or abstains from speech he is always hard at work. Indeed, although he has now reached the term of life where men of great achievement may rest on their laurels in dignified ease, it may be questioned whether he has ever followed up anything with more unrelenting zeal and enthusiasm than he has displayed in the unremitted work given to this his latest and, in some respects, his greatest invention.

Last June note was made in these pages of the formation of the Edison Storage Battery Company, with a capital of $1,000,000, and since then reference has been made to the establishment of a factory at Glen Ridge, N. J., not far from the Edison Laboratory, for the production of the battery. This means a good deal more than the superficial signs would indicate. At this present moment, the Glen Ridge factory is so far advanced that the manufacture of batteries will begin with the new year, and deliveries should come early in the spring. The inquiries and orders are such as to ensure that there will be no accumulation of the output, although provision has been made for an initial production of 100 horse-power capacity daily, although this Mr. Edison looks upon only as an entering wedge. The factory was originally a plant for the manufacture of fine jewelry, and some of its machinery is still available, but it has been thoroughly renovated and modernized, and a large amount of new machinery, tools, etc., has been put in. The main building is three stories, in addition to which there are large wings comprising machine shop, drying rooms, nickel-plating plant, etc. Dynamos, engines, boilers, etc., are already in place, and the machine shop has a fine equipment, including some special apparatus.

A mile or two away—the distance depending on which road you take—is the Edison chemical plant at Silver Lake. Here the well-known Edison-Lalande battery has been made for some years past, and now the chemical plant necessary for the new storage battery has been added. Several acres of land have also been acquired, the site being an ideal one for manufacturing uses, and the plan being to carry out here whatever extensive changes may be found necessary in the future, rather than in residential Glen Ridge, or in the crowded Edison works at Orange. Large shops have already been built at Silver Lake for the new enterprise. One of these will be devoted to the water distillation plant. Another will be devoted to the treatment of the nickel, and is already equipped with the necessary vats, etc. A third large shop is occupied by the plant for preparing the iron oxide and the graphite. All embody many novelties in construction and equipment, and show that not only has a master mind been actively employed on the various problems, but that no small amount of executive ability has been given to the task of preparation. Indeed, at the present time, the attention is incessant that is being given to the subject by Mr. Edison's staff, especially by Messrs. W. S. Mallory, W. E. Gilmore, F. R. Upton and J. M. Hill.

When interviewed on the subject last week, Mr. Edison expressed himself with the firmest conviction as to the real success he has attained in the new battery. Analyzing the cost of electric automobile operation, he pointed out that by far the largest percentage of cost lay in the element of depreciation. Under the most rigorous tests, subjected to the severest brutality that such an appliance could ever be supposed to endure in actual service, the element of depreciation, as shown by the records, appears to have dwindled to an inappreciable minimum. These tests now extend virtually over a couple of years, but are still being persisted in, with the object of determining any weakness, wherever it may lurk. As to the cost of the cell, Mr. Edison proposes to market it somewhere around the present cost of lead batteries. So far as can be ascertained, the type of cell noted above is the standard, such as would be used, for example, in automobile work. But it would appear that for stationary work far larger grids can be used; indeed, there is said to be no valid reason why they should not be 10 ft. high, or even as big as the side of a house. For separators between the plates, several successful types have been used, some of which are quite original. As a matter of fact the cell is so full of plates there is little room provided for either separators or the potash solution; but with plates so thin—one-tenth of an inch all told— the separators are naturally thin to be in keeping. The containing boxes are, as has already been noted, of steel. The weight of the solution is put at not to exceed 20 per cent of the plate weight.

The Institute Meeting and New Members.

The 150th meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street, New York City, Friday, Nov. 22, 1901, President Steinmetz in the chair, 200 members and guests being present. The general subject of the evening was "Methods of Distribution," upon which papers were presented by Messrs. Louis A. Ferguson, of Chicago; Henry G. Stott, of New York; Harold W. Buck, of Niagara Falls; Charles F. Scott, of Pittsburg; W. S. Barstow, of New York; W. L. R. Emmet, of Schenectady; Professor W. L. Robb, of Hartford, and Philippo Torchio, of New York. These papers are presented in abstract on page 891. The subject and papers were discussed by Messrs. Steinmetz, Dunn, Arthur Williams, Burnett, Henshaw and J. W. Lieb, Jr.

At the meeting of the board of directors in the afternoon the following associate members were elected: Cravath, James Raley, Western editor ELECTRICAL WORLD AND ENGINEER, 1139 Monadnock Block, Chicago, Ill.; Crossman, Gilbert, telephone engineer, Western Electric Company, 463 West Street, residence 80 Washington Square E., New York City; Dusenberre, George Brown, assistant to fourth vice-president Westinghouse Electric & Manufacturing Company, Pittsburg, residence Englewood Park, Pa.; Eastman, George Nial, in charge of testing laboratory, Chicago Edison Company, 139 Adams Street, Chicago, Ill.; Freudenberger, William Kaiser, chief electrician, the Colorado Fuel & Iron Company, residence 209 East Evans, Pueblo, Col.; Hamilton, Ralph Bergen, manager the Packard Electric Company, Limited, St. Catharines, Ont.; Hoopes, Maurice, mechanical engineer, J. G. White Company, 29 Broadway, residence 30 East Thirty-ninth Street, New York City; King, Harry R., electrical engineer, Western Electric Company, Chicago, Ill.; Lanphier, Robert Carr, superintendent and electrician, Sangamo Electric Company, Springfield, Ill.; Ludvigsen, Hans Valdemar, electro-chemical engineer, Blaagaardsgade 17 Copenhagen, residence Straudvejen 119, Hellerup, Denmark; Nesbit, Joseph Newton Gray, superintendent winding department Warren Electric Manufacturing Company, 416 Fulton Street, Sandusky, Ohio; O'Brien, Albert Dallam, assistant New York & New Jersey Telephone Company, 15 Dey Street, New York City, residence 151 Columbia Heights, Brooklyn, N. Y.; Pott, Arthur Henry, consulting engineer, with Preece & Cardew, residence 81 Cornwall Gardens, S. W., Queensgate, London, England; Reuterdahl, Arvid, president and chief engineer the Reuterdahl Electric Company, residence 366 Willard Avenue, Providence, R. I.; Ruchgaber, Albert Felix, draughtsman, Rapid Transit Subway Construction Company, residence 373 Carlton Avenue, Brooklyn, N. Y.; Rus-

sel, Edgar, captain Signal Corps, U. S. A. War Department, Washington, D. C.; Schildhauer, Edward, engineering department Chicago Edison Company, 139 Adams Street, Chicago, Ill.; Schmidt, Lambert, president the Lambert Schmidt Telephone Manufacturing Company, 32 Broadway, New York City, residence 138 Schippen Street, Weehawken, N. J.; Soren, Townsend Hodges, electrical engineer, General Electric Company, Schenectady, N. Y.; Tannatt, Eben Tappan, managing civil and electrical engineer the Oahu College Trustees, P. O. box 92 Honolulu, H. Ty.; Van Dyck, William Van Bergin, electrical engineer and contractor, residence 439 Manhattan Avenue, New York City; Weymouth, Thomas Rote, electrical engineer, International Hydraulic Company, 40 Wall Street, residence 80 Washington Square E., New York City; Zwietusch, Edward Otto, electrical engineer, Telephon Apparat Fabric Petsch, Zwietusch & Co., Salzufer 7, Charlottenburg, Germany.

CURRENT NEWS AND NOTES.

ENGINE BUILDERS' MEETING.—The Engine Builders' Association of the United States will hold a meeting at Sherry's, Fifth Avenue, New York City, Dec. 2-3, to be followed by dinner at the same place on Dec. 3 at 8 P. M.

UNDERWRITERS' ELECTRIC MEETING.—The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the New York board rooms, 32 Nassau Street, beginning 10 A. M. Tuesday, Dec. 3.

MUNICIPAL ELECTRICIANS.—There will be a meeting of the executive committee of the International Association of Municipal Electricians, this week at Corning, to select and assign papers to be read at the meeting at Richmond, Va., next year.

ELECTRICITY AND CANCER.—Professor John E. Gilman, of the Hahnemann Medical College, Chicago, is responsible for a renewal of the statement that the Röntgen ray is a cure for cancer. He claims to have made successful treatment in several "incurable" cases.

THE SUBMARINE BOAT "FULTON," built by the Electric Boat Company, made a stay of 15 hours continuously under water on Nov. 23-24, at Cutchogue, L. I., with a crew and two officers of the Navy. The test which has not yet been officially reported upon, appears to have been quite successful. The submersion is said to be by far the longest on record.

MEETING OF MECHANICAL ENGINEERS.—The American Society of Mechanical Engineers will hold a meeting Dec. 3-6 at its headquarters in New York City. A number of interesting papers are listed as usual. The committee on standardization of dynamos and engines will also report. A feature will be the dedication of the memorial to Robert Fulton in Trinity Churchyard.

PRIZE FOR SUBMARINE.—A special cable dispatch from Paris says that the sexagenarian, M. Goubet, who is popularly dubbed the "father of submarines," is going to receive a prize of $20,000, given by a philanthropist, M. Osiris, for the most notable invention shown at the last Paris Exhibition. As nothing there was considered worthy, the prize was handed to the Paris Press Association, whose choice, it is expected, will fall on M. Goubet.

FISH BITE IN CABLE.—The Eastern Extension Telegraph Company has brought to notice an interesting fact in connection with the interruptions occurring in submarine telegraph cables. A fault removed a few months ago from the company's Sydney-Nelson section at as great a depth as 330 fathoms, was found to contain a tooth firmly fixed in the core of the cable, although the core was protected by the usual sheathing of thick iron wires and outer coverings. An expert examination of the tooth proved it to belong to a species of shark, the exact variety of which could not be identified; but it appears that five known varieties of sharks are found to exist at a depth of 300 fathoms, and one at a depth of even 500 fathoms.

ELECTRIC STAGES FOR NEW YORK.—Six new electric stages, each with a seating capacity of 17 persons, will be put into service this week on Fifth Avenue by the New York Electric Vehicle Transportation Company. Within another week two more will be ready, and soon there will be two "double-decker" stages, each seating 34 persons. The horse stages will continue, as at present, making trips at two-minute intervals, while the electric stages will run on a schedule of their own, ten minutes apart. As they are capable of a speed greater than that of the horses, they should be able to pass several of the old type in the course of each trip. They will make about 80 miles a day.

LONDON UNDERGROUND PLANS.—Mr. Charles T. Yerkes, in the course of an interview published in *The Daily Mail*, as he left London for New York, reveals a scheme to run a deep level express line underneath the existing Metropolitan district road. Mr. Yerkes says the contracts have been signed, and that work will be begun shortly. Commenting upon the multiplicity of locomotion schemes for London that are coming before Parliament, *The Times* says: "There is danger of repeating the mistake made above ground and of allowing things to be done piecemeal, instead of subordinating all to a general plan. A careful study of the experience of New York would be of immense benefit to the metropolis. The Americans have thrown away a good many expensive plants and are now embarking upon larger enterprises than ever; and consequently they are an exceedingly useful people to study."

TRACTION CONCESSION IN CHINA.—Mr. Conger, the United States Minister in Pekin, has protested, it is reported, against a concession which the Canton Viceroy has granted to a French company for an electric railway from Canton to Wu-Chau, on the ground that it violates Wu Ting Fang's contracts with the American syndicate, which has the concession for the Canton-Hankow line. The French Minister is pressing China to ratify the concession, arguing that the American contract has been forfeited by the sale of a controlling share of the original stock to the Belgians. The question is further complicated by the fact that Sheng has contracted with a German firm to supply cash and materials to the value of $1,000,000 for the construction of the Ping-Hsiang Branch Line, which also is contrary to the terms of the Washington contract. Mr. Conger is awaiting instructions from Washington on this point.

USE OF MOLDING MACHINERY.—At the recent meeting of the National Founders' Association in New York City, on the question whether the molding machine, for a complicated class of machinery, was a profitable investment, Mr. G. E. Emmons, of the General Electric Company, of Schenectady, opened the debate by stating that after considerable reluctance he adopted the molding machine, not meeting with success until he obtained a trained operator of the machines to supervise their operation. Since then, he said, their adoption has been most successful. Intricate and comparatively large castings are being turned out on the machines now, and, while upward of 60 of them are now in use at the Schenectady shops, the number is constantly being increased. He produced figures showing the adoption of the machines to be a very profitable investment. Mr. Emmons stated that his experience showed that the molders on certain difficult work were obtaining better results than did the laborers first employed.

ANTI-HUNTING DAMPER.—The employment of eddy current circuits in connection with alternating-current machines is not a new development, but recently they have come into prominence in various forms as anti-hunting devices. As far back as 1892 an eddy-current circuit was employed on a type of Stanley motor, in this case consisting of copper bars sunk flush in the stator and at each end connected to a copper ring. Similar to this is a well-known squirrel-cage "amortisseur" of Maurice Leblanc. Within the past few years several special forms of dampening devices have been described, principally in connection with rotary converters. One of these consists of a copper bridge between the poles, another of a copper ring surrounding the poles, and the third of a copper sheathing covering entirely or partially the pole face and extending over the edges. A patent issued Nov. 19 to A. D. Lunt describes still another form, which consists of a copper case or sheathing applied only to the pole tips. The sheathing or tip case is fashioned to fit neatly about the tip and is secured thereto by a bolt at each end.

RUBBER IN VENEZUELA is the subject of a most interesting report in the Consular Bulletins of the State Department from Consul Goldschmidt, of La Guayra. It embodies a description of the caoutchouc of the Upper Orinoco by Dr. Lucien Morisse, who says that 50,000 emigrants could easily be employed in the forests gathering the gum, and cutting the trees, without any injury to the permanence of the supply.

TRANSMISSION IN CALIFORNIA.—Before the close of November, the Standard Electric Company, of California, expects to complete its high-tension line into the Eighth Street sub-station in San Francisco. When this is completed there will be ready for disposal in San Francisco electrical energy developed on the Yuba River and conveyed via the lines of the two great transmission companies, the Bay Counties Power Company and the Standard Electric Company, a distance of 222 miles.

A CURTAIN ROD TIES UP THE BOSTON ELEVATED.—A curious accident occurred in Boston a few days ago, resulting, it is stated, in considerable damage to the electrical equipment of the Boston Elevated Railway. A woman, evidently on a shopping tour, was carrying home a couple of brass curtain rods, one of which dropped on the track at the Sullivan Square terminal. It fell across the third rail and one of the traction rails, and short circuited the system. Considerable insulation was destroyed and traffic was interrupted for some time.

A HIGH-SPEED ROAD FOR CHICAGO.—The Aurora, Elgin & Chicago Railway, now being built, will employ a third rail weighing 100 lbs. per yard. This road is to give a high-speed service between Chicago, Aurora and Elgin by way of Wheaton. The track is being laid with a view of maintaining a maximum speed of 70 miles an hour on the level, and the motor equipments which have been ordered are designed for that speed. The General Electric train control system is to be used on the cars, and there are to be four 125-hp motors on each car.

ELECTIONEERING BY PHONOGRAPH.—It is stated that a candidate for municipal honors in Sheffield, England, has latley been putting his views before the electors by means of a phonograph. At a recent Parliamentary election in Victoria, one of the candidates shirked the task of personally airing his views by sending a phonograph around the various townships in charge of a man on horseback. The electors, however, resented the application of this time-saving method, and left the owner of the machine at the bottom of the poll. The main difficulty seems to lie in the fact that, while the phonograph will render a speech plainly enough, it cannot be heckled or made to reply to questions.

TALKING TO MARS.—In a recent lecture in Philadelphia, Sir Robert Ball is reported to have utterly discredited any idea of "talking with Mars." Sir Robert estimated that to signal Mars so as to be seen by a Martian astronomer who happened to be looking this way, using the wigwag system, we should need a flag 300 miles long and 200 miles wide, waved from a staff 500 miles long. Flashlight signaling he considers equally impracticable. If Lake Superior could be filled with petroleum and set on fire, the resulting blaze might be discerned as a speck of light, but not sufficiently prominent to suggest that anything unusual was in progress. He does not appear to have considered electrical means worthy of discussion.

REGULATION OF ALTERNATING CIRCUITS.—A patent issued Nov. 19 to A. R. Everest describes a means for regulating the voltage of an alternating-current circuit, whereby with a constant generator voltage the voltage of the distributing circuit may be kept constant at all loads, or may increase with increase of load, in the latter case corresponding to the effect of over-compounding at a generator. In the simplest form an inductance is used in one leg of the circuit to be regulated, and another beyond the first in shunt across the circuit. The first-mentioned inductance is designed so that its core is saturated throughout the full range of the load, while the shunt inductance has its coil so proportioned that its core remains unsaturated during normal operation. In other applications of the principle a compensator is connected across the distributing circuit, and one end of the generator circuit connected to an intermediate point of the compensating coil. In still a third application a condenser is added in shunt to the saturated inductance, a compensator being also used.

CONDENSER SINGLE-PHASE MOTOR.—In most single-phase motor starting devices the torque is a minimum at starting, but with increasing speed is increased by the addition of the torque produced by the armature reaction of the motor, which finally preponderates. For purposes of comparison it is, therefore, desirable to compare motor-starting devices only with respect to the torque which they produce at the moment of starting. In a patent granted Nov. 19 to Charles P. Steinmetz it is stated that when a phase displacement for starting is produced through the agency of self-induction in series with a main or mains, he has found it impossible in the cases of a motor with a quarter-phase winding to obtain a symmetrical quarter-pahse system for starting, without which the starting torque is not as large as would otherwise be the case. He has discovered, however, that by the use of a condenser or a device possessing effective capacity, the impressing circuits of the starting device may be so adjusted as to produce e. m. f.'s equal in value to each other and displaced in phase by 90 degs., thereby securing a marked increase in starting torque. As illustrated applied to a single-phase squirrel-cage motor as a quarter-phase starting device, a condenser is connected at one side to the middle point of the field winding and at the other side to a "compensator" across the mains. The compensator appears to be a choke coil, and it is stated that it may be replaced by the secondary winding of a transformer.

LETTERS TO THE EDITORS.

Modified Three-Wire System.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Aug. 3 I notice a paragraph on a modified three-wire system patented July 23, consisting of two compound generators used in the ordinary way on two sides of a three-wire system, and a third, or more, double-voltage machine used between the two outers, all the machines being compounded and the outer brushes connected by an equalizing wire.

For my firm I have installed a plant on exactly the same lines, which was running in November, 1900. It was originally a simple two-wire system, with two compound machines, their brushes being connected by an equalizing wire. It was then decided to increase the plant, and, acting as engineer for the Boulder City Council and for my firm, I had it changed to a three-wire system, and added on a third machine at 440 volts, and used this machine with the equalizing wires in the manner stated. The plant has worked successfully ever since, the regulation being excellent.

I do not know of any other plant in this country run in this fashion, and I have never heard of any before. All the machines and engines were supplied by the B. F. Sturtevant Company, of Boston, and have given every satisfaction.

PERTH, WEST AUSTRALIA. L. J. B. WALL.

Electrical Engineering in England.

To the Editors of Electrical World and Engineer:

Sirs.—I was not a little surprised to see an article in a recent Export Issue of your paper by Mr. E. Kilburn Scott regarding the conditions of electrical factories in Great Britain and the incompetence of electrical engineers in general. The article is one which, considering Mr. Scott's own position and his own education in the business, had better never have been written by him. And any criticism of this nature would have come better from other pens. As a matter of fact, Mr. Scott is quite wrong in many of his statements, and in conversation is quite willing to admit that many of the electrical factories in Great Britain are first rate in every particular.

Your correspondent, during the two years which he has been in Great Britain, has visited personally a great many of the factories of electrical manufacturers in Great Britain, and he is quite prepared to

state that they compare extremely favorably with factories either in the United States or on the Continent. There could not possibly be a better factory than that of the English Electrical Manufacturing Company and the factories of the Electric Construction Company, Thomas Parker, Limited, Ferranti, the Brush Electrical Engineering Company, Bruce Peebles & Co., Newton Electrical Works, and Electro-Motors, Limited, and a number of others leave almost nothing to be desired for the amount of business which they are doing. It is quite true that some of the older companies have plants which are to a certain extent obsolete, but many of them are making arrangements for new factories, or are already building them, and within the next year or two there will be in Great Britain some of the best electrical factories that it would be possible to see anywhere.

London, England. A. C. Shaw.

DIGEST
of
Current Electrical Literature.

Dynamos, Motors and Transformers.

Induction Motors with Phase Compensation for High-Speed Railroads.—Heyland.—He refers to Reichel's description of the induction motor of Siemens & Halske for the experimental high-speed railroad (Electrical World and Engineer, Nov. 2). It was required that the motor should start at three times the normal load. This is accomplished by switching the motor from the normal e. m. f. of 1150 volts over to 1850 volts. At the same time the power factor decreases from 0.9 to 0.75. He shows that it is an inherent disadvantage of the ordinary induction motor that it cannot be designed in such a way that it works with uniform efficiency for wide variations of load. Favorable conditions for one load mean unfavorable conditions for another load. He says that his induction motor "with phase compensation" (Digest, Aug. 31, also Electrical World and Engineer, Sept. 28, page 492), could be used for such purposes to good advantage. One might say that the power factor does not become unity, before the motor has approximately attained its speed. This is true, but it is possible to design the motor so that its maximum power factor without compensation is obtained for that overload at which it is to start. What the value of the power factor would be at normal operation, is of no account, as then the compensation of the phase difference renders the power factor equal to unity. Such a motor would have very favorable dimensions—a strong field, few windings, shallow slots, low straying, and an excellent power factor when starting with overload. The available space can be made use of to obtain the best efficiency and the least heating, one does not have to take into account the power factor. The compensating device can be restricted to a small space, and is best connected directly to the transformer. After it has been put in its place no more attention or regulation is required. There is no switching over after starting; the motor starts with a power factor equal to 0.9, which then goes over to unity. Another great advantage is the electric braking, which is just as simple as for the direct-current motor. The ordinary induction motor as used in the Siemens & Halske high-speed railroad car requires two processes of switching, and a storage battery besides. With the compensated induction motor, however, it is only necessary to switch the primary leads to a rheostat, exactly as with a direct-current shunt-wound motor. He gives the following comparison of the ordinary induction motor and his compensated motor: When started at three times the normal load, the ordinary motor has a power factor 0.75 and requires one process of switching, his compensated motor starts with a power factor 0.9 and requires no switching. At full load the ordinary motor has a power factor 0.9, his compensated motor a power factor equal to unity. When running below full load, the ordinary motor has a power factor smaller than 0.9, his motor has a power factor equal to unity. The no-load current is 50 amperes for the ordinary motor and 3 amperes for his motor. The efficiency is 95 per cent for both motors. Breaking requires two processes of switching and a storage battery with the ordinary motor, and a single process of switching without battery with his motor. Hence his compensated motor only betters the conditions and does not deteriorate them in any way. He promises a further article, "When the results of the tests of the experimental motors will have been collected."—*Elek. Zeit.*, Nov. 7.

Rotary Converters vs. Motor Generators.—H. S. Meyer.—An article criticizing some statements in the article in Electrical World and Engineer, Sept. 21, page 460, in which motor-generators of both the synchronous and the induction types made by the Oerlikon Company were compared with rotary converters and the necessary step-down transformers of some other make. He says that the comparison of machines of entirely different makes does not lead to satisfactory figures. In the case of motor-generator sets, the figures given for the efficiency are taken from curves, obtained either by calculation or tests, while the figures for the rotary converter are values guaranteed by some American manufacturer. As it is common practice in the United States to allow, in all guarantees concerning electrical constants of a machine, a safe margin of ½ to 1 per cent under the value obtained in actual test, the comparison should be corrected from this point of view. If this is done, a decided advantage appears on the side of the rotary converter. It should furthermore be borne in mind that the motor-generator sets seem to be built on special order, while the rotaries and transformers quoted are of standard make. The comparison of heating constants also shows inconsistency, as values obtained from actual tests after a full-load run of 10 hours, are compared with guaranteed limits, which can only refer to tests of a much severer character, corresponding to the standard American heating guarantees for this class of machine. Regarding weight, the advantage is also in favor of the rotary converter, and he gives figures to show that the same is the case regarding cost. He estimates that for a 300-kw plant, a saving of $2,400 to $3,300 is in capital outlay effected by the choice of rotary converters instead of motor-generators. Finally, regarding the floor space required, the rotary converter is again preferable, as the transformers can be located either in the basement or on an elevation in the sub-station, leaving only the rotaries to be placed on easily accessible ground. With the motor-generator proposition, more than double the actual floor space is required for the two machines. Other favorable points of the rotary converter are the large overload capacity and the easy method of compounding on the alternating-current side by phase control. He agrees, however, that in certain cases the motor-generator is to be preferred. He concludes that both classes of machines have their field, but wherever possible, from the requirements of the system, a rotary converter should be given the preference as being cheaper, more efficient, and taking less floor space. In an editorial note it is said that to make Meyer's statement regarding costs conclusive, it would be necessary to work out the yearly sum required for attendance in each case. In actual practice the type of machine used will often be decided on the unquestioned merit of simplicity of working in the cases of the motor-generator, or small floor space required in the case of rotary converter.—Lond. *Elec.*, Nov. 1.

Calculation of Polyphase Generators.—Pichelmayer.—An illustrated article on the determination of the armature stray field. This is difficult to calculate, but can be determined with sufficient exactness by means of experiments with actual machines, the results of which can be used later for the calculation of similar machines. He gives a simple formula, containing a coefficient, which he has determined for various types. The values of this coefficient, thus determined by experiment, are given in a table. Another method for determining the stray field is as follows: If the magnet system is removed and the stator winding is supplied with the supply current, the e. m. f. required for driving the supply current through the winding, is very nearly equal to the e. m. f. of straying. This experiment must be made with the same frequency as that intended to be used with that machine.—*Elek. Zeit.*, Oct. 31.

REFERENCE.

Coupling.—An illustrated description of the Zodel elastic and insulating coupling by means of which the dynamos are connected to the turbines in the power stations of the Jungfrau Railroad.—*L'Ind. Elec.*, Oct. 25.

POWER.

REFERENCES.

Mechanical Applications of Electricity.—RICHARD.—An article giving illustrated descriptions, taken from patent specifications, of several new inventions—the Hopkinson drill, the Liebert electromagnetic control of machine tools, the Weyland-Smith system of automatic regulation of rolling mills, the Quimby electric pump, the Thomson-Houston automatic valve for electric pumps, and the Hewlett automatic regulator for compressed air canalizations.—*L'Eclairage Elec.*, Oct. 12.

Snoqualmie Transmission.—An illustrated article on "Æsthetics in and extensions of the Snoqualmie transmission," especially a description of the new sub-station of the Seattle Cataract Company and the Tacoma Cataract Company.—*Jour. of Elec.*, Oct.

TRACTION.

REFERENCES.

High-Speed Electric Railways.—CARUS-WILSON.—The first part of an illustrated article on the experiments made by the German Association for the Study of Electrical High-Speed Railways, and on the two experimental cars built by this association, which have been fully described in ELECTRICAL WORLD AND ENGINEER. In some editorial notes it is said that apparently the electrical and mechanical difficulties attending the construction of the car have been so successfully overcome that failure to attain a speed of 120 miles an hour need hardly be apprehended, and that the really serious difficulties will probably be found in the track.—Lond. *Elec.*, Nov. 1.

St. Louis.—A long illustrated description of the new power stations of the St. Louis Transit Company. After the street railway companies of St. Louis were consolidated, two new modern power plants were built which replace 11 old stations, four of which were cable power houses. There is also one rotary converter sub-station where three-phase currents are changed into direct current. The article is well illustrated by diagrams.—*St. R'y Rev.*, Nov.

Contact Device for Feeding Automobiles from Overhead Wires.—REYVAL.—An illustrated description of the Vedovelli contact device by which automobiles are supplied with current from two overhead wires. It is a small carriage running on the two overhead wires as rails.—*L'Eclairage Elec.*, Oct. 12.

Automobile.—GASNIER.—An article in which he calls attention to the fact that in a competitive test, arranged by a French automobile journal in 1899 and 1900, it was found that in the present automobiles about one-half of the power generated by the motors is lost in the gearing. It is, therefore, of importance to have exact methods of measuring the power available at the wheels of an automobile. He describes at some length the method used for this purpose in the contest mentioned above, and a new improved method.—*L'Ind. Elec.*, Oct. 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Switches.—KENNELLY.—An abstract of a lecture given at Sibley College, Cornell. The character of an installation is clearly indicated by the form of switching devices used. Among the most interesting forms of switch are the very satisfactory modern oil immersed switches for extremely high-tension service. A noticeable feature of all of the modern switches for opening high-tension circuits is their extreme simplicity, the main endeavor being to obtain a long break, with safety to surrounding apparatus and to the attendants. The switches for manipulating circuits of large current-carrying capacity at moderate pressures are much more complicated in mechanism on account of the massiveness of the parts and of the mechanical force necessary to operate them. There is a peculiar danger in the handling of large alternating currents, especially in the opening of heavy overloads or short circuits. The energy stored in the medium about the circuit is one-half the inductance multiplied by the square of the current, and this energy must be dissipated while the switch is being opened. If the operator happens to open the switch when the current is passing through zero, no trouble can result. But if the circuit is broken when the current is at or near maximum, its potential energy is very great. The only possible disposition of this energy after the circuit is open, is in the electrostatic form with the result that in circuits of large inductance and small capacity the pressures generated may be dangerously high, amounting to many times the normal circuit pressure. This effect must be distinguished from that known as resonance in which the reactance due to inductance and capacity balance at a certain frequency, and hence give rise to great local pressures.—*Sibley Jour.*, Nov.

REFERENCES.

Trafford Park.—The first part of an illustrated article on the supply of electric power, light and fuel gas in Trafford Park, Manchester. Direct-current generators, assisted by motor-driven balancers, supply the local area by means of a three-wire network with 500 volts between the outers. To areas further away, three-phase currents will be transmitted, which will then be changed to low-tension direct current by means of motor-generators. The generating plant at present in use consists of two sets, each of 1000 horse-power.—Lond. *Elec. Rev.*, Nov. 1.

Narragansett.—A long and well illustrated description of the Narragansett Elec. Lighting Co.'s system, which furnishes light and motive power for half of the State of Rhode Island.—*Elec. Rev.*, Nov. 9.

German Plant.—WINAWER.—An illustrated description of the plant supplying current to Niederbronn and Reichshofen, two small German towns at a distance of a mile from each other. The three-wire direct-current system, with 440 volts between the outers, is used. Two thousand incandescent lamps of 16 to 25 candles, 30 arc lamps, and some motors of together 30 horse-power, are supplied from a steam-driven dynamo.—*Zeit. f. Elek.*, Oct. 20.

Mill Installation.—BENTOM.—An illustrated description of the electric installation of a cellulose plant and a paper mill in Cosel, Germany. The three-wire direct-current system, with 220 volts between the outers, is used for lighting, direct current at 220 volts for traction, while three-phase currents are used for transmission.—*L'Eclairage Elec.*, Oct. 26.

Combined Lighting and Traction Switchboard.—An illustrated description of the Ferranti switchboard for a combined 460-volt lighting and 500-volt traction system.—Lond. *Elec.*, Nov. 8.

WIRES, WIRING AND CONDUITS.

Wiring Rules.—WORDINGHAM.—He distinguishes between wiring rules and supply rules. Wiring rules properly deal with the details of the devices employed to utilize a supply of electrical energy, with the means adopted to control the supply to such devices and with the provision, fixing and protection of the conductors for distributing the energy within the premises, to which the supply is given. He discusses the question of wiring rules and supply rules under the present legal conditions in Great Britain. Central station engineers should make and enforce such regulations as are necessary to ensure a satisfactory supply of energy to all classes of consumers, they should give their active support to the carrying out of essential rules as to the wiring of their consumers' premises as laid down by the (Brit.) Inst. Elec. Eng., and should rigorously abstain from interfering in petty non-essential details. The same issue contains two letters by Jeckel and Wilmshurst, on wiring regulations.—Lond. *Elec.*, Nov. 8.

REFERENCES.

Calculating Polyphase Circuits.—An article giving formulas for calculating the sizes of wires for two-phase and three-phase circuits. —*Jour. of Elec.*, Oct.

Conduits.—SULLIVAN.—An article on interior conduit construction and the national electrical code.—*Elec. Rev.*, Nov. 16.

ELECTRO-PHYSICS AND MAGNETISM.

Electron Idea.—KAUFMANN.—A lecture on the development of the electron idea. The modern theory of electrical and allied optical phenomena, which may be summarized under the name of the electron theory, means practically a return to views as laid down in the sixties and seventies by Weber and Zoellner, but modified by the results of Maxwell's and Hertz's researches. The various theoretical and experimental researches which have led to the electron theory, are briefly summarized in a review which is quite interesting, but cannot be abstracted. As is well known, the theory supposes the existence of negatively charged "electrons" of a mass of about one two-thousandth of the mass of an atom of hydrogen, while the positive charge is always associated with the more massive atom, as a whole. This view completely obviates an objection which was formerly used to disprove the ionic theory of gaseous conduction. It had been asked, how it could be possible for a monatomic gas, say, mercury, to dissociate itself into ions. The answer is: Not into electrolytic

ions, but into a positively charged atom and a negative electron; both together form the neutral monatomic molecule. The paper is discussed in an editorial at the end of which the practical usefulness of the electron theory is discussed. To prove that the electron theory may have practical utility, the following argument is given. "Since the discovery of the electron has been made independently of Röntgen's discovery of his famous rays, it is conceivable that the fully enunciated electron idea might have been published before Röntgen made his discovery. In that case it would have been possible to have predicted the Röntgen rays, to have predetermined their properties, and subsequently to have constructed apparatus for their manufacture for any practical purpose."—Lond. *Elec.*, Nov. 8.

Tesla's Artificial Lightning.—H. J. RYAN.—A reproduction of a photograph of Tesla, sitting in his laboratory amidst a shower of electrical discharges. "It is said that the length of the path that these sparks traversed is about 70 ft. It is well-known that at high pressures approximately 15,000 volts are required to break down each inch of air at common temperatures and pressures. This amounts to 180,000 volts to the foot. From this we see that the pressure required to produce a 70-ft. spark must be about 12,600,000 volts." The use of such high pressures for wireless telegraphy and transmission of waves in general is pointed out. Tesla's ambition is said to be to work out a "reliable method for the efficient and continuous development of high-pressure, high-frequency currents, after which he would in due course expect to work out a system for the long-distance transmission of power, using the universal atmosphere as the medium of propagation of the electrical energy by the transmission of such energy either as dielectric flux or magnetic flux—details to be decided upon after a satisfactory source of high-pressure high-frequency current has been povided."—*Sibley Jour.*, Nov.

Thermoelectric Force and Electric Resistance.—HARRISON.—An abstract of a Brit. Phys. Soc. paper on the variation with temperature of the thermoelectric force and of the electric resistance of nickel, iron and copper, between the temperatures of —200 degs. and + 1050 degs. The curves for variation of the thermo e. m. f.'s with the temperature of copper-nickel and coper-iron couples are roughly a straight line and a parabola respectively. The electric resistance of nickel increases with the temperature almost parabolically up to 370 degs., when a change of slope occurs and the resistance increases much less rapidly and almost linearly up to 1050 degs. In the case of iron the resistance curve does not change its parabolic form till nearly 800 degs., when it becomes linear and remains so up to 1050 degs. He concludes that the thermoelectric change in nickel-copper coincides approximately with the resistance change, but that no thermoelectric peculiarity exists for iron-copper at the temperature of the iron resistance change.—Lond. *Elec.*, Nov. 1.

Susceptibility of Ferric Chloride.—MOSLER.—An account of an investigation of the temperature coefficient of the magnetic susceptibility of ferric chloride with varying concentration. A 10-per-cent solution has a temperature coefficient of 0.00268, at 28 per cent there is a sudden increase, and at 33 per cent a maximum of 0.00358 is attained. The original value is regained at a concentration of 41 per cent.—*Ann. der Phys.*, No. 9; abstracted in Lond. *Elec.*, Oct. 25.

Magnetic Induction in Crystals.—WALLCRANT.—The permeability of crystals depends upon their position in the magnetic field. It may happen, as in the case of pyrrhotine, that a crystal is entirely non-magnetic when the direction of the field coincides with the ternary axis of the crystal, though the same crystal will show decided magnetization in other positions. The present author shows that this behavior can well be represented by mathematical formulas.—*Comptes Rendus*, Oct. 21; abstracted in Lond. *Elèc.*, Nov. 8.

Magnetization and Modulus of Elasticity.—TANGL.—An account of an investigation of the relation between longitudinal elasticity and magnetization. If a wire is magnetized under constant tension it changes its length. If it is magnetized in such a manner that its length remains constant, the tension varies. The ratio between the two alterations is proportional to the modulus of elasticity under the magnetization applied. This is the principle on which his measurements are based. The results go to show that magnetization increases the modulus.—*Ann. der Physik*, No. 9; abstracted in Lond. *Elec.*, Oct. 25.

REFERENCES.

Electric Waves.—ABRAHAM.—A discussion of the theory of the propagation of electric waves along wires. He distinguishes two cases, in the first of which the return current is a pure conduction current, and in the second, displacement currents also come into action. He discusses the relation between the conditions of propagation and the electromagnetic energy of the waves.—*Ann. der Phys.*, No. 10; abstracted in Lond. *Elec.*, Nov. 8.

Dielectric Strain.—MORE.—A note on dielectric strain, in which he replies to the criticism of Sacerdote, noticed before in the Digest.—*Phil. Mag.*, Nov.

Point Discharges.—TAMM.—An investigation of the manner in which the amount of electricity discharged by a point maintained at a certain potential, depends upon the moisture and pressure of the surrounding air.—*Ann. der Physik*, No. 10; abstracted in Lond. *Elec.*, Oct. 25.

Fluoroscope.—CALDWELL.—An illustrated article on a new method of obtaining stereoscopic effects in the fluoroscope.—*Elec. Rev.*, Nov. 16.

Bismuth.—LOWNDS.—An account of an investigation of "the thermomagnetic and thermoelectric properties of crystalline bismuth." He studied the longitudinal and transversal thermomagnetic phenomena and the thermoelectric force with relation to copper.—*Phil. Mag.*, Oct.

Magnetic Induction.—BUCHANAN.—A brief "contribution to the theory of magnetic induction in iron and other metals." It is a continuation of a former paper, in which he gave a general theory. He now applies the theory to some of Ewing's experimental results. The curves for annealed iron and for hardened iron are subjected to harmonic analysis.—*Phil. Mag.*, Nov.

Terrestrial Magnetism.—The October issue contains a German paper by Ebert, on the distribution of the electric ions in the higher layers of the atmosphere; an illustrated description of the Lloyd-Creak dip circle for observations at sea; several reports by Kesslitz, Moureaux, Haga, Snellen and van Rijckevorsel on the magnetic observations made during the total solar eclipse of May 17, 18, 1901, in several observatories in Austria, France and Holland; also a biographical sketch with portrait of Professor von Bezold.—*Terr. Mag.*, Oct.

ELECTRO-CHEMISTRY AND BATTERIES.

Dielectric Constants of Pure Solvents.—SCHLUNDT.—Nernst and Thomson have deduced the rule that, other things being equal, the greater the dielectric constant of a medium, the greater is its dissociating power. The present author had made an extended study of the dielectric constants of pure solvents. A number of new examples have been found which follow the Nernst-Thomsen rule, but also some striking exceptions which show that the rule is inadequate. The exceptions indicate that the nature of the solvent, as well as the dissolved substance, are of prime importance in determining whether a solvent will conduct electricity. Other results of the investigation are: The value of the dielectric constants for the homologous series of compounds examined, decrease with increase of molecular weight. The introduction of the cyanogen group in a compound causes a marked increase in the value of the dielectric constant. In this respect the cyanogen radical produces a greater effect than all other radicals which have hitherto been systematically studied.—*Jour. Phys. Chem.*, Oct.

REFERENCES.

Increasing the Capacity of Accumulators.—HEIM.—An illustrated translation in abstract of his German paper on the influence of temperature on the capacity of accumulators which was noticed recently in the Digest.—Lond. *Elec.*, Nov. 1.

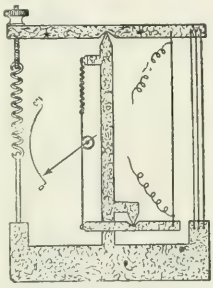
Influence of Electrical Waves on Chemical Action.—LENGFELD and RANSOM.—A brief note on some preliminary experiments in which they studied the influence of electrical waves of 300 meters length upon chemical action. The results so far showed no influence.—*Jour. Phys. Chem.*, Oct.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Absolute Measurement of Self-Inductance.—DUANE.—A description of a method of measuring the absolute value of the self-induction of a coil without using a standard of self-induction or of capacity. Suppose the coil is wound in two parts. If the current flows in the same direction through both coils in series the self-inductance of the whole, which may be called *I*, is the sum of the self-inductances of the two coils plus twice the mututal inductance. If the current flows in opposite directions through both coils in series, the self-inductance of the whole, which may be called *II*, is the sum of

the self-inductances of the two coils minus twice the mutual inductance. In the first part of the method the ratio of *I* and *II* is measured by comparing each with a third self-inductance. In the second part of the method the value of the mutual inductance is measured, which can be done by any of the usual methods (for example, with the earth inductor and ballistic galvanometer or the doubly wound solenoid and ballistic galvanometer method). The difference of *I* and *II* is four times the mutual inductance. As the ratio and difference between *I* and *II* are known, *I* and *II* can be calculated directly. In order to use this method it is necessary to be able to break the circuit of the coil at some point inside of it. This can be done best during the winding. He suggests that all coils that are to be used as standards of self-inductance, be wound in two sections. It is not desirable to break the coil in such a way that he mutual inductance is small; on the other hand, it is not desirable to break the coil in the middle. The best method of winding lies between these two. If the coil to be measured is not wound so as to be broken conveniently, its self-inductance can be measured by means of the above method, slightly modified, by joining the self-inductance to be measured in series with another self-inductance coil of the same order of magnitude, and placing the two coils near together so that the mutual inductance has a certain value. The self-inductance of the total combination, considered as one circuit, is measured, and also the ratio of the two coils. The two coils must, of course, retain their relative position during the entire measurement, otherwise the mutual inductance would vary. (In some cases it might suffice to wind a temporary coil over the one to be measured and removing it again after the measurement.—Comp.)—*Phys. Rev.*, Oct.

Hot-Wire Instruments.—SOULIER.—An illustrated description of hot-wire voltmeters and ammeters, devised by Chauvin and Arnoux. The special feature of the instruments is the method used for compensating for the variation due to temperature changes and for increasing the deviations of the needle. Several wires of the same material and cross-section as the wire heated by the current to be measurd, are fixed at one end to the frame of the instrument, and are connected at the other end to the one terminal of a lever, pivoted on its center. These wires are shown at the left hand of the adjoining figure and are not in circuit. They are tightened by the action of the spiral spring, shown at the right hand of the figure. Parallel to the bundle of insulated wires there is the real "hot wire," connected at one end to the lever mentioned before, and at the other end to another lever which is in connection with the device for increasing the deviation of the needle. It will be seen that when the temperature of the air rises, the bundle of insulated wires compensates for this temperature error of the hot wire. The device for increasing the deviation of the needle acts as follows: When the hot wire varies its length due to the heating of the current, the lowe lever, one arm of which is connected to the hot wire, is acted upon, the other arm is connected to a fixed point of the frame by means of a thread and spiral string. A point of this thread is fixed to a cylinder of small radius and revolvable around its axis. When the lever is acted upon, the cylinder is turned and the needle, connected with this cylinder is deflected. It can be shown that his arrangement is very sensitive. The hot wire used can stand three times the normal current without any other inconvenience except that the zero point of the instrument is changed, but it can easily be restored by means of a screw. Voltmeters and ammeters of this type are described.—*L'Ind. Elec.*, Oct. 25.



HOT-WIRE INSTRUMENT.

Direct-Current Meter for Small Currents.—An illustrated description of the Hookham meter for small currents. The 5-ampere size starts at 0.05 ampere. The instrument resembles in some respects a Perry meter. Its armature is in the form of an inverted cylindrical cup, which rotates in an intense permanent magnetic field, and to which contact is made by means of mercury. The cup rotates on a vertical spindle. No extra brake is provided, as the cup, rotating in a strong magnetic field, is itself an eddy-current brake. This braking action is proportional to the speed of rotation, but the fluid friction is also to be reckoned with, which is proportional to the square of the speed. The friction is, therefore, too great at high speeds, and to compensate for this, an electromagnet is provided, through which the main current passes on its way to the armature of the meter. The action of this coil is to weaken the field in which the armature rotates and to reduce the brake force relatively to the driving force, as the current and speed increase, so to compensate for the slow error at high loads which would otherwise result from fluid friction of the mercury. This object is attained by diverting part of the field of the permanent magnet from the main path.—Lond. *Elec.*, Nov. 8.

Alternating-Current Terminology.—BOUCHEROT.—A communication referring to the recent suggestions, made by the editor of that journal, as noticed in the Digest, Nov. 2 (see also ELECTRICAL WORLD AND ENGINEER, Nov. 16, page 805). He believes the term "magnetizing power" would be better than "fictive power," and "magnetizing current" better than "current in quadrature." His argument is that the term suggested by him would give at once a definite idea of the action of the component of the current in quadrature, as in the great majority of apparatus used in practice, it produces a magnetic field and magnetizes the apparatus. The case of the current in quadrature, absorbed by a condenser, is only an exceptional one, of small importance.—*L'Ind. Elec.*, Oct. 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Wireless Telegraphy.—TURPAIN.—Illustrated descriptions, taken from British patent specifications of several new inventions: Oscillator and coherer of Armstrong and Orling; coherers of Brown; coherers of Marechal, Michel and Dervin; coherer, relay and decoherer of the Am. Wireless Tel. Co., with operation by compressed air; an arrangement of Ferrie to use the coherer in ordinary telegraphy over wires; rather complicated wireless telegraphy apparatus of Cervera Baviera; and a relay of Guarini Foresio.—*L'Eclairage Elec.*, Oct. 19.

Automatic Telephone Exchange.—An illustrated article on the automatic telephone exchange at Fall River, Mass.—*Elec. Rev.*, Nov. 16.

MISCELLANEOUS.

United States and Great Britain.—An article on "American competition as it really is." British manufacturers are recommended to follow Americans in an improvement of methods of manufacture, better arrangement of machine tools, the use of machines capable of doing work more rapidly, and the adoption of modern systems of gauge working; but they should not drop the commendable quality of durability. "American work will often be very well designed, and surprising results will be obtained from small amounts of material, but durability is not a prominent feature." American "wares are perhaps mechanically good, they look well, are made perhaps promptly to time, but they do not possess the quality of durability." "Now, are our engineers going to learn order and method, and good shop practice, before the Americans learn liberal design, and the secret of durability?" "The success of American competition has caused a very severe epidemic of swollen head among the Americans, and they have presented the ridiculous picture of a nation behind a 50 per cent wall of tariffs, shouting that they can whip the world. Yet Americans consider themselves a humorous people."—Lond. *Elec. Rev.*, Nov. 8.

REFERENCES.

German Manufacturing Plant.—An illustrated description of the plants of the Union Electric Co. and of Loewe & Co.—Lond. *Elec.*, Nov. 1.

Manufacturing Plant.—An illustrated description of the works of the Stanley Electric Manufacturing Co. at Pittsfield.—*Elec. Rev.*, Nov. 2.

Glasgow Exhibition.—An illustrated description of exhibits of the British Schuckert Co. on electrically-driven double-acting duplex plunger pump, an electrically-driven winch, an overhead traveling crane, a high-pressure switch, electric drills, and several exhibits relating to electric traction.—Lond. *Elec. Rev.*, Nov. 1.

British Manufacturing Plant.—An illustrated description of the works of "Electromotors, Limited," in Manchester.—Lond. *Elec. Rev.*, Oct. 25.

German Manufacturing Plant.—A continuation of the serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany, giving a well illustrated description of the plant of Lahmeyer & Co.—Lond. *Elec.*, Oct. 4.

Storage Battery Manufacturing Plant.—Marmor.—An illustrated article on the plant of the Storage Battery Company, of Hagen, Germany.—*Cosmos,* Oct. 5.

Electrical Engineering in Europe.—Alderson.—An illustrated article on technical high schools in Germany and Switzerland.—*West. Elec.,* Oct. 26.

New Books.

Mill Building Construction. By H. G. Tyrrell. New York: The Engineering News Publishing Company. 40 pages, 46 illustrations. Price, $1.

While this little volume contains but 40 pages, the information it gives is in such condensed form that it appears to cover the entire subject of mill building construction, so far as relates to practical details and data. The first chapter is on loads, under which are treated roof, floor and crane loads, snow and wind loads, and miscellaneous loads. Very full data of weights are given, including a table of weights of various kinds of merchandise load. The second chapter is on general design, the sub-heads being walls and roof trusses, spacing of trusses, jack rafters, roof coverings, truss connections, rafters, bottom chords, purlins, stress factor, lighting and ventilation and the estimation of cost. In the latter section is a table of prices which enable the approximate cost of a building to be quickly estimated. The third chapter is on "Design and Structural Details," with the following sub-heads: Foundations and anchorage, concrete floors, asphalt floors, wood floors and car shed floors—all of these referring to ground floor construction. Upper floor construction is treated under the heads of steel trough floors, corrugated iron and bridge arch floors, steel girder and timber floors, and slow-burning wood floors. Roofings are treated under the heads of slate roofing, asphalt roofing, slag and gravel roofing, corrugated iron roofing, sheet steel roofing, crimped and steel roll roofing, tin and terne plate roofing, rubber and asbestos roofing and wood and metal shingle roofing. A table is given of the comparative cost of the above roof coverings.

The final section is on miscellaneous structural details, including wall anchorages of roof trusses, doors and windows, ventillators and gutters and down-spouts. Throughout the book are scattered working drawings of details, and under each section are given complete data as to weights, dimensions and area, loads and useful tables of cost.

The Induction Motor. By B. A. Behrend. New York: Electrical World and Engineer. 105 pages, 56 illustrations. Price, $1.50.

This volume, containing 105 octavo pages, is devoted to a simple, graphical treatment of the elements of design and characteristic performance of the polyphase and single-phase induction motors, and of the general alternating-current transformer. The author says in his perface: "I have made the induction motor the subject of early and special studies, and a comparison of my treatment of its theory with the purely mathematical theories will show how far I have succeeded in simplifying and elucidating so complex a subject."

The book is written from the designer's point of view. Such point of view in this instance is based upon a considerable knowledge of the physical characteristic existence and performance of the induction motor. That is to say, the author derives his treatment of the induction motor from a close study of its actual performance as modified by design changes. The treatment amounts to but little more than a statement, in which graphical methods are largely employed, of the nature of the results of actual trial and study of the fundamental phenomena of behavior of the induction motor.

The reader who hitherto has made some considerable study of the induction motor as usually treated in our language will find this work of great interest on account of the distinctly different and more composite and, therefore, simpler mode of treatment herein employed. Though the modes of treatment are beautifully simple, the author evidently throughout expects that the reader is already familiar with the physical and practical properties of the induction motor. For this reason the reader who is just beginning his studies of the induction motor should first read S. P. Thompson's "Polyphase Electric Currents and Alternating-Current Motors."

The opening chapter gives a graphical treatment of the General Alternating Current Tansformer. This is followed by a chapter on the Character of the Magnetic Field in the Polyphase Motor. The form dimensions and magnetic and electric proportions here taken up have reference to the real model of the induction motor as it actually exists. The next two chapters define the *short circuit* and *leakage factors* as the chief factors upon which the actual characteristic behavior of the induction motor depends. Three chapters are then given up to the calculations for the design and predetermination of the performance of a 200-hp, three-phase motor and a 180-hp single-phase motor. The final chapter of the book is on the Polar Diagrams of the General Alternating-Current Tansformer. Three appendices include a reprint of Kapp's excellent statement of the working properties of the induction motor and some useful graphical methods.

This book is altogether out of the common run of books in that it gives distinctly and only what the author himself has produced. While some reference is made to those who originated the component methods employed, yet the treatment, as a whole, is decidedly original with the author, so that the purchaser of this book will in nowise be securing a repetition in phraseology of what has been said by many others on the induction motor.

BOOKS RECEIVED.

How to Build a 3-hp Launch Engine. With a Full Set of Working Drawings and Explanatory Text. By E. W. Roberts, M. E. Cincinnati, Ohio: The Gas Engine Publishing Company. 66 pages, illustrated. Price, $2.50.

Linear Drawing and Lettering. Accompanied by a blank book for lettering. By J. C. L. Fish. Palo Alto, Calif.: J. C. L. Fish. 65 pages, 46 illustrations. Price, $1.25.

Compressed Air. Its Production, Uses and Applications. By Gardner D. Hiscox, M. E. New York: Norman W. Henley & Co. 322 pages, 40 tables and 545 illustrations. Price, $5.

Les Applications Pratiques des Ondes Electriques. By Albert Turpain. Paris: C. N. Naud. 412 pages, 271 illustrations. Price, 12 francs.

Outlines of Electro-Chemistry. By Harry C. Jones. New York: Electrical Review Publishing Company. 106 pages, 13 illustrations. Price, $1.50.

Practical X-Ray Work. By Frank T. Addyman, B. Sc. (Lond.). Electrique. By Henry Martin. Paris: Ch. Beranger. 760 pages, 870 illustrations. Price, 25 francs.

Congres Internationale D'Electricite. Rapports et Proces-Verbaux. By M. E. Hospitalier, Rapporteur General. Paris: Gauthier-Villars. 526 pages, illustrated. Price, 20 francs.

Schalpungsarten und Betriebsvorschriften. By Alfred Kistner. Berlin: Julius Springer. 210 pages, 81 illustrations. Price, 4 marks.

The Elements of Alternating Currents. By W. S. Franklin and R. B. Williamson. Second Edition, rewritten and enlarged. New York: The Macmillan Company. 333 pages, 238 illustrations. Price, $1.75.

Motor-Driven Tools.

The general economical advantages of the electric motor for driving machine tools have become so fully recognized that one can safely predict that it is a matter of comparatively few years when all large machine shops will be electrically driven. In addition to the advantages arising from superior economy in distribution of power, and in freedom from a maze of belting, with consequent reduction of shop expense and better utilization of space—which advantages alone suffice to establish the superiority of the electric over the belt drive—for certain work and classes of tools the electric motor is peculiarly adapted as a source of power. Indeed, its use promises to work a revolution in at least one department of machine shop practice, for in certain heavy work it has been found that instead of bringing the work to the machine, the latter when motor driven may with much greater advantage be transported to the work. To illustrate some of these particular advantages of the electric motor as applied to machine tools, we print herewith several views of electrically-equipped tools, for which we are indebted to the Westinghouse Electric & Manufacturing Company.

Fig. 1 shows a large portable tool operated by an induction motor, which, as will be seen, is enclosed in the base. The disproportion

between the size of the motor and the tool which it operates is quite striking, as is also the fact that a tool of this enormous size should be a portable one. This is one of a number of new tools in the new

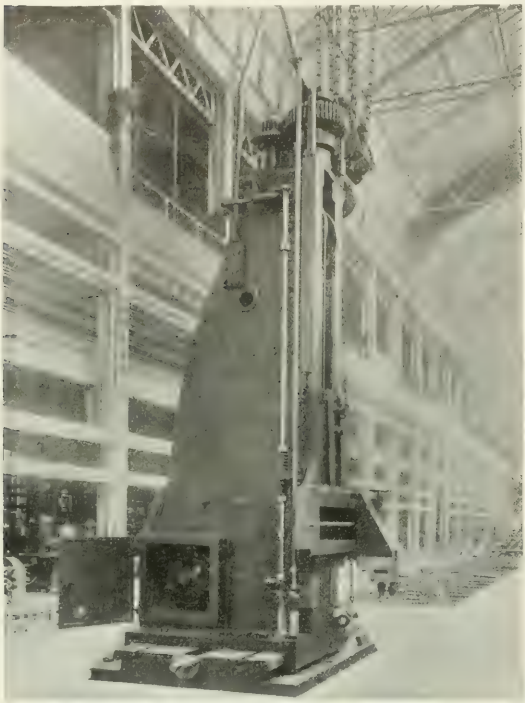


FIG. 1.—LARGE PORTABLE TOOL.

bay of the Westinghouse works at East Pittsburg. A great area of the floor of this bay consists of bed plates to which work may be

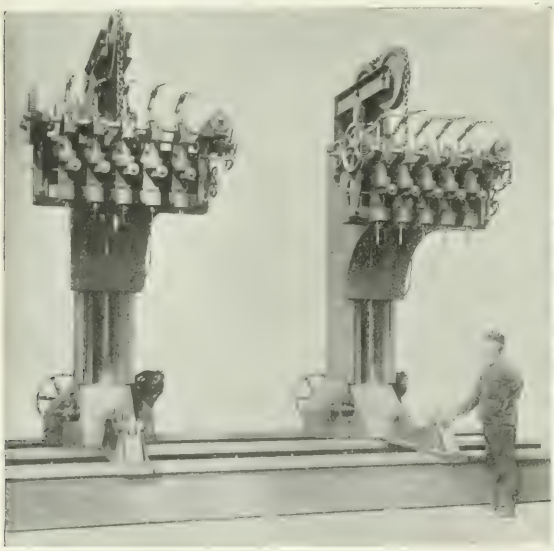


FIG. 2.—BOILER PLATE DRILLING MACHINE.

fastened in the most convenient situation, the tool required being then moved to the work.

Fig. 2 shows a ten-spindle boiler plate drilling machine, and Fig. 3 a double-slotting machine for locomotive side frames, both of which illustrate the advantages of the electric motor in the case of tools having movable power elements. The simplicity of the arrangement

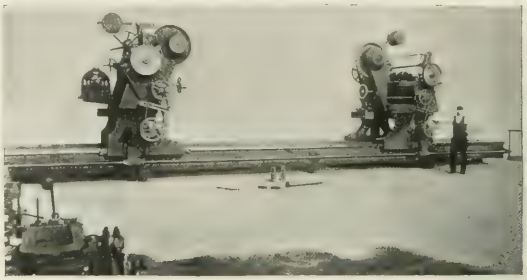


FIG. 3.—DOUBLE SLOTTING MACHINE.

with motors is in notable contrast to that which would be necessitated were the tools belt driven.

In Fig. 4 is shown a boring mill driven by an induction motor, and having a variable-speed gear attachment. In this case the motor and the entire change gear is enabled to be placed beneath the floor level. The 28-ft. boring mill of Fig. 5 is driven in this manner from

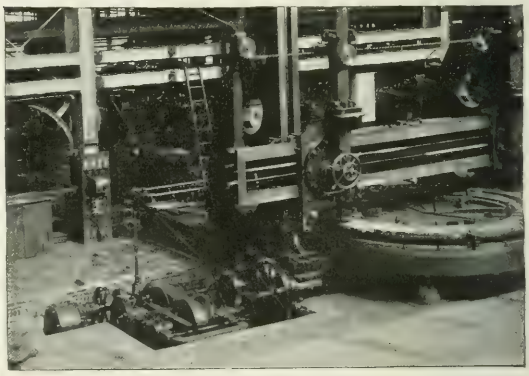


FIG. 4.—BORING MILL.

a covered-over pit, and in addition there is a small motor mounted on the top frame to furnish power for raising and lowering the immense cross-head.

Fig. 6, showing the end of a 122-inch lathe, illustrates admirably

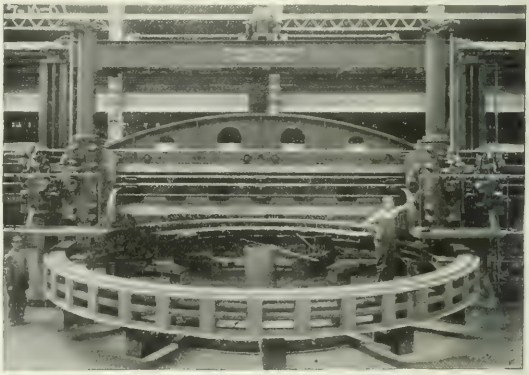


FIG. 5.—28-FOOT BORING MACHINE.

the simplicity with which an electric motor may be applied to a machine tool, and the small amount of space which it occupies, even in a machine of the power of this lathe. This is also illustrated in Fig.

7, which shows a 14-spindle drilling and boring machine for working on water-tube boilers.

As an inspection of the cuts will show, some of the tools illustrated

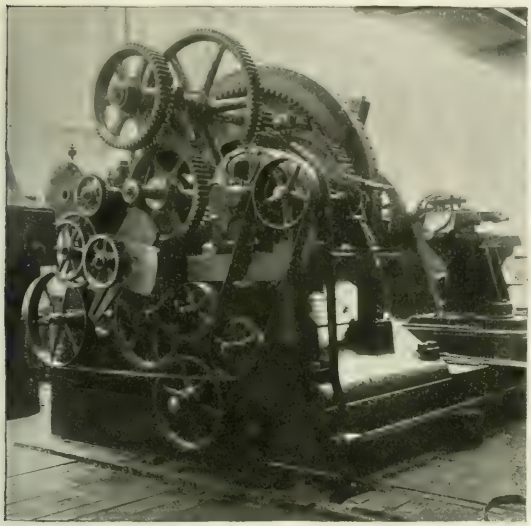


FIG. 6.—122-INCH LATHE.

are driven by induction motors and others by direct-current motors, the kind employed in any case depending, not on the type of the

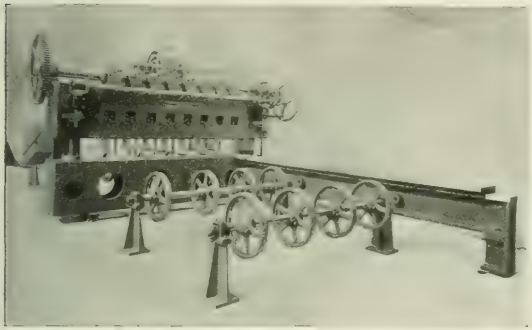


FIG. 7.—SPINDLE DRILLING AND BORING MACHINE.

motor, but on the character of the source of power. All of the machines illustrated are driven by Westinghouse motors.

Bullock Railway Generators.

The accompanying illustrations show a 1000-kw Bullock railway generator, and some details of both engine and belt-driven types of the railway machines manufactured by the Bullock Company.

The frames of these machines are divided horizontally, and are eliptical in section with pole seats projecting sufficiently to allow of machining to provide for a perfect magnetic point between yoke and pole. The pole pieces are from thin annealed sheet steel having high magnetic permeability. The form somewhat resembles a letter "T" having one-half of the upper line cut away. They are assembled with each alternate sheet turned so that the formation of the pole is a perfect "T," but owing to its peculiar form, the pole is slotted to a depth of about ½ inch across its entire face. The effect of this is a more perfect distribution of magnetism in the air-gap resulting in a fixed point of commutation and sparkless operation at all loads.

The shunt and series coils are separately wound. The shunt coil is in each case wound upon a built spool of press and fuller boards. After winding the exterior of the spool and coil is covered over with cotton tape and the coil finished by an exterior winding of "Sampson" cord which is varnished with shellac, thus giving to the finished coil a handsome appearance. The series coil is of copper strip insulated with cotton and similarly treated. By winding the coils separately, better radiation is secured, and the ample carrying capacity and good ventilation guarantee a low temperature under constant load.

The armature coils are all bar wound, i. e., copper strip is forced into a cast iron mould of the proper form for the coil, the coil consisting of two or more convolutions, according to requirements. After being thus formed each convolution of the coil is wrapped throughout

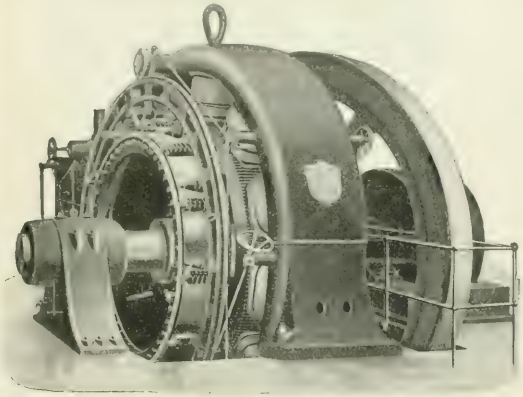


FIG. 1.—1000-KW ENGINE TYPE RAILWAY GENERATOR.

with cotton tape. The several convolutions are then grouped and the ends or exterior portions are again wrapped with tape, forming the unit winding. After being thus far completed, the coils are dipped in insulating varnish and placed in the drying oven. When the drying process is complete the active portion of the coil or that part embedded in the armature core, is covered with several thicknesses of red rope paper, "Empire" paper, India mica, and an outside covering of "Fish" paper, each layer being treated with shellac. The coil is then put into a steam heated press and assumes a rectangular form of the exact dimensions of the core slot. It remains in the press under heat until all surplus insulating varnish and shellac has been driven out, and while still under pressure the coil is cooled. Fig. 2 shows a partly wound coil of a 250-kw belt-driven generator.

The commutator bars are standardized, thus facilitating repairs when necessary. The mica used is of a special quality, and in service

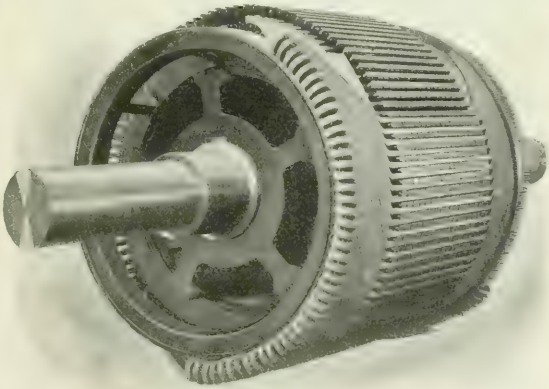


FIG. 2.—PARTLY WOUND ARMATURE OF 250-KW GENERATOR.

wears uniformly with the copper and adds materially to the life of the same. The bars are well insulated from the shell. Ample brush service has been provided to care for current to be carried and brush friction without undue heating.

The armature core is built from laminations of thin sheet steel mounted upon a spider of cast iron. The ends of the arms are of a dovetail formation, carefully machined for an exact fit, and engage slots on the inner periphery of the core. The slots for the

windings have parallel sides with grooves near the top into which the coil retaining wedges are driven. These wedges obviate the use of band wires, and protect the coil from mechanical injury. Thus should a bearing run hot and melt out, the windings would not be injured by contact with the poles. No band wires are used.

The brush holder (Fig. 3) is very simple in design, and of the reaction type. A dovetail groove is cut in its face, in which a projecting screw head from the brush engages. This prevents the

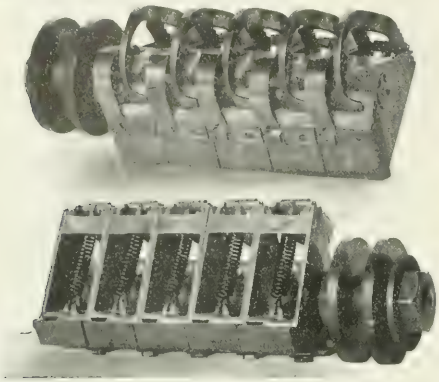


FIG. 3.—FRONT AND BACK OF BRUSH HOLDER.

brush from jarring out or swinging away from the holder when the tension finger is raised. Carbon brushes of rectangular section and beveled ends for tangential contact are used. Flexible leads connect the brushes with the holder furnishing a direct path for the current.

A heavy cast iron ring is mounted upon three trunions supported by the yoke (Fig. 4). Internally projecting arms carry the brush studs. Brush studs of like polarity are connected to copper cross connectors, mounted between the yoke and brush ring. These connectors are wound with "Sampson" cord and connected by leads to the terminal board. On engine type machines of 200 kilowatts and above, there is a brush shifting mechanism for shifting the brushes latterly. This movement is very similar to the end play in belted machines, and obviates any tendency of the brushes to groove or cut the commutator.

The design of these machines permits a large air-gap. Operation, however, is not seriously interfered with, even with quite a large dis-

FIG. 4.—BRUSH HOLDER YOKE.

placement of the armature, and no material change in the magnetic pull on the armature occurs with such displacement. The generators will run perfectly in multiple with other similar machines. They are so designed that they will take proportion of the load under all variations. Great care is taken to have the mechanical and electrical balance of the machines perfect. The standard for insultion is based upon the specifications adopted by the American Institute of Electrical Engineers.

The Regulation of Electric Light.

A practical device for regulating the light of an incandescent lamp which may be simply applied to an ordinary fixture has long been needed, and the Sayles electric light regulator, shown herewith, appears to satisfy the want. By its use, the light of an incandescent lamp may be graded through five stages, the light at the lowest stage being even less than can be safely furnished by turning down a gas jet, and corresponding to that given forth by a small oil night lamp. That is to say, it places the incandescent lamp as to light control practically on a parity with the gas jet.

It is a somewhat singular fact that the saving over normal consumption when a light is reduced below normal by means of resistance, is sometimes contested, and even by electricians who should know better. The misunderstanding, however, has probably been due to considering only the matter of watts per candle-power, instead of viewing the question from the meter, and, therefore, the consumers', standpoint. Without means of regulating a lamp, the consumer either continues to use a lamp at its full candle-power, though he may desire less light, or he turns it off when he should otherwise be quite willing to have it in circuit at a lower candle-power. In the first case he pays the price of 50 watts for a larger amount of light than he may require, whereas by the insertion of resistance he could procure the actual amount of light he desires at the cost, say, of 25 watts. It is true that the watts per candle-power would be greater in the case of the reduced light owing to the loss in the resistance, but the consumer is only concerned with the cost of burning the lamp as he desires and as is registered by the meter, and not with a technical question of efficiency per unit of light.

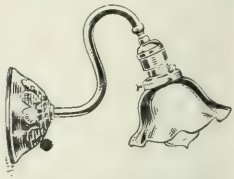
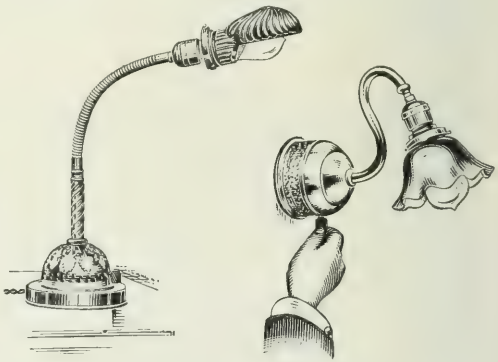


FIG. 1.—OVER OUTLET BOX.

In other words, the only choice offered him is to burn a light at normal candle-power or, say, 50 watts, or at a smaller candle-power with less watts per lamp and, therefore, at less cost than for normal light, even though at a greater rate of energy consumption on the unit or watt-per-candle-power basis. We have assumed that the misunderstanding has been due to considering only the matter of watts per candle-power, for the slightest consideration of Ohm's law in its form watts = current × voltage, makes it evident that, with the voltage constant and current reduced below normal by resistance, the watts per lamp will be reduced in proportion to the current.

Notice of the device illustrated appeared in these columns at the time of the issue of the patent upon which it is based. Since that time the details of manufacture have been carefully worked out by Mr. J. E. Sayles, manager of the Electric Regulator Company, 136 Liberty Street, New York, formerly general agent of the Edison



FIGS. 2 AND 3.—PORTABLE AND CANOPY TYPES.

Electric Illuminating Company, of New York, and later identified with the electric heating business. A delay of several months was caused by a somewhat protracted illness of Mr. Sayles, but there have been now placed on the market several forms of this regulating device, which has been approved by the Underwriters and by the New York Department of Public Buildings, Lighting and Supplies. It has also been tested and indorsed by the New York Edison Company, with a certificate that it affords an "actual saving at the meter"

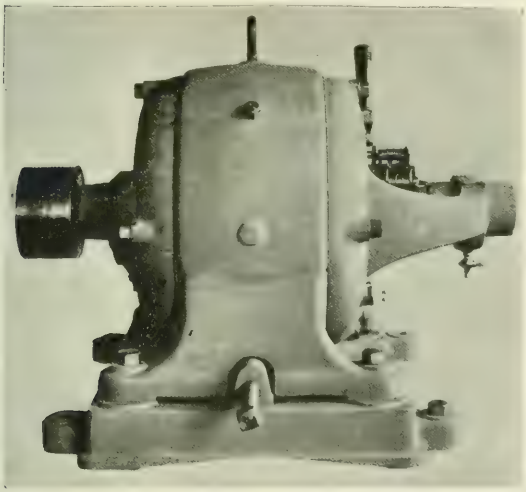
of about one-third to three fourths "as the volume of light is reduced."

We give herewith illustrations of three of the forms manufactured, consisting of a complete portable lamp ready for connection, and of two canopy types which can be applied to any fixture. One of the latter is adapted to use where no outlet box is installed, in which case the regulating device, which consists of a switch, resistance tube and base, all covered by a canopy, is fastened to the wall by feet stradling the crow-foot; the other has the feet mounted on the outlet box, but in both cases the device passes over the insulating joint and is perfectly insulated and securely held in place. It is governed by a key projecting from the canopy, or in the case of the portable, from the base.

The device, which embodies a cast-iron enameled resistance tube of ingenious construction, is practically indestructible, and operates to control the light in the most efficient and satisfactory manner. The especial point is made that the device only requires the use of the usual commercial lamp as supplied by all lighting and supply companies, and does not require that special lamps shall be purchased by the consumer. In the case of a 50-watt lamp, the consumption at reduced candle-power is about 33, 25, 18 and 12½ watts, respectively, corresponding to the several switch points. The device is applicable both to direct and alternating-current circuits.

Reliance Dynamo and Motor.

We illustrate herewith a type of dynamo and motor made by the Reliance Electric Company, of Milwaukee, Wis. As will be seen, the frame is made of one solid circular piece of cast steel, the bottom of which is shaped to form the feet. There are four-pole pieces, oval in form, with shoes cast solid on the same, and so shaped as to hold the field coils firmly in place. The pole pieces are accurately fitted



DYNAMO AND MOTOR

to the frame in a manner to insure the best magnetic contact and the greatest stability.

The heads are of cast iron and reversible. They are fitted to the frame with a perfectly tight machine joint, and held securely in place by tap bolts screwed into lugs on the frame. The bearings are of gun-metal, and of generous dimensions, with large oil pockets and "ring oilers" insuring cool running. The shaft is ground and polished to a perfect gauge at the bearings.

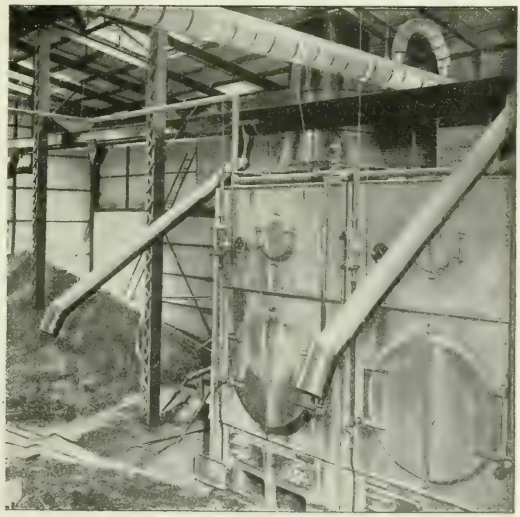
The armature core is made up of thin steel disks, insulated from each other, and assembled under a heavy pressure upon a cast iron spider. The disks are separated at intervals with a plate which forms a series of vertical ducts through which a constant flow of air is forced when the armature is in motion.

The armature coils are all form wound, and each coil is insulated to withstand a breakdown test of 2000-volt alternating current. The system of winding is such that a positive circulation of air is maintained through the coils and end winding while the machine is in operation. After the coils are inserted in the slots of the armature disks and before being connected to the commutator, a further insulation test is applied.

The field coils are also form wound, and, as in the case of the armature coils, are interchangeable. They are slipped over the pole pieces before bolting the same to the frame, and are easily removed or replaced. The commutator bars are held securely in place by wedge-shaped steel rings and ring nuts threaded to the shell and perfectly insulated with India mica. The commutator is assembled under a heavy pressure and braking process. The brush holder is of brass, and employs carbon brushes.

Coal Handling Machinery for a Small Plant.

The cut herewith illustrates a coal-distributing plant designed and erected by the Aultman Company, of Canton, Ohio, for the Lewis Bergdoll Brewing Company, of Philadelphia, Pa. This steam plant has 12 boilers, fired by hand, with anthracite pea coal. A side track runs parallel with the end of the boiler room. Coal is received in bottom dump cars and dumped into a hopper beneath the track. From the bottom of the hopper a chute controlled by an automatic discharge gate leads the coal to a bucket elevator located just inside the end wall. This elevator discharges into a 12-inch steel screw conveyor 65 ft. long, operating in a steel trough (as shown in the illustration), placed on the columns of the building 19 ft. above the boiler room floor. The front of each boiler is served with coal through discharge gates and spouts placed at proper intervals in the bottom of the conveyor trough; these discharge gates being operated from the floor level. The capacity of the system is 30 tons of coal per hour from car to boiler room. A 6-hp electric motor furnishing



COAL-HANDLING APPARATUS

the requisite power to operate it. The approximate cost of the entire apparatus erected in place is less than $1,000.

A reserve storage of coal for several days' consumption is stored under cover in the vacant space next to the elevator, which can be allowed to flow back into the elevator booth for distribution by the screw conveyor in the same manner as coal direct from the cars would be distributed. Where gondola cars are used the track hopper is replaced by a shoveling hopper into which the coal is shoveled from the cars, a chute leading from this hopper into the elevator.

In a steam plant of the size illustrated, eliminating the advantages of storing several days' coal supply under cover, and the saving in time effected, a conservative estimate of the direct money saved by the use of a coal-handling plant is said to be not less than $400 per year, after allowing a liberal percentage for interest, maintenance, depreciation and power cost to operate it, a sum of sufficient magnitude to make its installation an object to owners of steam plants.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 4 per cent, nominal; time money was freely offered, closing at 4½ per cent for 60 days to six months on high grade collateral, and 4½@5 per cent on good mixed collateral. The stock market showed a very strong and advancing tendency, owing to the fact that further expected heavy gold exports did not take place at the end of the week, and on various favorable reports regarding some of the principal stocks, including local tractions. Little attention was given to the industrials. The traction stocks showed a strong tone, Manhattan being the object of renewed reports of buying by the Vanderbilt interests. A more plausible reason for its advance from 128¾ to 137½ was that the present earnings and the prospect that with electrical equipment the property would do still better have caused heavy purchases by capitalists connected with the company, thereby rendering the stock scarce in the market. There was considerable covering of shorts in Metropolitan Street Railway, which also advanced, intimations being given that the company will soon issue $10,000,000 of new stock to be subscribed for at par by the present stockholders. After having reached 171¼, the closing price of Metropolitan on Saturday was 168½, the sales aggregating 92,100 shares, Brooklyn Rapid Transit ranged between 67⅛ and 69¾, closing at 67½, a net loss of 1⅛ points, the sales aggregating 85,160 shares. On Wednesday many extravagant rumors regarding General Electric were current. It was hinted that a large stock dividend would be declared, not for several months, perhaps, but that it would be fully 50 per cent, if not 66⅔ per cent. With it is to go, according to the rumors, a cash dividend of 15 per cent. Only 4700 shares changed hands during the week, quotations ranging between 257½ and 263½, closing at 263, a net gain of 5 points. Western Union made a net gain of 1¼ points, closing at 91⅜. In the outside market Electric Boat preferred on Saturday opened at 45 and advanced to 50 on the purchases of 300 shares. Following are the closing quotations of Tuesday, Nov. 26:

NEW YORK.

	Nov. 19.	Nov. 26.		Nov. 19.	Nov. 26.
American Tel. & Cable..	96	—	General Electric.....	257⅛	274
American Dist. Tel.....	36	—	General Carriage.....	¾	⅜
Brooklyn Rapid Transit.	68¼	67½	Hudson River Tel.....	110	112
Ches. & Pot. Telephone..	—	—	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	170	—	Metropolitan Street Ry..	168¾	167¾
Electric Boat.....	17	20½	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	40	47	N. Y. Elec. Veh. Tran...	5⅝	9¼
Electric Lead Reduc'n...	1⅞	2	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	2¼	2	Tel. & Tel. Co. of Am..	—	—
Electric Vehicle pfd.....	4½	4¼	Western Union Tel.....	90⅝	91⅜

BOSTON.

	Nov. 19.	Nov. 26.		Nov. 19.	Nov. 26.
Am. Tel. & Tel.....	157	160	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	132	—
Boston Electric Light...	—	—	Westinghouse Elec.....	70	—
Erie Telephone.....	21¼	24	Westinghouse Elec. pfd.	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Nov. 19.	Nov. 26.		Nov. 19.	Nov. 26.
American Railways.....	44½	45½	Phila. Traction.....	97⅛	97½
Electric Storage Battery.	57	58	Philadelphia Electric....	5	5
Elec. Storage Batt'y pfd.	57	58	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	6⅞	6½	Pa. Elec. Veh. pfd.....	1	1

CHICAGO.

	Nov. 19.	Nov. 26.		Nov. 19.	Nov. 26.
Central Union Telephone.	40	—	National Carbon pfd.....	84	83
Chicago Edison.....	—	155	Northwest Elev. com....	39	36
Chicago City Ry.....	188	188	Union Traction.....	12⅞	11⅜
Chicago Telep. Co.....	—	225*	Union Traction pfd.....	52½	47¼
National Carbon.....	20	19½			

*Asked.

WASHINGTON TRACTION SECURITIES.—Under a decree of the United States Circuit Court, in the suit of the United States Mortgage & Trust Company, trustee, against the Washington (D. C.) Traction & Electric Company, the stock and bonds of the various properties of the latter company, covered by a collateral trust mortgage, were sold at auction at Norfolk, Va., on Nov. 23 for $5,000,000. The stocks and bonds were bought in for the reorganization committee. The purchasers were Julien T. Davies and Brainard Tolles, of New York, who acted for the United States Mortgage & Trust Company. A large amount of the bonds of the City and Suburban and the Aancostia and Potomac railroads, which are constituent properties of the Washington Traction Company, are owned in Baltimore. The Washington Company owns 39,865 shares of the stock of the Anacostia out of 40,000 shares issued, and 30,602 out of the 35,000 shares of the City & Suburban. Other constituent lines are the Metropolitan Railroad, Columbia Railway, Georgetown & Tennallytown, Brightwood Railway, Wilmington, Woodside & Forest Glen, Washington & Great Falls, Washington & Rockville, and the Washington & Glen Echo. Of all these lines the Washington Traction Company owns 110,478 of an aggregate issue of 115,993 shares of stock, of the total par value of $5,818,100. It also owns the stocks of the two electric light plants of Washington. These securities were pledged to secure an issue of 4 per cent bonds. Default in interest on these bonds caused the foreclosure sale and the reorganization, which is the next step. The holders of a majority of these bonds have agreed to the terms of the reorganization.

ATLANTIC COAST ELECTRIC COMPANY.—William Evarts Benjamin, president of the Atlantic Coast Electric Company, which has failed to pay the interest due on some of its bonds, says: "While it has been fully determined to reorganize the finances of the company, we have not as yet mapped out our plan of reorganization. Nothing has been done except to hold up the payment of interest due Nov. 1 on its outstanding 5 per cent bonds. This, of course, draws the attention of all the security holders, and paves the way for financial reorgnaziation." Mr. Benjamin said he did not think the plan of reorganization will include the issuance of a general mortgage of $1,500,000, as has been reported. He said that all the security holders will be satisfied with the scheme of financial reorganization. The Atlantic Coast system is a combination of trolley lines from Belmar, N. J., to Pleasure Bay. The company also owns the entire stock of the Atlantic Coast Electric Light Company, which supplies the lights of Asbury Park, Neptune Township and other nearby places. The company has $1,500,000 capital stock. Its net earnings for the year ending Sept. 30, 1900, were $138,918. Among the directors are H. H. Rogers, Daniel O'Day and Colonel George B. M. Harvey, who was once president of the company.

CHICAGO TAXES.—The United States Circuit Court has refused to help the Chicago corporations in the matter of their taxes. The application of the Chicago Union Traction Company and the Consolidated Traction Company for an injunction restraining the State Board of Equalization from assessing the capital stock of these companies for 1900, was denied by Judges Grosscup and Humphrey, and the temporary injunction issued by Judge Grosscup was dissolved. No written opinion in the case was filed. Judge Grosscup stated orally at length the reasons for the decision, explaining that later Judge Humphrey would file a written opinion. This oral statement occupied 40 minutes. Immediately after the decision was announced assessments aggregating $75,000,000 and involving over $1,000,000 in 1900 taxes were made by the State Board of Equalization as the fair cash value of the capital stock of the traction companies over and above the assessment on their tangible property. The $75,000,000 valuations made take the place of $3,500,000 valuations made last year as representing the fair cash value of the property assessed. The next move is awaited with interest.

GENERAL ELECTRIC EARNINGS.—It is understood that the earnings of the General Electric Company are phenomenally large. For September the net earnings aggregated $900,000, but October net earnings broke all previous records, amounting to $1,000,000, and from orders now on hand it is known that the company will be able to show $1,000,000 net per month the balance of this year. These earnings make sure that the General Electric Company will be able to accumulate a surplus of at least $18,000,000 by April 1, which will permit the restoration of its capital to $40,000,000, as it was previous to the reduction in 1898. Its surplus now amounts to nearly $15,000,000. It would only require $8,000,000 of net earnings per annum to show 20 per cent per annum on a capital of $40,000,000 and the company will be able to show better than this for the year to end Jan. 31.

CENTRAL UNION TELEPHONE.—President Sabin, of the Central Union (Bell) Telephone Company, has sent to stockholders a report of the business done by months so far this year. The statement shows a considerable gain in the number of exchange stations and rental earnings, and in the gross revenue of the company. For instance, the rental earnings in January were $126,411 and in October $153,770. It is estimated in the circular that the rental earnings for November will be $156,000, and in December $160,000. At the time of Mr. Sabin's connection with the company in April there were 75,341 stations. At the end of October there were 91,485, a gain of 16,144. Gross revenue for January, 1901, was $192,889 for August, 1901, $220,435.

LIGHTING CONSOLIDATION AT PORT JERVIS, N. Y.—A certificate consolidating the Port Jervis Light & Power Company,

the Deer Park Electric Light Company, of Port Jervis, Limited, and the Port Jervis Gas Company, has now been filed with the Secretary of State. The name of the new corporation is the Port Jarvis Electric Light, Power & Gas Company, and it is to operate in the town of Deer Park, Orange County, and Pike County, Pa. The capital is $400,000, and the principal office will be at Port Jervis. The directors are Ralph S. Weaver, Benjamin Ryall and W. A. Parshall, of Port Jervis; R. H. Beach, of East Orange, N. J., and C. R. Horn, of Catasauqua, Pa. The consolidation has already been noted in these columns.

CHICAGO ELEVATED BONDS.—Directors of the Chicago Northwestern Elevated Railroad are to meet this week to decide the terms on which about $4,000,000 additional bonds will be issued. These are part of the $5,000,000 which the directors still have authority from shareholders to put out. The bonds will be offered to shareholders at a price in the neighborhood of the market value, 96⅛ to 96¼, but some rights will be given. The last bonds issued were offered to shareholders for 90, but it was not expected that shareholders would profit as much from the present lot. The old 5 per cent bonds will be called for redemption on Jan. 1. Many of these bonds have been taken up already by the company at 105.

TELEPHONE, TELEGRAPH & CABLE.—The Boston & New York, the Knickerbocker and Massachusetts Telephone companies have been absorbed by the Telephone, Telegraph & Cable Company of America, and they will hereafter be operated as one company, eliminating local organizations.

Commercial Intelligence.

THE WEEK IN TRADE.—Mild weather and car shortage have had a visible effect in trade and industry. The former condition manifests itself in the limited consumptive demand in some sections, yet the reorder demand from jobbers the country over and the inquiry for holiday goods are equal to, and in the latter case, superior to those of recent preceding years. The car shortage grows worse instead of better, and many industrial centers report interruption to trade and industries, and limited volume of shipments as a consequence. In the iron and steel market, prices have advanced, pig iron being 50 cents to $1 a ton higher at nearly all markets. While the car shortage has curtailed business somewhat, the unprecedented demand for production and consumption is largely responsible for the higher prices. Some works in the Pittsburg district are somewhat hampered on account of the lack of supplies of pig iron. Steel billets are scarce at $28 per ton. Finished products are without much change, but Central Western mills will not promise deliveries of steel bars inside of 60 days, while structural material is hard to get. The gross earnings of leading railways for three-fourths of the current year aggregate $934,742,540, which is an increase of 12.1 per cent over the same period last year. The net earnings amount to 15.8 per cent greater than those for the same nine months of last year. The failures for the week, as reported by *Bradstreet's*, aggregated 223, as against 213 the week previous, and 215 the same week last year. Copper was dull throughout the week and transactions were very few. Quotations are 16½@16¾c. for Lake, 16¼c. for electrolytic in cakes, wire bars and ingots, 16c. in cathodes and 15¾@16c. for casting copper. The United States production in October showed an increase of 3.2 per cent, which makes the output for the ten months about .1 of 1 per cent greater than that for the same period last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Nov. 13: Antwerp—Machinery, 2 pkgs., $90; materials, 16 pkgs., $1,066. Amsterdam—Material, 1 pkg., $75. Argentine Republic—Materials, 83 pkgs., $2,125. British Possessions in Africa—Material, 1 pkg., $10. British East Indies—Materials, 9 pkgs., $191. Baden—Materials—1 pkg., $300. British Australia—Materials, 41 pkgs., $2,263. Chili—Materials, 15 pkgs., $520. Cuba—Materials, 65 pkgs., $2,543. Central America—Materials, 22 pkgs., $570. Dresden—Materials, 1 pkg., $30. Glasgow—Materials, 1 pkg., $80. Genoa—7 pkgs., $325. Hamburg—63 pkgs., $5,836. Havre—2 pkgs., $200; materials, 1 pkg., $67. London—Materials, 97 pkgs., $4,230. Leeds—Materials, 3 pkgs., $210. Liverpool—Materials, 119 pkgs., $3,498. Mexico—Materials, 9 pkgs., $281. Milan—Materials, 3 pkgs., $250. Marseilles—Materials, 20 pkgs., $200. Manchester—Materials, 15 pkgs., $739. Nice—Materials, 1 pkg., $50. Newfoundland—Materials, 3 pkgs., $81. Nova Scotia—Materials, 1 pkg., $102. Peru—Materials, 19 pkgs., $662. Port Ross, Africa—Materials, 9 pkgs., $300. Riga—Materials, 1 pkg., $25. Rome—Materials, 2 pkgs., $100. Santo Domingo—Materials, 10 pkgs., $161. U. S. of Colombia—Materials, 6 pkgs., $76. Belfast—Machinery, 4 pkgs., $45. British East Indies—Machinery, 14 pkgs., $4,600. Bremen—Machinery, 1 pkg., $70. British Australia—Machinery, 47 pkgs., $22,471. Central America—Machinery, 22 pkgs., $570. Dublin—Machinery, 3 pkgs., $75. London—Machinery, 206 pkgs., $21,300. Leicester—Machinery, 6 pkgs., $175. Liverpool—Machinery, 219 pkgs., $29,580. Mexico—Machinery, 6 pkgs., $83. Manchester—Machinery, 94 pkgs., $7,615. New Zealand—Machinery, 2 pkgs., $50. New Castle—3 pkgs., $500. Southampton—Machinery, 1 pkg., $105; machinery, 2 pkgs., $270. U. S. of Colombia—Machinery, 3 pkgs., $213. Vienna—Machinery, 12 pkgs., $828.

WESTINGHOUSE IN ENGLAND.—A special telegram from Pittsburg of Nov. 22 says: The British Westinghouse Electric Manufacturing Company, which is building a great plant in England, is now selecting the workmen who will have charge of its plant. These, so far as the managing and important positions are concerned, will be filled entirely with Americans from the works at East Pittsburg, near this city, the site of the plant of the Westinghouse Electric & Manufacturing Company. As the British works are to be an almost exact duplicate of the plant here, the men selected will not find much change except that they will be placed over men for the most part English. About 100 managers, foremen and others are now being advanced. They are all skilled mechanics who have been with the company for many years. A number have been offered positions more lucrative in the English plant, but have preferred to remain in the United States. The general manager of the British plant will be William Lownes, of Pittsburg. Another feature of the planting of the American industry in British soil is that 120 young Englishmen are now at the Westinghouse works here becoming familiar with the workings of the concern. They are mostly from the mechanical and polytechnic schools of Manchester, and were selected by the British investors in the enterprise. They will be made assistant foremen, etc., and from among them are to be picked the future foremen, managers, etc., as the places held by the men who go from here to establish the industry become vacant.

THE TROLLEY IN MEXICO.—The journal of the Bureau of American Republics has the following: Reports state that Senor Vales Castillo, of Merida, Yucatan, Mexico, and Senor Julio Rendon, manager of the Progreso Lighterage Company, now in New York City, and who can be addressed care Mr. F. G. Canton, 29 Broadway, New York, propose to soon build an electric road 25 miles long between Merida and Progreso. Senores Ricardo C. Rivas and Galvas, Merida, also propose to build an electric road in Merida, to cost about $500,000. It is stated that a company is being organized to convert the Ferrocarril Muelle y Almancenes del Comercio de Progreso into an electric road and extending the same, at a cost of about $150,000. All the materials for these projects will be purchased in the United States.

PNEUMATIC TOOL COMBINATION.—A plan is now being attempted to organize a pneumatic tool consolidation, to include both British and American concerns, to be known probably as the Chicago Pneumatic Tool Company, and capitalized at $10,000,000. The purpose is to unite all the concerns engaged in the production of pneumatic machinery, such as drills and riveters, which are used extensively in mining, submarine and bridge work, as well as in steel working and railroad shops. It is proposed to include the following companies: The Chicago Pneumatic Tool Company, the Boyer Machine Company, of Detroit; the Franklin Air Compressor Company, of Cincinnati, and the Tate Howard Company, of Manchester, England. J. W. Duntley, president of the Chicago Company, is at the head of the new company.

STREET RAILWAY STORAGE BATTERIES.—The Electric Storage Battery Company, of Philadelphia, has installed 158 sets of batteries of Chloride accumulators in street railway service for the purposes of regulation, carrying the peak during heavy traffic and for use in emergencies. These batteries representing over 103,000 kilowatt-hours of output, are installed in power houses, sub-stations and rotary transformer stations, and cover every application of storage battery to street railway service. Among recent installations are those for the Detroit United Railway, consisting of 250 cells; the Chicago City Railway, 250 cells; the Southern Ohio Traction Company, 290 cells, and the Fairmount & Clarksburg Railroad, 250 cells.

BULLOCK APPARATUS FOR CANADA.—Another large three-phase alternating-current generator is being shipped to Canada from the Bullock plant at Norwood, Ohio. It is to be installed in the plant owned by M. P. Davis at Shieks Island, and is rated at 1350 horse-power. The normal operating speed of the machine is 180 revolutions, and it is to be direct coupled to a Hamilton waterwheel. In the official test, the dynamo was operated for a short period at 50 per cent over speed at which time the peripheral speed reached the high rate of 10,400 ft. per minute. The Bullock Company's works are crowded with orders for large machines and necessary extensions to the plant are now being made.

ELECTRIC TRACTION AT SHANGHAI.—Shanghai is to have an electric traction system, a special meeting of the ratepayers (mostly Britishers) of that Chinese city having passed a resolution to advertise for tenders to construct and operate an electric traction system. The municipality reserve the right to take over the undertaking within a given period, and under conditions to be determined on in the near future. A Mr. Hans Ziegler, said to represent British electrical interests, has been making overtures to the Shanghai authorities for some time past, but his propositions have been rejected. Mr. J. S. Fearon, of the commission house of Fearon, Daniels & Co., of 87 Front Street, New York City, who is now in China, has taken a leading part in the deliberations of the Shanghai authorities regarding the project. Several years ago a steam road was operated between Shanghai and several towns within a radius of some 30 miles. The extreme popularity of the road, however, caused its discontinuance, as the Chinese Government considered it was too much of an object lesson for the natives, and the road was purchased at an exorbitant figure by the authorities, who shipped the entire rolling stock to the island of Formosa, where it was dumped. The Chinese Government will have no jurisdiction over the contemplated electric traction project, as the road will operate within the foreign settlements.

BIG NEW ENGLAND TROLLEY SYSTEM.—At the first meeting of the Boston & Worcester Street Railway Company, held last week, officers were elected and contracts aggregating more than $1,500,000 for the construction of a new street railway line from Boston to Worcester were awarded. The new officers are: William Butler, president; H. Fisher Eldridge, of Portsmouth, N. H., vice-president; George A. Butman, of Boston, treasurer; H. W. Sprague, Arthur E. Childs, W. H. Trumbell, of Boston; Charles C. Pierce, of Brookline; John H. Whipple, of Brockton; Albion R. Clapp, of Wellesley; Fred C. Hines, of Newton; Charles W. Shippee, of Milford, and Alexander B. Bruce, of Lawrence, directors. Contracts were given to J. F. Shaw & Co. for the immediate construction of the line. The company has started work on a power station at Framingham, whence the line will be operated. The rails and ties have been distributed between Framingham and Natick. The Framingham, South Borough and Marlborough, the Framingham Union, and the Marlborough Street Railways, which have been acquired by the new company, will be operated from power stations already in use, and the company will have car barns at Wellesley and Westborough. Application will be made at once to the Selectmen of Wellesley for a location in that town in order to complete the line from Boston to Worcester.

THE JAMES LEFFEL & CO., of Springfield, Ohio, report the following recent sales and shipments of their steam engines and boilers: 8 by 10 engine for Porto Rico, to be used in driving machinery made only in England, for a special purpose; complete new outfit of 50-hp automatic engine, with 60-hp boiler for a modern flour mill plant in Wisconsin; complete new outfit of 8 by 10 engine, with 25-hp boiler for a hat factory at Oaxaca, Mexico; 6½ by 10 automatic engine for an electric plant on a plantation near Santiago, Cuba; 6-hp horizontal engine and boiler mounted on skids for driving a portable wood-sawing outfit in Wisconsin; 6½ by 10 engine and boiler complete for Barranquilla, Colombia, S. A.; 7½ by 10 automatic engine, and 3-hp vertical engine and boiler for customers in Spain; 7 by 10 engine and boiler for Monterey, Mexico; 9½ by 12 automatic engine for flour mill at Decatur, Ind. This company is also installing considerable new equipment in the way of machine tools, new power plant, including a 100-kw direct-connected unit, new blower system of heating, new electric traveling crane over a large erecting floor, new down-draft furnaces in connection with a new blacksmith shop equipment, etc. When completed, they will have one of the most modern and up-to-date shops extant specially adapted for producing their output, consisting entirely of waterwheels, steam engines and boilers.

ELECTRICAL PLANT FOR PORTO RICO.—Some important contracts have just been awarded in connection with the irrigating and electrical plants of the South Porto Rico Sugar Company's Guanica property located on the southern side of the island. The General Electric Company is to furnish two 250-kw dynamos with exciters, panels, etc.; six transformers; the same number of induction motors aggregating 350 horse-power, and two 75-kw rotary converters with transformer panels, etc. The Sterling Boiler Company, 26 Cortlandt Street, is to build three 200-hp water tube boilers, while the engines—two compound condensing machines of 320 horse-power each—will be manufactured by the Fitchburg Engine Company, of Fitchburg, Mass. The contracts for the pumping equipments to be utilized for irrigating purposes and consisting of six pumps, having a capacity in all of 20,000,000 gallons per day, will be let within the next few days. The before-mentioned contracts were placed through Mr. Percival R. Moses, electrical engineer, of 35 Nassau Street, New York City.

LARGE BATTERY MANUFACTURING PLANT.—The Nungesser Electric Battery Company, of Cleveland, Ohio, has commenced work on what is claimed will be the largest plant in the country devoted exclusively to the manufacture of electric batteries. The new building will be 130 by 140 ft., and two stories high, and will be located at King Street and the Lake Shore Railway. By reason of the immense and constantly growing demand for telephone and other batteries, the present plant, which has a capacity of 4000 cells per day, is entirely inadequate to the demands, despite the fact that important additions have been made during the past year. With the new plant in operation, the company will have a capacity of over 10,000 cells per day. Nungesser batteries go largely to jobbers, and shipments of 25,000 to 50,000 cells are not unusual. It is probable that before long the company will announce a new storage battery upon which Mr. Nungesser has been at work for some time.

BALL ENGINE ORDERS.—The Columbia Plate Glass Company, of Blairsville, Pa., has recently ordered an electric plant. One 300-hp and one 80-hp direct-connected Ball engines supply the power. The Wills Creek Coal Company, Byesville, Ohio, is about to install a 175-hp engine, built by the Ball Engine Company, Erie, Pa. The Jacksonville Gas Light & Coke Company, Jacksonville, Ill., is making quite an increase in its electric plant. The Ball Engine Company will build the engine, a 500-hp cross compound direct connected to a General Electric generator. The Ball Company is also furnishing an engine arranged for direct connection to a Sprague generator, to the Indiana Elevator, Chicago.

AIR POWER CARS A FAILURE.—The compressed air cars run on Twenty-eighth and Twenty-ninth streets before the Metropolitan Street Railway Company abandoned the experiment and went back to horse-power on those lines, have now been moved up to the car-barns on the Harlem flats near 216th Street and Kingsbridge Road. The Compressed Air Company officials claim that the cars were worn out by the heavy traffic which was carried on them. The cars are being stowed in winter quarters along with many open cars. Their ultimate failure and removal has been predicted several times in these pages, and it is believed they will stay permanently out of commission.

BOILERS FOR TRINIDAD LIGHTING PLANT.—The electric lighting plant of the Trinidad Electric Company, Limited, the Canadian-American enterprise, which is about to operate lighting and traction systems in Port-au-Spain, Trinidad, British West Indies, is to be equipped with two 250-hp boilers from Thayer & Co., incorporated, 39-41 Cortlandt Street, New York City. The boilers will be built by the Aultman & Taylor Machinery Company, of Mansfield, Ohio. It will be recalled that T. W. Teele, formerly of the Boston Elevated Railway, is manager of the Trinidad Company, and that Walter P. Plummer, Cable Building, 621 Broadway, is purchasing agent.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, has just sold to M. A. Bradley, of Cleveland, a 200-kw, three-bearing generator. The same company secured the contract for the installation of the new apparatus for the new Globe-Wernicke plant in Norwood, consisting of one 200-kw direct-connected generator, five 30-hp motors, three of 65 horse-power, two of 20 and two 10-hp motors. The Triumph Company furnished in prior orders about 1400 horse-power. The Tribune Company, Cincinnati, has contracted for one 200-kw and one 100-kw direct-connected generators.

SMITH-VASSAR TELEPHONE COMPANY DISSOLVED.—Judge McAdam, of the New York Supreme Court, has granted an order dissolving the Smith-Vassar Telephone Company, of 27 William Street, and appointed Herman W. Williams receiver with a bond of $500. Proceedings for the voluntary dissolution of the corporation were begun a year ago. The company was incorporated on Oct. 25, 1895, with a capital stock of $1,000,000. The annual report of the company filed in January last showed liabilities of $100,000.

LARGE POWER HOUSE.—It is stated that the Everett-Moore syndicate is preparing to build one of the largest power houses in the world from which it will operate the city lines and a portion of the interurban system of the Detroit District Railway. It is stated that about $1,000,000 will be devoted to new equipments for the new system and between $1,000,000 and $2,000,000 will be expended for power houses.

NEW WESTERN ELECTRIC BUILDING.—The Western Electric Company has been granted a permit to erect a ten-story office and factory building in connection with its present plant at 277 Clinton Street, Chicago. The new building will be 55 by 151 ft., and will cost $172,000.

POWER IN MONTANA.—The Madison Canyon Electric Power Company is pushing work on an immense power plant to cost about $5,000,000 to furnish power for most of Madison County, besides Butte.

General News.

THE TELEPHONE.

FORT SMITH, ARK.—A line of the National Telephone Company is being built from Caney, Kan., to Collinsville, I. T.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has leased a building in order to provide larger quarters for its local exchange in Redlands, Calif., where many improvements will be made in the service.

BAKERSFIELD, CALIF., has the largest number of telephones of any of the towns on the Pacific Coast, in proportion to population. There are in actual use 935 telephones. The switchboard in the local exchange is to be enlarged at once to keep pace with the growth of business.

SAN FRANCISCO, CALIF.—The Western Union Telegraph Company's business in California has grown considerably within the past few years, notwithstanding the fact that one of the best long distance telephone systems in the world covers the State and the coast. A new copper wire was recently completed from Chicago to Los Angeles, via El Paso, with a special view to the growing fruit business of Texas. An additional telegraph wire is being strung from Chicago to the Pacific Coast touching San Francisco and Los Angeles, via Omaha, Denver, Albuquerque and Barstow. This line, which will soon be completed, will run parallel with the Santa Fe Railroad.

DENVER, COLO.—The Rocky Mountain Bell Telephone Company has just received franchises to build exchanges in Casper, Douglas, Lander and Thermopolis, Wyo., and is building some 250 or 300 miles of territorial lines.

GREENVILLE, ILL.—The Greenville City Council has granted to J. H. Steinhaus a telephone franchise.

JERSEYVILLE, ILL.—The Calhoun County Telephone Company has decided to extend its lines into St. Louis.

LEWISTOWN, ILL.—The City Council recently granted a 99-year franchise to the Lewistown Automatic Telephone Company.

GRIGGSVILLE, ILL.—The Farmers' & Merchants' Union Telephone Company has certified to an increase of capital stock from $2,500 to $20,000.

MOLINE, ILL.—A temporary injunction has been granted to the East Moline Company which restrains the Crescent Telephone Company—the independent concern at Port Byron which has been building a toll line to Moline—from building through East Moline.

VINCENNES, IND.—A visit to Indianapolis and a close inspection of the new telephone plant at that place by a company of prominent citizens has resulted in a movement to put in an independent telephone plant in this city.

INDIANAPOLIS, IND.—The New Lisbon Telephone Company has been incorporated with a capital of $5,000. The company will operate in Dudley, Liberty and Henry Townships in Henry County. Mr. John A. Miller heads the board of directors.

INDIANAPOLIS, IND.—The Board of Public works has granted to the Central Union Telephone Company permission to construct underground conduits in the territory north of Twenty-first Street. The company proposes to establish a branch telephone exchange at Pierson Place and Twenty-first Street.

MARION, IND.—The United Telephone Company has awarded the contract for the underground and the ærial cable systems, for its new plant in this city to F. B. Bissell, of Toledo, Ohio, and J. F. Butterfield, of Chicago. The contract price is $40,000. There will be 60,000 feet of underground and 50,000 feet of overhead cable work.

NEWTON, IA.—A telephone company has been organized among the merchants of Baxter and influential farmers residing northwest of that town.

SIOUX CITY, IA.—The Sioux City & Black Hills Telephone Company has been organized at Ponca, Neb., with $100,000 capital to build a toll line from Sioux City to the Black Hills, 520 miles. The officers are: J. J. McCarthy, Ponca, president; E. E. Hallstead, Ponca, secretary; F. B. Row, Sioux City, manager.

TOPEKA, KAN.—The Independent Telephone Company is planning to build a line from Topeka to Meriden, which will give connections between the Topeka line and the independent line reaching from Atchison to Meriden.

TOPEKA, KAN.—The Kansas City Council has granted a 30-year telephone franchise to John Enoch. This franchise will be used to organize a Kansas City terminus for the Kansas Independent Telephone Company, of which B. F. Pankey is one of the promoters.

HARTFORD, KY.—A battle royal is on between the Rough Rider Telephone Company, a local enterprise, and the Cumberland Company, which seeks to drive the former out of business by low rentals. The Rough Rider Company is preparing to build a line to Morgantown, Ky.

MENOMINEE, MICH.—A twenty-one-year franchise has been granted the Green Bay & Lake Michigan Telephone Company, owned by ex-Governor Schofield and A. L. Hutchinson, by the Council. The line is to be extended from Escanaba to Milwaukee.

ST. JOSEPH, MO.—Mr. Lyle, of Maysville, has sold his telephone line in DeKalb County, and the two companies have been merged into one.

JEFFERSON CITY, MO.—The Harrison County Mutual Telephone Company, of Brooklyn, capital stock $9,000, has been incorporated by E. Reynolds, F. Davis, J. L. Stanton, and others.

RED LAKE FALLS, MINN.—A telephone line from Third River Falls to Roseau is projected. H. Fant is the projector.

CONCORD, N. H.—The New England Telephone Company is preparing to construct a line from Franklin to White River Junction.

GLENVILLE, NEB.—A telephone company has been formed at this place.

PLATTSMOUTH, NEB.—The Plattsmouth Long-Distance Telephone Company has made application for a franchise in South Omaha. It offers to make a reduction of 30 per cent in all telephones and to furnish the city departments with instruments free of charge.

COHOES, N. Y.—The Dolgeville Telephone Company has been sold to the Interstate Telephone Company of Little Falls.

NEWBURGH, N. Y.—An application for a franchise for a new telephone system is being considered by the Catskill Board of Trustees.

WILLIAMSBURG, OHIO.—A franchise has been granted to the Citizens' Telephone Company to build and maintain an exchange in this place.

NEVADA, OHIO.—The telephone exchanges at Wyndor and Nevada are being connected by a toll line which is being built by both companies.

MARIETTA, OHIO.—The Bell Telephone Company is at work on a new exchange building at Marietta. Cables are being laid on several of the business streets.

EAST HAMILTON, OHIO.—The City & Suburban Telephone Association, of Cincinnati, has been granted a franchise to erect and maintain a system in East Hamilton.

UPPER SANDUSKY, OHIO.—The United States Telephone Company has filed a $1,000,000 mortgage here to the Cleveland Trust Company on all its property in Ohio.

MT. VERNON, OHIO.—H. C. Devin and E. W. Breece, of the Mt. Vernon Telephone Company, are endeavoring to secure a franchise for an exchange in the neighboring town of Utica.

CINCINNATI, OHIO.—A temporary restraining order has been issued against the City & Suburban Telephone Association restraining it from erecting its poles and stringing wires in Delphos near Cincinnati.

WILLOUGHBY, OHIO.—At the annual meeting of the Willoughby Home Telephone Company, held a few days ago, the board of directors and officers were re-elected, the only change being in the election of J. H. Smart as secretary-treasurer, to succeed J. S. Ellen. The other officers are: L. W. Penfield, president; W. C. Collister, vice-president, Fred. Strom, general manager.

TORONTO, OHIO.—The Citizens' Telephone Company, of Toronto, which has recently succeeded the Phœnix Telephone Company, of this place, is making extensive improvements to its exchange. A combination central energy and magneto switchboard of 300 capacity is being installed by the Cleveland branch of the Kellogg Switchboard & Supply Company, of Chicago, and new instruments are being supplied to all subscribers in the town.

CLEVELAND, OHIO.—The United States Telephone Company has filed with the County Recorders of all the counties through which its lines pass, a deed of trust for $1,800,000 to the Cleveland Trust Company, supplemental to a $1,350,000 mortgage. The original mortgage was filed last year. The $450,000 increase covers improvements which have been made in the telephone system since the mortgage was made. The mortgage will be increased from time to time as the mileage of the toll lines increases.

YOUNGSTOWN, OHIO.—The exchange of the Youngstown Telephone Company occupies the unique distinction of being on stilts. The company occupies the top story of an office building and the owners of the building desired to tear it down and build a new one. The telephone company protested that it could not move without making expensive changes and disorganizing its service, and as it held a lease on the room it declined to move. Accordingly the top floor of the building was elevated on a firm base and the lower portion of the building was torn down. New foundations are being built and the new building will be eight stories high—considerably higher than the old building—so that the top floor will have to be raised from time to time. The work of the exchange goes on as usual, the room being reached by an outside stairway.

CLEVELAND, OHIO.—Through the aid of a newly organized and well equipped contract department, the Cuyahoga Telephone Company is making phenomenal gains in its subscription lists. At present the number of subscribers is something over 9000, and the manager of the department states that orders for individual telephones are coming in at an average rate of 25 per day. The company is also showing remarkable gains in its private branch exchange work. Many of the large factories and mercantile establishments have recently improved their telephone service by this convenient service, while many of the numerous large apartment houses now being erected are to be equipped with private branch exchanges. Within the past sixty days branch exchanges have been installed in three factories, four mercantile establishments and four apartment houses, and others are to be installed as soon as the apparatus can be secured.

WELLSBORO, PA.—Work has been begun on a telephone line between Liberty borough and Roaring Branch.

SCOTTSBORO, TENN.—A new telephone system is being installed here which will give two exchanges for Scottsboro. The line is being built from Bridgeport to Huntsville.

NASHVILLE, TENN.—The Richland Telephone Company, of Grainger County, has been incorporated; capital stock, $1,000. Wm. Stone, Sam McBee, A. E. Foster, W. A. Frazier and Sam McKinney are the incorporators.

LA CROSSE, WIS.—The Hillsboro and Wonewoc Telephone Company will lease the Viroqua & Wonewoc branch of the La Crosse & Southwestern Telephone Company's line.

MADISON, WIS.—The Milwaukee Telephone & Telegraph Company, with the general purpose of using and licensing others to use all sorts of devices for conveying sound, has filed articles of association with the Secretary of State. The capital stock is $25,000, and the incorporators are F. C. Winkler, Edwin Reynolds and E. A. Wadhams.

FOND DU LAC, WIS.—The much-rumored consolidation of all the independent telephone companies in Wisconsin will probably be effected early in the spring. This information comes from one of the directors and principal stockholders of the Little Wolf River Telephone Company. The consolidation will greatly increase the efficiency of the service of the various companies to enter the combination and will probably require the construction of a number of additional toll lines and exchanges throughout the State.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The citizens of Haywards, Calif., are agitating the question of arranging for a bond issue for the purpose of acquiring the electric lighting plant now operated by a private concern. A municipal water plant may also be provided for.

FRESNO, CALIF.—The citizens of Fresno will decide, at special elections, whether or not they are in favor of municipal ownership of public utilities. One proposition is to vote for $250,000 worth of water bonds, and the other is for bonds, in the sum of $250,000, to install a municipal lighting plant.

ALAMEDA, CALIF.—The Board of City Trustees of Alameda recently decided to increase the capacity of the municipal electric lighting plant and to reject a proposal made by the Oakland Gas, Light & Heat Company, to supply Alameda with electric current for lighting after midnight. Bids have been called for for an additional engine and dynamo.

LOS ANGELES, CALIF.—The Kern Power Company, with a capital of $5,000,000, fully subscribed, has filed papers of incorporation. It proposes the manufacture of electricity for light, heat, and power; also the acquirement of water rights, the construction of bridges and pipe-lines, and the obtaining of all kinds of franchises. The directors are H. E. Huntington, S. W. Hellman, A. Borel, C. De Guigne, W. G. Herckhoff, A. C. Balch, and H. W. O'Melveny. It is proposed to obtain power on Kern River, 150 miles north of Los Angeles.

SAN FRANCISCO, CALIF.—The city trustees of Riverside, Calif., recently received two propositions to furnish the town with electricity for municipal lighting and power. The municipality owns an electric transmission line and has been buying current from private companies. Judge Campbell offered to construct a 600 horse-power generating plant on Lytle Creek, using hydraulic power. At the end of thirty years he would turn the plant over to the city free of charge. He wishes to sell electric power to the city at a rate of $6 per horse-power per month, for a minimum of 350 horse-power, and would charge but $5 per horse-power for all additional power used. The Mt. San Bernardino Power Company offered to install an electric power plant on Mill Creek, to pay $15,000 for the city's transmission line and to supply the city with 400 horse-power at $2,000 per month. It will guarantee the municipality against loss by failure of the plant and will give bonds to complete the plant by Dec. 31, 1902.

WILMINGTON, DEL.—The Standard Light Company, of Wilmington, has been chartered to manufacture and deal in incandescent lights and electrical fittings; capital, $500,000.

MONTICELLO, ILL.—The Monticello Electric Light Company, of Monticello, has certified to an increase of capital stock from $10,000 to $20,000.

SPRINGFIELD, ILL.—The Genoa Electric Light Company, of Genoa, has been incorporated; capital stock, $10,000; incorporators, George Loptien, H. L. Canfield and A. C. Anderson.

CUMBERLAND, MD.—The Cumberland Electric Light & Power Company has been incorporated with $50,000 capital by Charles W. Kilbourn, New Brunswick, N. J.; Arthur Le Roy Fell, Washington, D. C.; Arthur L. Bosley, Baltimore, and Duncan Sinclair and John G. Wilson.

GRAND RAPIDS, MICH.—The Edison Light Company has decided to install a new 1500-hp engine and generator of 1000 kilowatt capacity. The new machinery has not yet been purchased. It will supplant a 1000-hp. unit. The company has nearly completed the work of taking down poles and installing an elaborate conduit system.

CHILLICOTHE, MO.—John Doll and P. A. Gibson, of Erie, Pa., are in Chillicothe looking over the field with a view to buying Chillicothe's electric light plant and building an electric railway from Chillicothe to Trenton. All they ask from Chillicothe is right of way in Livingston County. They would also expect a street lighting contract with the city.

WILMINGTON, N. C.—The Wilmington Gas Light Company has obtained control of the street railway and electric light plants in this city.

ASHEVILLE, N. C.—Ladshaw & Ladshaw, of Spartanburg, S. C., have completed plans for the W. F. Weaver Power Company for the construction of an electric power plant on the French Broad River, six miles from Asheville. The plant will cost about $200,000 and two 750 kilowatt generators will be installed. The power will be utilized for operating a cotton mill and an electric railroad.

GOLDSBORO, N. C.—The special committee has reported to the Aldermen regarding an inventory of the plant of the Goldsboro Electric Light Company, and probable cost of same. The committee recommended that the city purchase the plant for $25,000. The Board of Aldermen adopted the recommendation, and the action will be taken as soon as the city floats the bonds and secures the money.

JERSEY CITY, N. J.—The American Town Lighting Company, Jersey City, capital $1,000,000, has been incorporated by Henry N. Gallaudet, Elizabeth; John J. Daly, Brooklyn, N. Y.; Edwin B. Ware, New York; Archie L. Wisner, New York; Joseph E. Cornigan, New York; Forsyth Wickes, New York; Joseph P. Cotton, Jr., New York.

ALBANY, N. Y.—The Adirondack Electric Company, of Lake Placid, has been incorporated; capital, $100,000. Directors: A. W. Boynton, Keesville, and H. S. Isham and F. A. Isham, Lake Placid.

ALBANY, N. Y.—The Century Light & Power Company, of New York City, has been incorporated; capital, $150,000. Directors: G. W. Glaentzer, of Ridgewood, N. J.; C. B. Hobbs, of Great River, L. I., and J. D. Fearhake, of Brooklyn, N. Y.

ALBANY, N. Y.—The Madison County Gas & Electric Company, of Oneida, has been incorporated; capital, $200,000. Directors: George S. Sheppard, John A. Underwood, Fred. H. Lynn, Mark L. Wilhelm, of Penn Yan, and George M. Wilhelm, of Oneida.

MADISONVILLE, OHIO.—An issue of $25,000 for electric light and water works improvements has been decided upon by a recent vote of citizens.

BEACH CITY, OHIO.—The Tuscarora Rubber Company, which has a large plant at Beach City, has submitted a proposal to the village Council to furnish light at a cost of $75 per arc lamp.

CINCINNATI, OHIO.—The Lovercombe Gas & Electric Company, of Cincinnati, has been incorporated, with $10,000 capital stock, by Fred. A. Lovercombe, Andrew Messner, Emil Schmidlin, Alois Wuest and Thomas L. Pogue.

ANDERSON, S. C.—The Anderson Water, Light & Power Company has completed over $500,000 in improvements at its plant on Seneca River. The dam as completed is 700 feet long and 44 feet high. The power developed is 4600 horse-power, and is transmitted to Anderson, where it is utilized in various ways.

KNOXVILLE, TENN.—In Baltimore the Hambleton syndicate has transferred the property of the Knoxville Traction Company and the Knoxville Electric Light & Power Company to the trust company which has purchased it. The property transferred is worth at least $1,000,000. The Knoxville Traction Company is capitalized at $750,000, and the Knoxville Electric Light & Power Company is capitalized at $110,000, and the stock sold on the market at an advance of ten per cent.

PARIS, TEX.—The Paris Light & Power Company filed an amendment to its charter, increasing its capital stock from $60,000 to $120,000.

SALT LAKE CITY, UTAH.—A Scranton, Pa., syndicate has just begun to break ground near Hailey, Idaho, for a 25,000 horse-power electric power plant for its three big quartz mills at that place. Shoshone Falls will be used for power. The company will also furnish power to Wood River Camp and the new copper camp at Contact, Nev., nearly fifty miles distant. In addition to this a trolley line will be built on the old stage line that runs to Shoshone Falls. It is said that the company will expend $2,000,000 on this new scheme. The company proposes to furnish power and light to all the towns and mining camps within a radius of 100 miles.

RICHMOND, VA.—The Virginia Electrical Railway & Development Company has closed a contract with the Electric Storage Battery Company, of Philadelphia, for a storage battery plant, the building for which will be located immediately adjoining the power-house of the company.

NORFOLK, VA.—The president of the Norfolk Heat, Light & Power Company, Mr. W. D. Pender, states that the company will be prepared to furnish electric power by the middle of December, if the Council decides that the company can use overhead wires. The matter rests with the Board of Electrical Control.

LEESBURG, VA.—The Leesburg Council has granted a franchise to Mr. Beverly Chichester for the erection of poles on the streets of Leesburg by a new electric light company, which will shortly erect a new plant here. This franchise was granted because of the unsatisfactory service of the plant now in operation.

SEATTLE, WASH.—The Great Northern Railroad Company is investigating the project of utilizing the surplus water power of Snoqualmie Falls, about 30 miles from Seattle, Wash., to operate electric locomotives to haul its trains from Seattle to the summit of the Cascade mountains. If the Great Northern's long distance transmission plan is proven to be feasible, the Northern Pacific Railroad Company will possibly obtain electric power from the same source to operate its trains from Seattle and Tacoma to the Cascades' summit. It is asserted that the available capacity of Snoqualmie Falls is 100,000 horse-power. The available head is 270 feet and only 10,000 horse-power are now developed for electric light and power supplied to Tacoma and Seattle.

MADISON, WIS.—The La Crosse Gas & Electric Company, with a capital stock of $600,000, has filed articles of association. The incorporators are W. Cargill, William S. Cargill and George MacMillan.

THE ELECTRIC RAILWAY.

DENVER, COLO.—It is reported that a company has been formed in Denver with a capital of $300,000, to build an electric railway from Denver extending into Ouray County, Colo.

SPRINGFIELD, ILL.—Charles C. Carroll, of this city, and D. B. Powell, of St. Louis, have sold the electric railroad on the Eads bridge at St. Louis to a syndicate of capitalists representing New York, Chicago, St. Louis and East St. Louis. The purchase price has not been made public.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company has increased its capital stock from $100,000 to $750,000.

ELWOOD, IND.—The Union Traction Company will extend its line from this city to Tipton and thence to Kokomo. Three more extensions are proposed.

UNION CITY, IND.—The City Council has granted a franchise to the Richmond, Union City & Portland Interurban Company to operate over the streets of this city.

EATON, IND.—The Muncie, Hartford & Fort Wayne Traction Company has given a contract to the E. P. Roberts Company, of Cleveland, Ohio, for a power house to be built in this city at a cost of $125,000.

FT. WAYNE, IND.—An important consolidation of interurban companies was effected here on Nov. 14, when the Toledo & Bryan Air Line Company merged its interests with those of the Indiana & Ohio Traction Company in a new corporation entitled the Ohio & Indiana Air Line, which will build a line from Toledo, Ohio, to Marion, Ind. The new company's lines when completed from Toledo to Marion will be 147 miles long.

BALTIMORE, MD.—Ex-Senator M. C. Alford, of Kentucky; W. J. Loughbridge, vice-president of the Third National Bank of Lexington, Ky., and Senator George D. Davis, of Detroit, Mich., are among the directors in a company organized to build a system of 140 miles of electric railways, of which Lexington will be the center. It will probably be built to connect the towns of Versailles, Frankfort, Paris, Georgetown, and other communities in the Blue Grass region. The company represents $7,000,000 capital stock and will construct a light and power plant at Lexington.

SARANAC, MICH.—At a special meeting of the City Council a franchise for an electric railway was granted to E. L. Alvord and I. F. Tucker, for the Saginaw & Grand Rapids Electric Street Railway through the village.

CONCORD, N. H.—Wallace D. Lovell says that if the citizens of Dover, Concord and the intermediate towns will raise $200,000 he will furnish the remainder of the $1,000,000 required for the construction of an electric railway between the two cities, for which he holds a charter granted by the last Legislature.

NEWARK, N. Y.—The construction of the Newark-Marion electric trolley line is assured. The contractors are Taylor & Tyles, of Worcester, Mass.

UTICA, N. Y.—The announcement is made that a trolley line will be constructed through the eastern side of the Adirondacks from Lake Champlain to Lake Placid. The starting point will be Keesville, and the route via Ausable Forks and Upper Jay. A company has been organized.

OTTAWA, OHIO.—The Toledo & Lima Traction Company has been granted a franchise through the town of Ottawa.

CINCINNATI, OHIO.—The Suburban Traction Company of Cincinnati has increased its capital stock from $50,000 to $60,000.

MASSILLON, OHIO.—The Canton-Massillon Railway has applied to the Massillon Council for franchises for several lines in the city.

CINCINNATI, OHIO.—The line of the Hamilton, Glendale & Cincinnati Traction Company has just been opened between this city and Hamilton.

CANAL FULTON, OHIO.—The village Council of Canal Fulton has agreed to grant a franchise through town to the Canton, Wadsworth & Lodi Electric Railway.

TOLEDO, OHIO.—J. C. Bonner & Company, Toledo, are placing on the market an issue of bonds of the Toledo & Bryan Air Line Railway in which they are interested.

AKRON, OHIO.—The Northern Ohio Traction Company has been granted a franchise by the City Council of Akron for a new line to touch the new manufacturing district south of the city.

STEUBENVILLE, OHIO.—The Steubenville Traction Company has closed a contract for a storage battery plant at Toronto to assist in the operation of the new Toronto extension of the road.

RICHWOOD, OHIO.—The Village Council has granted a franchise through town to the Defiance, Ottawa, Kenton & Columbus Railway, which proposes to build a line from Defiance to Columbus.

COLUMBUS, OHIO.—The Cincinnati & Cleveland Traction Company has brought suit in the Ohio Supreme Court to compel the Probate Court of Hamilton County to grant the company a franchise in that county.

ALLIANCE, OHIO.—The Alliance Street Railway Company has applied to the Alliance City Council for a 25-year blanket franchise on existing lines and for certain extensions. It is probable that the franchise will be granted.

COLUMBUS, OHIO.—It is reported that the Everett-Moore syndicate has made overtures to the Columbus Railway Company with a view to absorbing the Columbus city lines. The story is denied by officials of the Columbus company.

CLEVELAND, OHIO.—The Wabash & Rochester Electric Railway Company has been organized, with Hon. D. A. Dangler, Cleveland, president; James Lynn, Wabash, Ind., vice-president, and Thomas W. Latham, Cleveland, secretary-treasurer.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company, of Youngstown, has been granted a 50-year franchise by the Mahoning County Commissioners to extend its Albert street line. Eventually the line is to be extended to Hubbard,

STEUBENVILLE, OHIO.—The Pleasant Heights Railway Company, which has recently completed a road in Steubenville, has secured right of way to extend the line to Mt. Calvary. It is said that eventually it will be extended to Wintersville and Richmond.

TOLEDO, OHIO.—The Toledo, Hicksville & Ft. Wayne Railway Company has been incorporated, with $15,000 capital stock, by A. K. Detwiler, Charles P. Griffin, Frank S. Harn, John Q. Tibbs, C. H. Masters, L. E. Flory, L. W. Brown, James Donnelly and Wm. O. Delaney.

TOLEDO, OHIO.—The stockholders of the Toledo & Indiana Railway Company have voted to increase the capital stock to $2,500,000. The Toledo & Indiana Construction Company will build this line, and the Toledo, Hicksville & Fort Wayne Railway. (See note in next column.)

CLEVELAND, OHIO.—The Cleveland & Warren Electric Railway is now under actual construction between Bedford and Geauga Lake, a distance of ten miles. The officers are: J. W. Conger, president; Dr. F. J. Morton, vice-president; A. B. Crafts, secretary, and Martin Dodge, general manager.

ASHLAND, OHIO.—The Wellington, Savannah & Mansfield Railway Company has purchased a site for a power-house near Savannah. C. H. Lawrence, of the International Construction Company, Toledo, which is building the road, has just returned from New York, where he placed contracts for rails and other materials.

CLEVELAND, OHIO.—The Cleveland Stock Exchange has listed the stock of the Lake Shore Electric Railway Company. The issue consists of $4,500,000 in common stock and $1,500,000 in preferred stock. The Lake Shore Electric will be bonded for $6,000,000, but only about $4,500,000 will be issued at the present time.

GENEVA, OHIO.—Construction work has been started on the power house at Geneva for the Ashtabula extension of the Cleveland, Painesville & Eastern Railway. The building will be 144x112 feet, and it will contain equipment sufficient to operate that end of the road and furnish current for lighting the city, franchise for which is now held by the Everett-Moore syndicate.

CLEVELAND, OHIO.—The Securities Company, of Cleveland, a New Jersey corporation, has qualified to do business in Ohio. Fred. S. Borton is president and George E. Bender, secretary. The company has a capital stock of $1,000,000. The Securities Company is the company organized by the Everett-Moore syndicate to handle its securities, and it has its headquarters in the Electric Building.

TOLEDO, OHIO.—The Toledo & Indiana Construction Company, of Toledo, has been incorporated with $15,000 capital stock by A. K. Detwiler, C. P. Griffin, Squire Garnsley, L. E. Florley, James Donnelly, L. W. Brown, Frank Yerbera, and W. P. Delaney for the purpose of constructing and equipping electric railways. The company will build the Toledo & Indiana Railway, which is promoted by the same people.

CINCINNATI, OHIO.—Directors of the Georgetown & Lexington Traction Company have arranged for the issuance of $250,000 in bonds to pay for the completion of the road and its equipment. The entire line from Georgetown to Lexington (Ky.) is graded. It is expected that the work will be finished and the road in operation within 90 days. The C. C. Tennis Construction Company, of this city, is building the road.

TORONTO, ONT.—Buffalo, N. Y., capitalists are negotiating for the purchase of the Peterboro & Ashburnham (Ont.) Electric Railway. If secured the purchasers intend to extend the line to Lakefield, Ont., a distance of seven miles, and will also equip the road with new rolling stock.

JENKINTOWN, PA.—The Huntingdon Valley Street Railway Company has been granted a charter to construct a new trolley line at Rockledge. The incorporators are I. A. Sweigard, president; J. R. Atmore and John S. Gilbert. The capitalization of the company is $30,000.

HARRISBURG, PA.—The following charters were issued at the State Department recently: The Eastern Rapid Transit Street Railway Company, Pittsburg, capital $6,000; the Vandegrift & New Kensington Street Railway Company, Vandegrift, capital $15,000; the Apollo, Vandegrift & Leechburg Street Railway Company, capital $50,000.

PITTSBURG, PA.—C. R. Bucheit, T. N. Barnsdall and E. W. Davis, all of this city, have purchased the electric light and traction plant and two toll bridges between El Paso, Tex., and Juarez, Mex., for $621,000. They will organize in New Jersey the El Paso Electric Company, with a capital of $1,250,000, and will build 50 miles of traction road along the Rio Grande. They have a 50-year franchise with the United States Government and a 10-year contract to supply light in El Paso.

MONTREAL, QUE.—At the annual meeting of the shareholders of the Montreal Electric Street Railway, the statement showed that during the year, the company carried 46,741,000 passengers. The net income per cent of capital was 11.80, the net earnings $795,413 and the operating expenses $1,105,000. The earnings for the year show a net profit of $649,251, as compared with $647,246 for the year previous. Out of this amount, four quarterly dividends of 2½ per cent each have been declared, amounting in all to $551,700, leaving a surplus of $97,551, of which amount the sum of $50,000 has been added to the contingent account, and the balance, $47,551, has been added to the surplus account. In addition to the electrically driven plant, the company has purchased and installed two steam units, capable of developing 3,000 horse-power. The company has decided to appropriate $100,000 for a fund, in order to transact the company's own fire insurance, to which fund will be added from $10,000 to $15,000 annually. The following gentlemen were elected directors for the year ensuing: Hon. L. J. Forget, James Ross, K. W. Blackwell, F. C. Henshaw and Hugh Montague Allen. At a subsequent meeting of the directors, Hon. Mr. Forget was re-elected president; Mr. Ross, vice-president, and Mr. F. L. Wanklyn, general manager.

KNOXVILLE, TENN.—It is stated definitely that control of the Knoxville Traction Company has passed into the hands of the Railways & Light Company of America. The Baltimore Trust & Guarantee Company brought about an issue of $850,000 bonds and it was from this company and others that the control was secured.

KNOXVILLE, TENN.—The Knoxville, Kimberlin Heights and Sevierville Electric Railway will be twenty-seven miles from Knoxville to Sevierville, and thence to the headwaters of the east and west forks of Pigeon River, seven and eight miles respectively, and with other branches, will make a total of about fifty-four miles projected and touching three counties. The company has just been chartered with a capital stock of $150,000.

PARIS, TEX.—The Paris Transit Company, which was recently incorporated here, is successor of the Paris Railway Company. It is now building an extension.

SALT LAKE CITY, UTAH.—The Consolidated Railway & Power Company of Salt Lake City, will make extensive improvements in its plant. A large power plant will be built on the banks of the Jordan River, and will cost in the neighborhood of $300,000. It will develop from 2500 to 3000 horse-power.

SALT LAKE CITY, UTAH.—The owners of the Rambler copper mine in the Douglas Creek district, near Grand Encampment, Wyo., will build an electric railway from the Ferris-Haggerty mine, to the Encampment smelter. The new line will be over thirty miles in length and will cost over $200,000.

SALT LAKE CITY, UTAH.—A deal is on foot for the consolidation of electric railway interests to build a $2,000,000 interurban system between the cities of Salt Lake and Ogden has just leaked out. It involves the purchase and consolidation of the Ogden & Salt Lake Railway, including the Hot Springs line and the construction of new roads to fill in the gaps between Brigham City, Ogden Hot Springs and Ogden. The road, it is said, will be under the control of the Everett-Moore syndicate of Cleveland, Ohio.

RICHMOND, VA.—A recent fire totally destroyed the four-story brick structure at the corner of Main and Seventh Streets, occupied by the Richmond Traction Company, the Virginia Electrical Railway & Development Company and the Tower-Binford Electrical Supply Company. Miss Emily Crump, a stenographer, was seriously injured by jumping from a second story window, and a negro porter is believed to have perished in the basement. A number of persons were slightly injured. The total loss is estimated at a little less than $100,000. There was $10,000 insurance on the building, which was owned by Charles T. Davis; the Tower-Binford Company had about $15,000 insurance on stock, and it is understood that the traction and electrical companies had full insurance on their stock and office furniture. The origin of the fire is a mystery. Those who were at work in the building heard a dull report and a moment later dense smoke and flames were seen to rise. It is believed that the boiler of the steam heating plant exploded.

TACOMA, WASH.—The Everett Railway & Electric Company has given a $1,000,000 mortgage to the Manhattan Trust Company, New York, securing bonds for the same amount. The company will extend its system.

KENOSHA, WIS.—Articles of incorporation have been filed by the Wisconsin Inter-Lakes Electric Railway Company. The capital stock of the company is $25,000. The men acting as incorporators are Gerald R. McDowell, Jacob Kroncke and W. T. Marlatt.

NEW INDUSTRIAL COMPANIES.

THE WOOLY SMOKELESS FURNACE COMPANY has been incorporated at Salt Lake City, Utah, with a capital stock of $200,000.

THE ELECTRIC SPECIALTY COMPANY, with Dr. A. W. Gregg, president, has been organized at Kennett Square, Pa. The company has a capital of $25,000.

THE MUNDER ELECTRIC COMPANY has been organized at Saco, Me., for the purpose of manufacturing electrical appliances and supplies, with $50,000 capital stock.

THE COMMERCIAL ELECTRIC TIME COMPANY, of New York City, has been incorporated; capital, $250,000. Directors: Ralph Jonas, Henry Best, and D. M. Edwards, of New York City.

THE AKOUPHONE MANUFACTURING COMPANY, of New York City, has been incorporated; capital, $50,000. Directors: R. C. Maroney, C. W. King and Peter Jenness, New York City.

THE CARBON LIGHT COMPANY has filed articles of incorporation at St. Louis, Mo. The capital stock is $25,000. John P. Barnes, John H. Lucas and William T. Johnson are among the shareholders.

THE CALIFORNIA INCANDESCENT LAMP COMPANY has been incorporated with San Francisco named as the place of business. Directors: F. D. Stringham, A. J. Dibblee, N. A. Dodge, F. Gallinger, and M. F. Michael. Capital stock, $100,000.

THE AMERICAN PUSH BUTTON TELEPHONE COMPANY, of New York City, has been incorporated at Albany; capital, $300,000. Directors: E. G. Potter and F. P. Duryea, of New York City, and R. S. Kristeller, of Brooklyn.

THE DULUTH GENERAL ELECTRIC COMPANY, of Duluth, Minn., has been incorporated; capital stock, $100,000. Incorporators: Alex. W. Hartman, Duluth; R. R. Dunn, St. Paul; Renwick B. Knox, Duluth; Curtis E. Van Bergen, Duluth, and Otto C. Hartman, Duluth.

MONTREAL, QUE.—The Dominion Subway Company is seeking incorporation to construct, maintain, etc., underground conduits, wires, cables and pneumatic tubes in this city. The proposed capital stock is $100,000, and among the names of the incorporators are Charles F. Sise, Robert McKay, Robert Archer, Hugh Paton and Charles Cassils, all of Montreal. The company's headquarters will be in Montreal.

LEGAL.

"PUNY" PUNISHMENT.—An electrical company in Reading, Pa., has asked that a verdict against it of $4,000 punitive damages be set aside on the ground that the word punitive was written "puny" by one of the jurors.

AUTOMOBILE RIGHTS.—A judge in New York when reversing a decision against an automobilist whose machine had caused a horse to run away and wreck the wagon to which it was attached, said: "The horse has no paramount or exclusive right to the road, and the mere fact that a horse takes fright at some vehicle run by new and improved methods and smashes things does not give the injured party a cause of action. Horses may take fright at conveyances that have become obsolete as well as those which are novel; but this is one of the dangers incident to the driving of horses, and the fact cannot be interposed as a barrier to retrogression or progress in the method of locomotion. Bicycles used to frighten horses, but no right of action accrued."

BREACH OF CONTRACT.—The Stromberg-Carlson Telephone Company has brought suit against the Reserve Construction Company, of Cleveland, for $100,000 for breach of contract. The Reserve Construction Company awarded a contract last April to the Stromberg-Carlson Telephone Manufacturing Company for the installation of the general switchboard equipment and the telephone instruments in Detroit for the People's Telephone Company, for the sum of $306,000. Subsequently, after the Stromberg-Carlson Company had made large preparations to fill the contract, the Reserve Construction Company refused to allow the Stromberg-Carlson Company to furnish the apparatus, and the contract was awarded to another concern, the excuse given by the defendant being the desire to avoid alleged threatened patent litigation. The plaintiff claims that any fears of patent litigation were wholly groundless.

LIABILITY FOR OPERATOR'S ACTS.—In Pacific Postal Telegraph Company vs. Bank of Palo Alto, 109 *Federal Reporter* 369, it is held that a telegraph company is responsible in damages for the criminal use of its wires and instruments by a telegraph operator acting in pursuance of a conspiracy with an outside party, and in criminal violation of the duties of his position and employment. It appeared that as a result of a conspiracy between a telegraph operator and a third party to defraud a bank, the plaintiff in the case, a forged telegraphic message purporting to be sent by another bank and ordering the payment of money to a designated person was transmitted to the plaintiff, and that the plaintiff, on the representation of the third party to the conspiracy that he was the person designated in the message, paid him the sum ordered. The Court said: "In holding the telegraph company liable for the wrongful, tortious, and criminal acts of the operator, we are not called upon to make any departure from the established principles of the law. No additional or independent reasoning is required to show that the rule as announced in the telegraph cases is sound and just. Its foundation is based on the principle, often applied by the courts in a great variety of cases, that, if one of two innocent persons must suffer loss by the act of a third, he who put it in the power of the third person to do such act should be compelled to sustain the loss occasioned by its commission."

OBITUARY.

MR. JOHN M. GWINNELL.—The death is announced of Mr. J. M. Gwinnell, president of the Duranoid Manufacturing Company, in the sixty-seventh year of his age.

MRS. JESSE M. SMITH.—A great many of our readers will note with deep regret the sudden death from pneumonia in New York of the wife of Mr. Jesse M. Smith, the well known electrical and mechanical engineer, formerly of Detroit. Mrs. Smith was ill barely three days. Of charming personality she was a frequent companion of her husband in engineering circles and at social functions of a professional character. Mr. Smith has the deep sympathy of a host of friends.

MR. JAMES J. MURRAY.—We regret to record the death of one of the most prominent glass manufacturers of Philadelphia in the person of James J. Murray. He underwent an operation two years ago, from the effects of which he and his friends thought he had fully recovered, but complications set in that resulted in an acute attack, and death followed after a week's illness, Nov. 10. Mr. Murray was proprietor of the Murray Flint Glass Works, at Trenton Avenue, Culvert and Waterloo Streets, one of the most complete glass factories in the country. He grew up in the glass business. Immediately after leaving school he became shipping clerk in 1869 in the old Kent Avenue and Morton Street factory, Brooklyn, then run by Messrs. Leach, Sneider & Pelletier. When this factory passed into other hands, he was selected, although a mere boy, as business manager for the Bushwick Glass Works on Maujer Street, Brooklyn, owned by Messrs. Hoover & Dannenhoffer. In 1878 Mr. Murray went to Philadelphia, and the firm name of Gill & Murray became favorably known to all the glass dealers of the United States, and to those engaged in the electric lighting field. Under the skilled management of Mr. Murray, from renters they soon became owners of the Washington Flint Glass Works at York and Thompson streets. In 1886 Mr. Murray, desiring a larger, more commodious and more up-to-date factory, he left Mr. Gill in charge of the old factory and erected the factory now bearing his name at Trenton Avenue, Culvert and Waterloo streets. Mr. Murray attended strictly to business, and until he felt the effects of ill-health he seldom took a vacation. His great pleasure was to run up to the mountains for a few days, but he usually absented himself for less than a week. He knew only two places—his factory and his home. Four years ago, however, he visited Europe, traveling extensively in France, Switzerland, Italy, Austria, Germany, Holland, Belgium, Great Britain and Ireland. This was one of the bright spots of his life of constant industry. What pleased him most in all he saw was a little spot in the northern part of the County of Antrim, Ireland, the home of his ancestors, where he himself saw the light of day, Aug. 9, 1853, but which he did not remember, having removed to America with his parents in 1856. Mr. Murray was of an amiable disposition, a good conversationalist, and, outside of his business, a most pleasant companion. He was an honest, upright, Christian man. His pew in the Cathedral was filled every Sunday. He leaves behind him a widow and three children. He was buried from the Cathedral, Logan Square, in the presence of a large number of devoted friends. After the solemn requiem high mass, Dr. William Kieran pronounced a beautiful eulogy, and the final blessing was given by the Most Reverend P. J. Ryan, Archbishop of Philadelphia. His remains were placed at the side of his distinguished brother, the author and historian, Dr. John O'Kane Murray, in the New Cathedral cemetery. Mr. Murray has a brother, Rev. Bernard P. Murray, in Chicago, and a sister, also residing in that city.

PERSONAL.

MR. H. L. PATTESON has been appointed purchasing agent for the Crocker-Wheeler Company, of Ampere, N. J.

MR. JOHN MARTIN, president of the John Martin Company, representing the Stanley Electric Manufacturing Company on the Pacific Coast, recently returned to San Francisco after an extended Eastern tour.

MR. ROBERT C. CLOWRY, vice-president of the Western Union Telegraph Company, is visiting the Pacific Coast on one of his regular tours of inspection. He recently arrived in Los Angeles in the special car "Electric" with a party of officials and friends.

MR. H. B. CAMP, of the company bearing his name, and whose vitrified clay conduits are well known in the electrical field for underground work, has been elected president of the Barberton Pottery Company, which will have quite an extensive plant at Barberton, Ohio.

MR. W. B. RANKINE, vice-president of the Niagara Falls Power Company, and other officers have recently returned from a trip to California, where inspection was made of the 184-mile transmission of the Bay Counties Power Company from the North Yuba River to Oakland and San Jose, as described in these pages.

MR. C. J. GLIDDEN.—The resignation of President Chas. J. Glidden as president of the subsidiary companies of the Erie Telephone & Telegraph Company, which was placed in the hands of the directors several months ago, has now been accepted and Mr. Glidden has severed his connection from the management of these corporations. He remains as a director.

DR. WILLIAM DUANE, professor of physics at the Colorado State University, has been granted a patent for an invention by which a large number of telegraphic messages may be sent over one wire, and earth return, at the same time. In the physical laboratory at the university, it is said, he has had as many as eighteen circuits working on the same wire.

MR. D. T. FOLEY, the well known purchasing agent of the Western Telephone Construction Company, Chicago, has recently accepted the position of general superintendent of the factory of the same company, with headquarters at Winthrop Harbor, Ill. His ability and energy admirably fit him for the combined position of general superintendent and purchasing agent, and the Western is fortunate in having a man so well qualified to fill the dual position.

MR. PHILIP JOHN MARKMANN, mechanical engineer of the Louisiana Purchase Exposition Company's Department of Works, who will plan the construction details of the big exhibit buildings, at St. Louis, Mo., has exercised a lasting influence on the building construction of Chicago, in which city he has made his home for a decade or more. The Schiller Building, the Stock Exchange Building and the Montgomery-Ward Building—all skyscrapers of the most approved modern fireproof construction—were built on working diagrams made under his supervision.

MR. JULIAN RALPH, the brilliant newspaper writer and war correspondent, says in the *Mail and Express*, on his return from Europe: "Over all the globe there is no street like Broadway. By day it offers the longest vista of costly mansions of commerce and the greatest unbroken length of busy crowds of which the globe trotter has knowledge. By night it is brilliant beyond comparison with any other city artery that exists. It is so ablaze with light, so brilliant, so fiercely glowing that if you could see it from a balloon five miles in air you might think the street a lantern set in the middle of the island, with thousands parading inside between the lamps."

MR. GONG HEE, of Portland, Ore., is preparing at St. Paul, Minn., what is said to be the first Chinese work on modern electricity. Mr. Hee is in St. Paul with Long Ka Tien, the American head of the Chinese Empire Reform Association. Gong Hee is a practical electrician, graduate of the electrical department of a Portland technical school, and has served as an apprentice and operator with an electric appliance manufacturer. His book, which will be a complete treatise in simple electricity and electrical application, is an extended translation of American text-books, with exhaustive original explanatory addenda, made necessary by the difficulty in translating electrical terms into a language which knows nothing of them. Mr. Gong has completed thirteen lessons, which takes his work up to the subject of electroplating. All of the work, including the multitudinous diagrams and working drawings, has been done with pen and ink. Eight months have been consumed in the work, and Mr. Gong expects to spend a similar period on the book before it is finished.

Trade Notes.

PAN-AMERICAN ENGINE AWARD.—The American Engine Company announces that on Nov. 20 it received the gold medal awarded by the Jury of Awards, Pan-American Exposition, for its American-Ball duplex compound engine.

GRAPHITE PENCILS are being sent out to its friends by the International Acheson Graphite Company, of Niagara Falls, made from graphite produced by Mr. E. G. Acheson's electrical process. The pencils are of excellent quality and write very nicely and smoothly.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to the fact that there are two good guarantees back of the goods it is selling; its own, and that of the manufacturers of the various articles. This applies particularly to Gutmann integrating wattmeters, Packard incandescent lamps, Adams-Bagnall arc lamps, and Packard transformers.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing to the trade a bulletin on Pittsburg transformers, describing in detail the transformer wiring for three-wire secondary distribution. This bulletin is of interest to all central station managers, and the Central Electric Company will be pleased to send copies to all who have not received them.

DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, Pa., has lately equipped a large and conveniently located shop for winding and repairing dynamos, motors, arc lamps, and electrical apparatus of all kinds, and has put in charge a foreman of wide experience and great ability. It is now able to turn out such work with great dispatch and with not less satisfaction to the customer.

KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has just issued Bulletin No. 6. It is entitled, "How to Construct Telephone Lines," and is an excellent little manual on this important subject. It is not only pithy and direct in style, but is illustrated with cuts that talk also. With the pamphlet goes a little "dodger" which gives a list of big exchanges using Kellogg apparatus.

NEW PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has just issued a circular illustrating and describing new styles of pumps. For the most part the circular is devoted to spraying apparatus, one of the outfits being operated by a gasoline engine. The company will soon issue a new catalogue of its triplex electric power pumps. It will gladly send catalogues and circulars to interested persons on application.

S. K. C.—The great transmission companies of California utilize almost exclusively S. K. C. apparatus for the production of the tremendous voltages and transmission of enormous power over such great distances. The system is manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and it received at the Pan-American Exposition the highest possible award, a gold medal, for high tension alternating current apparatus.

RICHMONDT ELECTRIC WIRE CONDUIT COMPANY.—The company formerly known as the above has recently changed its name to the American Interior Conduit Company. The personnel of the company has not changed, nor has the product been altered in the slightest. The company still manufactures the Richmondt conduit, but the new name not only indicates a broader field than before, but characterizes the nature of the conduit. During the scarcity of tube caused by the steel strike, the company embraced the opportunity to install additional and improved machinery, thereby greatly increasing the factory output, which was necessary because of the immense demand which the conduit has had. The ready favor with which Richmondt conduit has been received is sufficient evidence of its utility and value.

I. P. FRINK, 551 Pearl Street, New York, who makes a specialty of lighting store interiors, show windows and show cases, reports the following prominent stores as having adopted recently his special patent window reflector, which is so well and favorably known to the trade: Houston & Henderson, Boston, Mass.; Lewis Dry Goods Company, Butte, Mont.; Schuette Bros., Manitowoc, Wis.; Simon Clothing Company, Des Moines, Ia.; the Church-Dodge Company, Troy, N. Y.; L. B. Ogilvie & Company, Paducah, Ky.; Marshall & Ball, Paterson, N. J.; Browning, King & Company, Cincinnati, Ohio, and their new Fourth Avenue store, New York; Adams Dry Goods Company, New York; Simpson, Crawford & Simpson, New York, and the show cases of Jos. H. Bauland Company, and art department of Frederick Loeser & Company, Brooklyn, New York. Mr. Frink is always glad to answer any question on the lighting subject, and his catalogue of the above specialties is a practical help in estimating on this class of work.

DRY KILNS.—Steam hot blast heating and drying apparatus and dry kilns form the subject of a valuable catalogue of 86 pages just brought out by the B. F. Sturtevant Company, Boston, Mass. This company has established a reputation for the scientific excellence of its trade literature, and the latest addition fully maintains the standard. Apart from the trade features, it is a valuable treatise on the general subject of artificial drying of materials, particularly lumber. The apparatus employed in the drying process is very clearly illustrated, and many of the illustrations show typical applications of the system. In the chapter on lumber drying the physical properties of wood are outlined, followed by a full description of the Sturtevant lumber dry kiln, its advantages being clearly pointed out. The general subject is so thoroughly discussed that any one interested in this line of work will have no difficulty in understanding the principles involved and the methods employed to obtain the results.

WHY NOT USE MONTAUK?—This is an obvious inquiry in regard to the following from the *Insurance Press*: "Insulating coverings for electrical wires are generally freely combustible, and even when a building is of practically fireproof construction and switchboard and other apparatus are of standard type, there is still an opportunity for considerable damage by fire following cross currents in bunches of heavily insulated wires. A recent inspection of one of the principal telephone stations in Boston, a risk claimed to be one of the best of its class, showed that the main switchboard, which was inclosed at the back, offered about as much opportunity for the spread of fire as a pile of twigs heaped together for a bonfire. A fire in the sub-station of the Portland Lighting & Power Company at Portland, Me., recently, was due to the ignition of insulation by an arc from a defective switch. The failure of the switch necessitated calling the main station by telephone to shut off the current. Meanwhile the fire had spread to the roof of the building. An insulating material which is sufficiently flexible to be used for covering wires, and which will not ignite at high temperatures, will be welcomed by underwriters, and favored by them in their recommendations to property owners and contractors." The Montauk Fire Detecting Wire Company, of 100 Broadway, New York City, regards its wire as a device exactly adequate to such conditions, either enclosed in the switchboard cables or run parallel with them.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOV. 19, 1901.
[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

686,704. BUSHING FOR INTERIOR CONDUITS; W. F. Bossert and F. T. Foxenberger, Utica, N. Y. App. filed Aug. 30, 1901. Conducting rails are fixed to the opposite sides of a plank, the trolley makes upper contact and is guided by the plank.

686,729. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; G. Heidel, St. Louis, Mo. App. filed March 18, 1901. Details.

686,739. ELECTRIC RAILWAY; F. Klepetko, Great Falls, Montana, and G. K. Fischer, Salt Lake City, Utah. App. July 19, 1899. The bushing has an ordinary thread at one end to fit into the box, and a coarse thread to receive the spiral conduit at the other end.

686,768. SYSTEM OF ELECTRICAL PROPULSION FOR RAILWAY OR OTHER CARS; G. J. Scott, Philadelphia, Pa. App. filed March 8, 1901. A dynamo is on the same shaft with the motor, the armature of the dynamo being short-circuited and its field magnet in circuit with the motor. The dynamo is inserted between the motor and the axle, and acts as a cushion in starting the car.

686,780. PROPELLING AND STEERING OF BOATS; M. J. Steffens, Chicago, Ill. App. filed July 12, 1901. Two motors driving two propellors are controlled from the shore through a cable.

686,832. ELECTRIC CONDUCTING CABLE; J. D. Peachley, Newark, N. J. App. filed Sept. 21, 1900. A cable composed of a number of insulated wires, each carrying a local mark of identification and a hermetical inclosure for protecting the marks.

686,835. MAGNETIC SEPARATOR FOR ORE OR CONCENTRATES; M. Ruthenburg, Philadelphia, Pa. App. filed May 28, 1900. A separator wherein the magnetizable portion of the material treated, is supported during the process of its extraction by means independent of the magnetic field.

686,836. ELECTRIC FURNACE; Marcus Ruthenburg, Philadelphia, Pa. App. filed Aug. 4, 1900. (See page 895.)

686,856. DYNAMO ELECTRIC MACHINE; W. Langdon-Davies and A. Soames, Surrey, England. App. filed June 14, 1901. An inclosed machine in which the armature is contained in a casing inside of the closed field-casing, ventilating passages being provided through the shaft.

686,859. ELECTRIC GENERATOR AND DISTRIBUTOR FOR MEDICAL TREATMENT; E. L. Madden, Kanawha, Ia. App. filed March 28, 1901. Details.

686,862. ELECTRIC RAILWAY; J. F. Munsie, Brooklyn, N. Y. App. filed Aug. 24, 1899. The switch controlling the branches to the working section is operated by a plunger and a bar carried by the car.

686,886. SEPARATOR FOR STORAGE BATTERIES; Rufus N. Chamberlain, Depew, N. Y. App. filed Sept. 21, 1900. A perforated plate of insulating material provided with raised ribs having a wavy form.

686,889. MAGNETIC SEPARATOR; H. M. Daggett, Philadelphia, Pa. App. filed Aug. 7, 1899. Relates to the relative shape of the pole pieces.

686,892. AUTOMATIC TELEPHONE SYSTEM; Ernest A. Fuller, Baltimore, Md. App. filed Aug. 22, 1901.

686,910. REGULATOR FOR INCANDESCENT LAMPS; F. C. Schofield, Lonaconing, Md. App. filed March 9, 1901. Relates to the disposition of the resistance material in the base of the lamp.

686,918. AUTOMATIC CIRCUIT BREAKER; H. P. Ball, New York, N. Y. App. filed June 25, 1901. Details.

686,919. INDICATING MECHANISM FOR ELEVATORS; A. H. Bates, Cleveland, Ohio. App. filed Jan. 17, 1898. The indicator automatically shows the progress of the car and the direction it should move in case it is stationary.

686,925. PARTY-LINE SELECTOR SYSTEM; Thomas C. Drake, of Malta, Ohio. App. filed March 2, 1901. (See page 895.)

686,941. BONDING PLUG; W. S. Jones, Chicago, Ill. App. filed March 16, 1901. An electrical bonding plug, tapered approximately uniformly and provided with a longitudinal groove of approximately uniform depth and of varying width.

686,942. ELECTRIC SERVOMOTOR; P. M. La Hegarat, Paris, France. App. filed March 12, 1901. Apparatus for controlling a motor from a distance.

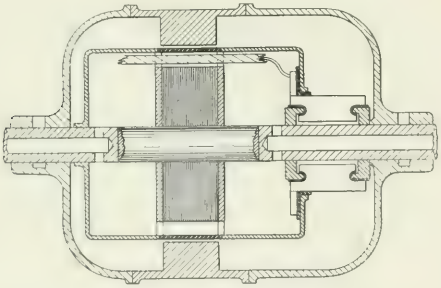
686,973. RAILWAY CROSSING SIGNAL; B. A. Karr, Council Bluffs, Ia. App. filed July 18, 1901. Details.

686,974. RAILWAY SIGNALING DEVICE; L. C. Karr, Council Bluffs, Ia. App. filed July 20, 1901. A track circuit closer operated by the flange of the wheel and embodying a dash-pot to hold the circuit closed a sufficient length of time.

687,042. ANTI-HUNTING DEVICE; A. D. Lunt, Schenectady, N. Y. App. filed June 25, 1900. (See Current News and Notes.)

687,044. RHEOSTAT; F. Mackintosh, Schenectady, N. Y. App. filed April 22, 1901. A rheostat having a length of resistance wire bent back and forth upon itself, and mounted between insulated heat-conducting plates, a number of bends of the wire being permitted to project from the edges of the plates, and contact-studs connected with said bends.

687,048. TRANSFORMER; W. S. Moody, Schenectady, N. Y. App. filed May 31, 1901. In a transformer, the combination with the core, of two superposed windings thereon which occupy less than the total winding space, and a separate auxiliary regulating winding located in the remaining winding space and connected with the inner winding, but not surrounded by the outer winding.



686,856.—Dynamo Electric Machine.

687,050. INDICATING INSTRUMENT; T. F. Mullaney, New York, N. Y. App. filed Aug. 16, 1901. In a synchronizing device, two voltmeters arranged so that the needles of both move in proximity to each other, and means for relatively adjusting the position of one voltmeter-needle with respect to the other.

687,053. MAGNETIC SEPARATOR; R. McKnight, Philadelphia, Pa. App. filed Feb. 4, 1901. In order that the attractive force of the magnets may not entail more work upon the power devices in moving the conveyor belt, the magnets are caused to travel with the belt.

687,060. SYSTEM OF MOTOR CONTROL; C. L. Perry, Schenectady, N. Y. App. filed June 21, 1900. In a system for controlling the operation of a plurality of switches, a plurality of actuating windings for said switches, and means for supplying current to a determined number of said windings in series, or to a lesser number in series with a current-limiting resistance.

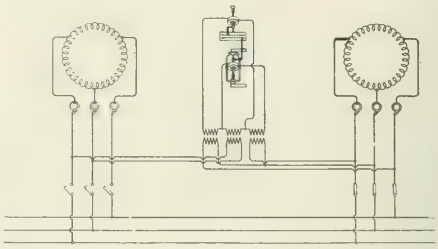
687,065. CIRCUIT BREAKER; R. H. Read, Schenectady, N. Y. App. filed July 18, 1901. A circuit breaker provided with main and shunt contacts, a path of low impedance for the shunt-contact when the main contacts are separated, and a blow-out coil cut into circuit before final rupture.

687,078. ALTERNATING CURRENT SYSTEM; C. P. Steinmetz, Schenectady, N. Y. App. filed May 26, 1900. (See Current News and Notes.)

687,087. SWITCH SIGNAL; B. H. Urschel and E. P. Thomas, Sugarridge, Ohio. App. filed May 26, 1900. Apparatus operated by a moving car in such a manner as to leave a signal light at one switch and at the same time turn on a light at the next switch ahead, and upon passing the latter, to turn out both lamps.

687,091. RAIL BOND; C. Walther, Berlin, Germany. App. filed June 27, 1900. A multiple contact device between the end of the bond and the rail.

687,098. ELECTRIC RAILWAY; G. T. Woods, New York, N. Y. App. filed June 29, 1900. Mechanical means are provided for automatically forcing the section switch to open when no current in excess of a pre-determined minimum, is flowing through its coil.

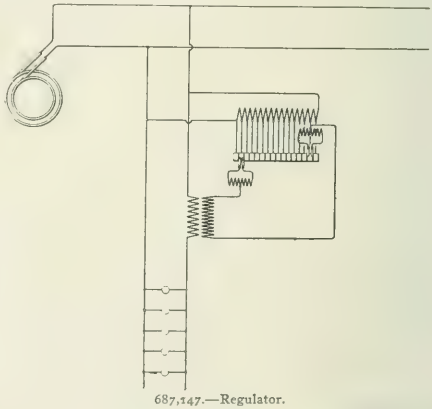


687,050.—Indicating Instrument.

687,121. ELECTRIC BATTERY; E. F. Callender, Galesburg, Ill. App. filed April 17, 1901. A hollow carbon element having a lining of insulating material, the zinc pencil passing therethrough.

687,124. SYSTEM OF ELECTRIC CIRCUITS; F. E. Case, Schenectady, N. Y. App. filed June 29, 1901. In an electric railway system, the combination with one or more electric motors, of a plurality of separately-actuated contacts for varying the motor speed, separate coils connected in multiple and responsive to different current strengths for effecting the actuations of said contacts, means for sending a current of varying strength through said coils, and means for cutting out preceding coils as each coil becomes energized.

687,140. SYSTEM OF ELECTRICAL DISTRIBUTION; A. R. Everest, Lynn, Mass. App. filed May 31, 1901. (See Current News and Notes.)



687,147.—Regulator.

687,141. CURRENT TRANSFORMER; A. R. Everest, Lynn, Mass. App. filed July 29, 1901. A current transformer comprising a primary having a symmetrical cross-section, a core of magnetic material conforming in shape with the cross-section of the primary, and a secondary suitably disposed in inductive relation with the primary.

687,143. SYSTEM OF MOTOR CONTROL; P. Farnsworth, Schenectady, N. Y. App. filed April 22, 1901. Means whereby any desired portion of the motors connected with the load through a clutch can have its counter-electromotive force varied by the inertia of the load to vary the potential around another portion of the motors rigidly connected with the load.

687,147. REGULATOR; R. Fleming, Lynn, Mass. App. filed July 20, 1900. The electromotive force impressed upon the primary winding of a regulating transformer, is made variable, as well as reversible, by shifting the primary terminals of the regulating transformer across a series of contacts connected at suitably graduated intervals to a compensator-winding supplied from the main circuit.

11,945. RAILWAY BRAKE; A. Green, Rochester, N. Y. App. filed March 26, 1901. The electric brake is applied at the same time as a mechanical brake, but at such a time in the movement as to obtain the highest efficiency of the electrical apparatus.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, DECEMBER 7, 1901. No. 23.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 7, 1901.

CONTENTS.

PAGE

Editorial 917
Right to Erect Telephone Lines in New York 920
Electrical Engineers of the Day—XXIII; Philip G. Gossler 920
The Telephone Exchange System of the Maryland Telephone & Telegraph Company, by Kempster B. Miller 921
Recent Common Battery Telephone Exchange Work in New York City, by Herbert Laws Webb 925
The St. Louis Exposition 925
Another Automatic Telephone Exchange in Massachusetts 928
The Economic Design and Management of Telephone Exchanges—I; by Arthur V. Abbott, C. E. 929
Theory of the Edison Nickel-Iron Cell, by E. F. Rocher, Ph. D. 931
An Association of Ohio Farmers' Telephone Companies 932
The Debt of Electrical Engineering to C. E. L. Brown—IV; by B. A. Behrend 932
A Telephone Money Order System 934
M. Berthelot's Jubilee 935
The Telephone in Texas 936
The Telephone Situation in Michigan 936
Telephonic Identification of Cats 937
Annual New York Meeting of the American Society of Mechanical Engineers 937
Standardization of Engines and Dynamos 938
The Faller Automatic Telephone Exchange 940
Some Applications of "Electric Osmose" 942
Engine Builders' Association 943
New Telephone Patents 944
Current News and Notes 944
LETTERS TO THE EDITORS:
Signal Corps Telephone Apparatus, by W. M. Lannan 946
American Manufacture of Pacific Cables, by James W. Marsh 946
Digest of Current Electrical Literature 947
New Books 951
New Form of Oil Break Fuse 952
Selective Lockout Party Line System 952
De Veau Telephone Apparatus 953
Apartment House Telephony 954
Two Connecticut Telephones 955
Molded Telephone Receiver 955
A New Telephone Exchange at Wheeling, W. Va. 955
New Motors for Sewing Machine Work 956
New Vertical Spindle Milling Head 956
An Improved Telephone Receiver 957
Shielded Type Motors 957
New "American" Telephone Apparatus 958
High-Pressure Non-Return Steam Trap 958
DEPARTMENTS 959

THE FOREIGN OUTLOOK.

There has been some falling off during the past year in the value of exported manufactures, although it may be doubted whether the quantities are any smaller. The chief reasons to explain the slight decline are the troubles in the Far East, the serious depression in Germany and the burdens of war that hamper England and are ruining South Africa. We are glad to note, however, that the branches in which our readers are more especially interested, hold their own, as will already have appeared from our weekly export summaries. For the ten months to the end of October, this year shows a total of $4,916,656 for electrical machinery, as compared with $4,555,015 in the same period of 1900. In the class of "electrical and scientific apparatus," the total is also $5,582,445 as compared with $5,401,365. Metal working machinery exports are, we regret to note, only $2,373,740, or less than half as much, and miscellaneous machinery is only $15,367,281, or nearly five millions less. Limitation of purchasing ability may explain much of this, but it is evident that the trade already started must be and can be extended by intelligent persistence, a wider area of sales offsetting a smaller margin of profit. The world at large has need of such goods in increasing volume and will buy in the best market.

THE TELEPHONE AND TELEGRAPH.

We have often speculated on the possibilities of rapid communication as compared with the facilities which are actually available. Great as have been the improvements in both telegraphic and telephonic methods, there is still a field for usefulness that is even now practically unoccupied. This is to be found in union of rapid telegraphy with the telephone as a distributing agent. We have on the one hand several beautiful methods of very rapid telegraphy capable of greatly increasing the capacity of every existing wire as a means of communication, and, on the other hand, a considerable network of long-distance telephone lines, beautifully proportioned for rapid work, and unutilized during a material part of every day. One of the chief objections raised against rapid machine telegraphy is the difficulty of providing adequate facilities for handling promptly the volume of business piled upon the receiving offices, and the serious dislocation of affairs in case of a temporary hitch in the transmission of messages. In long-distance telephony the main practical hindrance to efficiency is the trouble in getting hold of the man at the other end of the line. Every one who has ever had occasion to use long-distance lines knows how busy they are during a considerable part of the day, and the irritating delays that come through no fault of the telephone company, but merely because so many persons are anxious to talk at once.

During the night, however, long-distance conversation is far from active for obvious reasons, especially after 10 or 11 o'clock, and the costly lines are earning far less than is desirable on the score of general economy. A line does not deteriorate from use, and the larger proportion of the time it can be kept busy the greater its net earning capacity. Now, let us see what would be the result of forming a joint committee, as it were, of these two methods of transmitting intelligence. Suppose, for instance, that during the four hours from 1 to 5 A. M. a single line between Chicago and New York were worked up to its full capacity by modern machine telephony. Assuming the use of an automatic printing instrument at a working speed of a hundred words a minute or thereabouts, 500 ten-word messages per

hour in each direction would be within the range of capacity of the system if such messages were directed to the respective telephone numbers of the recipients. These message slips could simply be filed away and telephoned to the proper addresses on the opening of business hours, the slips being mailed as an additional check, as fast as telephoned. Meanwhile, during the day and evening such registered messages would be taken from telephone subscribers on a typewriter and passed along to be perforated or otherwise prepared for rapid transmission during the night. The result would be a very convenient and cheap method of sending messages which would be delivered in the course of a few hours, and a considerable increase in the earning capacity of every long telephone line. Something in the way of delivering telephone messages is now often done, but we know of no comprehensive and cheap scheme for extending such a service by rapid telegraphy.

One conspicuous advantage of such a process is the benefit put at the disposal of telephone subscribers by affording them a very cheap and convenient means of sending night messages. It would probably effect this result without at all injuring the regular long-distance telephone business, which is peculiarly a hasty service utilized to economize time to the utmost. It would rather occupy a special place by itself, giving a very useful and economical service for many purposes, and giving the telephone subscriber remarkable advantages in general means of communication. Whether it would in the long run pay to extend such a service to the delivery of messages to non-subscribers, in other words, to a general telegraph business, is a matter worthy of further consideration, but this is in nowise directly involved in the proposition here advanced. One convenient feature of the matter is the ease with which the plan could be tried and worked out into the best commercial form, and the facility with which the service could be extended in case its reception by the public warranted such a step. Every year the long-distance telephone service becomes more and more important to its patrons, and if hand in hand with its extension went what would be in substance a cheap night telegraph service, both the public and the telephone companies would be the gainers. We have not here broached any of the more revolutionary proposals involving the use in every case of wires for simultaneous telegraphy and telephony, nor have we opened the general question of an open competition between the two great methods of transmitting intelligence. There certainly is a considerable opportunity for such radical moves, but without any introduction of dubious methods or policies there is here a capital opportunity for opening a new source of revenue and doing the public a favor that would still further increase the popularity of the telephone. It is an experiment which could be gone into in the most tentative way and worked out to its legitimate conclusion without any great expenditure or radical change in existing relations. In the form indicated or in some manner closely allied thereto, it is certainly worthy of a serious trial even if only on a single long-distance line.

Telephony in America.

Our current issue presents an interesting picture of the general telephonic situation in this country. On every hand the greatest activity prevails. Old exchanges are being remodeled and renovated. Large new exchanges are everywhere under construction, or contemplated; and the flow of new capital into the field is enormous. It seems likely that such development must continue for some time to come, the average facilities for the country, as a whole, being far below the percentage of equipment to population that prevails not merely in regions where the "independents" have been most energetic but in some Bell territory, where competition has hardly been felt.

It will be noted that much, if not nearly all, of the new exchange work is being done along the lines of the "central energy," "common battery" system, which can hardly any longer be regarded as being on trial, although we know some managers who do not look upon it as the final expression of the art. In the meantime, automatic exchange telephony is occupying attention, and our present issue contains articles on two efforts in this interesting field. Whither they will lead we cannot say, but every one will admit that the attempt to work automatically is an effort in the right direction. It is many years, however, since we first recorded inventions along this line.

The industrial activity in telephony is attested not only by the introduction of new methods and improved apparatus but by the formation of new local companies and their rapid growth, as shown very strikingly by the copious notes in our department of telephone news. Many of these companies are small, and many are trying to give good service at rates far below those which can long ensure efficiency and solvency; but all are helping to put the telephone in its right place as a universal and indispensable means of intercommunication.

Delegates to the A.I.E.E. Annual Convention.

While the next annual convention of the American Institute of Electrical Engineers, is yet a long way off, it is nevertheless not too early for bodies of the membership to begin to take under consideration the formation of State and district organizations as provided for by the new constitution, which bodies shall be entitled to send a delegate to the annual convention. This feature of the new constitution is a most commendable one, and particularly so because its realization will not only give a more national character to the general meeting, but will also enable distant bodies of the membership to have a greater voice in the management of the Institute than it has been possible for them to have in the past. The provision referred to forms Article IX. of the new constitution, and specifies that in each State or Territory of the United States in which there are 50 or more members and associates, an organization may be formed which shall have the privilege of being represented at the annual convention by one delegate to each 50 members. Upon application to the secretary a list of names will be forwarded of the membership in the given State, and upon organization the secretary is required to prepare and distribute the necessary circulars for the nomination of a delegate. The constitution directs that the appointment of the delegate thus nominated shall then be made by the board of directors, which shall also name an alternate delegate—presumably also to be nominated by the State membership. The delegate thus appointed is entitled to receive from the treasury of the Institute a sum of money sufficient to cover the cost of his railroad fare, and he may cast as many votes as he shall hold proxies from his constituents upon any question brought before the annual convention.

From the above statement it will be seen that the initiative toward the formation of State organizations lies with the individual members, which implies that to take advantage of the provision some one or more members in each locality will have to take the lead. In several localities outside of New York City there are already more than the necessary 50 members, and in quite a number of others the shortage is so small that if a few of the resident members were to enlist their services in the cause, the list could easily be expanded to the required quota of 50. Should this, however, be impossible, the same Article provides that the members and associates of a State or Territory not having a sufficient number of members may, upon the request to the board of directors, be authorized to join with the members and associates of a contiguous State or States and form a district, which for the purposes of the Article shall be considered as be-

ing one State, but shall be called a district, and shall take its name from the State therein having the largest membership.

It is quite probable that within the next few months a programme for raising an Institute building fund will be brought to a successful issue, in which case the next annual convention would be one of unusual interest and importance. As a consequence it appears extremely desirable that the membership in different States of the Union should take advantage of the provision of the new constitution referred to, and organize in order that they may have a delegate present to take part in the settlement of important questions that may come before that meeting. The choice of a delegate will confer no small honor on the recipient, and incidentally the names thus brought forward will materially assist the membership as a whole and the Board of Directors with respect to determining upon nominations for vice-president, which nominations by the new constitution are required to be made with a view to maintaining a geographical distribution of the incumbents of that office.

The Distribution of Electrical Energy in Cities.

The batch of papers read before the November meeting of the American Institute of Electrical Engineers and abstracted in our issue of last week, are of particular interest as revealing the trend of thought and opinion in regard to the relative advantage of direct and alternating-current apparatus. It is now conceded as a matter practically beyond dispute, that alternators must be installed in the central generating stations of large cities owing to the distances between a satisfactory power house site and the center of electrical distribution, as well as on account of the necessarily large radius of transmission. In small cities it is conceded that alternators are preferable to direct-current generators at the central station, owing to the scattered nature of the lighting service, and to the high pressure that must be used to reach the scattered lighting economically. In fact, it is now generally admitted that practically the only cases where direct-current lighting generators are preferable to alternators are those of isolated plants, or small densely lighted areas with good local facilities for the supply of fuel—conditions which suggest magnified isolated lighting plants.

Granting that alternators must be selected for central station generation, the question arises as to how much of the system should be kept alternating, and where does it pay to convert from alternating to direct current? Manifestly, if the regulation of pressure could be kept equally good in either system, and if the various translating devices, lamps and motors could be made equally cheap and serviceable for either system, then the selection of an alternating-current generator for the supply of electric power to the system would necessarily entail the use of alternating currents from one end of the system to the other. The trend of present opinion is, however, that while alternating currents are specially advantageous for the generation and transmission of electric power, and are superior in these respects to direct currents, the regulation and delivery of power are better secured by direct currents.

In regard to regulation, the drop of pressure with load is greater in the alternating-current system than in the direct-current system, by reason of the additional inductive drop which the direct-current system does not know. Consequently, in low-pressure distribution the conductor has to be made larger if alternating currents are used. Moreover, in large low-pressure networks the storage battery is the great modern equalizer and safeguard against sudden break-down; it is the flywheel of the whole system, regulating the pressure automatically, and preserving the service in cases of sudden brief breakdown of the steam plant in a central station. For this reason alone the direct-current distribution system has been greatly preferred to the alternating by the engineers of large low-pressure distributions.

With regard to translating devices, the arc lamp will operate equally well on either the direct current or the alternating-current distribution system, if the latter has the usual frequency of 60 cycles per second. The incandescent lamp will also operate equally well on either system if the frequency of the alternating system is over 30 cycles per second. With motors, however, the case is different. The synchronous alternating-current motor is superior to the direct-current motor in regard to the maintenance of constant speed, but, of course, is far inferior in regard to starting power. The modern alternating-current induction motor starts satisfactorily, except from the standpoint of starting-current flow, and gives satisfactory service at constant full speed. It is also superior to the direct-current motor in point of construction, being devoid of commutator and much less likely to burn out. On the other hand, it is not on a parity with the direct-current motor in the capability of regulating its speed under load, and at present it is considerably more expensive in this country than the direct-current motor. In large cities a considerable amount of the demand for power comes for elevators and hoisting machinery generally. In this class of machinery it is necessary to regulate the speed, and the comparison is very much in favor of the direct-current motor for such purposes.

It seems safe to say that if elevator motors could be operated by alternating currents as cheaply and effectively as by direct currents, a number of cities would be likely to operate their entire system by alternating currents, in spite of the less perfect security and regulation, in the absence of storage battery reserve. Since about one-third of the output of a large central generating system is for the supply of motors, of which elevator motors form, or tend to form, a considerable fraction, the importance of the alternating-current motor problem is readily observed. It is really the keynote to the whole situation. Partly owing to the simpler system of distributing mains in the direct-curent system, partly owing to the advantage of storage battery regulation, and largely owing to the commercial inferiority of the alternating-current elevator motor in comparison with its direct-current prototype, engineers go to the trouble, complication and expense of installing rotating machinery, i. e., converters, in numerous sub-stations, in order to supply direct currents to the distributing network of mains.

We may, therefore, look forward with hope to such improvements in the manufacture of the alternating-current motor as will reduce its first cost, and increase its torque under variable speed, without unduly increasing the current it absorbs. The direct-current motor has probably more closely approached its limitations in regard to cost and serviceability than has the alternating-current motor. If the alternating current motor can be so far cheapened and improved as to place it on terms of equality with its direct-current rival, we may expect to see the direct-current distribution system, with its converter sub-stations, slowly give place to the alternating-current distribution system with no mechanical moving parts between the geenrator at the central station and the motor on the consumer's premises.

Summing up the matter, we may say that at the present time the generation and transmission of electrical energy on a large scale belong to the field of alternating currents, while the distribution of electrical energy on a large scale from a system of city mains still belongs to direct currents. And that in the transmission of electrical energy by polyphase alternating currents the four-wire three-phase system seems to have distinct advantages in mixed lighting and power systems over the three-wire, three-phase system.

Right to Erect Telephone Lines in New York State.

The question was brought before Judge Chester, of the New York Supreme Court, recently, of the right of the Monticello Telephone Company to erect telephone lines in that place. It will be seen that while denying a writ of mandamus, the Judge reflected upon the behavior of the board of trustees in not exercising the functions for which it was created. He said: "The company asks for a peremptory writ requiring the defendant to grant to it a permit to erect poles, string its wires and conduct its business in the village of Monticello according to the terms of its written application presented to the board of trustees of such village. The laws defining the rights of telephone companies and the powers of the boards of trustees of villages seem reasonably clear. The transportation corporations law (Laws 1890, Chapter 566, Section 102) gives to telephone companies the right to erect, construct and maintain the necessary fixtures for their lines upon any of the public roads, streets and highways within the State. And this has been held to be a franchise directly from the Legislature to the corporation to use the public streets for constructing and maintaining its lines. Barhite v. Telephone Company, 50 App. Div. 25, 63 N. Y. Supp. 659. But, notwithstanding this, the village law (Laws 1897, Chapter 414, Section 89, Subdivision 9) confers upon boards of trustees of villages power 'to regulate the erection of telegraph, telephone or electric poles, or the stringing of wires in, over or upon any of the streets or public grounds.' This is a power involving discretion upon the part of the board of trustees, and the exercise of this discretion cannot be controlled by mandamus. While the courts can compel the exercise of the power, the particular method of its exercise cannot be controlled by mandamus. People v. Commissioners, 149 N. Y. 26, 43 N. E. 418. Manifestly neither the court nor the board of trustees of the village has any right to grant the request of this company to string its wires upon poles belonging to other companies, as appears by the application filed by the company with the board of trustees it has requested the privilege of doing. It appears very clearly here by the papers used on this application that the board of trustees have sought to either prohibit entirely or to embarrass the telephone company very materially in its rights to use the streets for the purposes of its company, and have delayed passing any regulations for that purpose a long time. It was not unreasonable, however, for the trustees to require the filing with them of a map by the telephone company showing where it desired to locate its lines and poles before passing an ordinance regulating their erection.

Electrical Engineers of the Day—XXIII.

PHILIP G. GOSSLER.

Mr. Philip Green Gossler is one of the youngest of the many young men filling positions of great responsibility in the electrical field, having been born in August, 1870, at Columbia, Lancaster County, Pa. Nevertheless, he has had up to the present time eleven years of active professional experience of the most varied character.

Mr. Gossler was graduated as mechanical and electrical engineer from the Pennsylvania State College in 1890, when he was not quite 20 years of age. During a portion of the following year he was engaged in mechanical and electrical engineering work, respectively, with the Chester Foundry & Machine Company, at Chester, Pa., and with the Edison General Electric Company at New York City.

In April, 1891, he began the work in which he has since then been continuously occupied—the practical electrical and mechanical engineering and operation of generating and distributing plants for electric lighting and power service. At that time he joined the staff of the United Electric Light & Power Company, of New York City. He remained with that company until he went to Montreal in May, 1895, to accept a position with the Royal Electric Company, of which company he is now general superintendent and electrical engineer. His duties have greatly enlarged and increased with the growth and development of the business of the Royal Company, and have included every form of engineering appertaining to steam plant, hydraulic or water power plant, high-voltage long-distance transmission, as well as local distribution.

When he entered the service of the United Electric Light & Power Company, of New York City, the business of that company consisted of the operation of the arc-lighting plant and system of the United States Illuminating Company, and the arc-lighting plant and system of the Brush Electric Illuminating Company, to which had but recently been added incandescent lighting by alternating current. Besides generating stations established especially for the latter service, several of the stations of the two companies were remodeled and reconstructed to provide in addition to their original service, a system of alternating-current incandescent lighting service.

At just about that time also was begun the distribution of current for arc and incandescent lighting by cables in underground conduits. Mr. Gossler was engaged in the most intimate and practical way in all the work attendant upon such remodeling and reconstruction, in new installations for new class of service, and in the selection, testing and placing of underground cables, then a new art. Amid all this varied practical work he did not overlook or avoid original investigation and work of precision for commercial purposes. In 1892 he conducted a series of most complete tests of incandescent lamps, the results of which were published in these columns in the issue of Sept. 17, 1892, and which, at the time, had a particular value in that they furnished valuable data from a source independent of the lamp manufacturer, and which were determined especially for the central station man.

With such a diversified experience in New York City during more than four years, he was in a special manner equipped to undertake the necessary remodeling, reconstruction and extension of the generating and distribution plant of the Royal Electric Company at Montreal. Some of the first and immediate results of that work

were embodied in a paper prepared for and read at the 1897 convention of the Canadian Electrical Association, and subsequently published in pamphlet form which received a widely extended circulation by reason of its appreciation by central station managers.

He has been closely associated with the installation and operation of the 20,000-hp water power electric generating plant on the Richelieu River, and the high-voltage 18-mile transmission line of the Chambly Manufacturing Company (now the Montreal & St. Lawrence Light & Power Company). The construction of the transmission line was done under his immediate supervision, and is notable as an example of best methods, and has a record of entire immunity from lightning damage during the four years it has been in position.

The administration of the business of the Royal Electric Company, the Imperial Electric Company, the Montreal & St. Lawrence Light & Power Company, and the Montreal Gas Company has recently been taken over by the Montreal Light, Heat & Power Company, all to be operated by the latter company as one organization. The scope and extent of the work under the charge of Mr. Gossler will thereby be greatly increased. By reason of his experience, ability and characteristic energy, it is easy to anticipate that he will fulfill the requirements of his increased responsibilities with the same satisfactory result and enlargement of his capabilities that have hitherto attended his efforts.

Mr. Gossler is a member of the American Institute of Electrical Engineers, and has been elected president for the current year of the Canadian Electrical Association.

The Telephone Exchange System of the Maryland Telephone and Telegraph Company.

By Kempster B. Miller.

THE telephone system of the Maryland Telephone & Telegraph Company, with headquarters at Baltimore, furnishes one of the most striking examples of the progress of independent telephony in this country, that I know of. A description of the personnel of this company, the system it has installed, and the work that it has accomplished, should, therefore, be of general interest to the telephone public. This company owns and controls plants in Baltimore, Catonsville, Pikesville and Roland Park in Baltimore County; Ellicott City, in Howard County, Maryland; Belair, Aberdeen, Churchville and Havre de Grace in Harford County; Wilmington, Delaware, and in many other smaller places. The personnel of the company is as follows: President, George R. Webb; vice-president and general manager, David E. Evans; chief engineer, Sidney Hand Browne. Mr. Webb has been the active spirit in the movement to give Baltimore a cheaper and better telephone service than that accorded by the Potomac Telephone Company, a local Bell licensee. He is as well president of the Pittsburg & Allegheny Telephone Company, whose headquarters are in Pittsburg, the system for which was described in an article by me in Electrical World and Engineer of Nov. 2, 1900. Mr. Webb is also president of the entire system of electric railways and electric light companies in Baltimore. Mr. Evans is well known to the electrical public, having conducted, before retiring, an extensive contracting business, making the construction of electric roads a specialty. To him the Maryland Telephone & Telegraph Company owes a great deal for his able management. Mr. Browne, the chief engineer, is responsible for the character of the large plants of both Baltimore and Pittsburg, and for the great rapidity with which they have been developed. Under his able guidance plants have been constructed within the past two years, for the same people who are interested in the Baltimore and Pittsburg plants, having an aggregate of over 17,000 telephones in actual service, and several hundred miles of toll lines. By these toll lines connections are afforded with something over 96,000 telephones belonging to other companies, and with which companies traffic agreements have been formed as to exchange of service.

In Baltimore the municipal subway system is used, for which an annual rental of 5 cents a duct foot is paid. The general system of distribution is entirely underground in a large part of the city. About 200,000 ft. of underground cable is installed, of which about 75 per cent of the total length is 200-pair cable. All cable is made up of No. 20 B. & S. copper wire, with two wraps of paper and sheath made up of pure lead without tin. It tests 300 megohms per mile, and shows an electro-static capacity of .085 m. f. per mile. This was manufactured by the Standard Underground Cable Company, of Pittsburg. About 100,000 ft. of aerial cable has also been erected, the sizes being from 25 to 150 pairs, the greater portion being 100 pair. The lead sheath of this is 3-32 inch thick, or thicker.

The general style of construction is modern, and, unlike many other independent companies, the plans of the Maryland Telephone & Telegraph Company have been liberal and broad, and the growth, which they have been able to handle easily, has been remarkable. When it is considered that the first service in the city exchange was given Jan. 1, 1901, and that there is now a total of considerably over 6000 lines actually working within the city limits, one of the best arguments of the popularity of independent telephony in general, and of this company in particular, is afforded. Less than two years ago there were not more than 2000 telephones in Baltimore; to-day there are 11,000, of which the Bell Company has about 5000. As an indication of the present rate of growth of the exchange, it is stated that, during the month of October, 575 new telephones were installed in Baltimore, and that the outlook indicates a still greater number for November. The management report that the company is in a most flourishing condition financially, and making good money, which, after all, is the ultimate measure of success in any business enterprise.

Fig. 1.—Operating Room, Druid Exchange.

There are four exchanges belonging to this company in the city of Baltimore, as per table on next page.

The main or Courtland Street exchange is located at the corner of Lexington and Courtland streets, just across from the Courthouse. The switchboard, and all central office apparatus for this ex-

change, and, in fact, for all of them, was furnished by the Kellogg Switchboard & Suply Company, of Chicago. The switchboard

Name.	Ultimate capacity.	Present lines in service.
Courtland	6,000	4,100
Druid	3,000	960
Henrietta	1,000	510
Windsor	1,000	490
	11,000	6,060

consists of 19 sections, of which 17 are for local and outgoing trunk work, and two for incoming trunk work. The sections are of angle

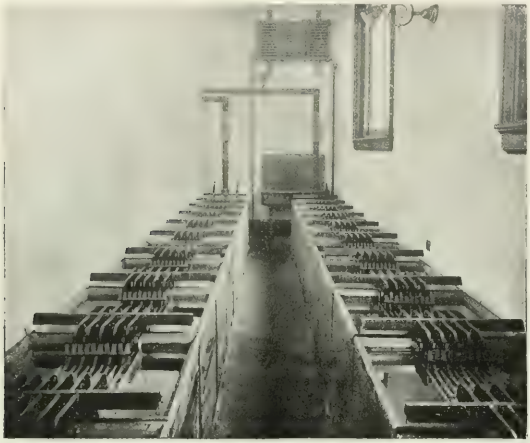


FIG. 2.—BATTERY ROOM, COURTLAND EXCHANGE.

iron construction, the weight of all the apparatus and cabling being borne by the iron structure, independent of the woodwork. This iron framework rests on the true floor. A false floor, or platform 17 inches high, is placed in front of the switchboard, against which false floor the woodwork of the switchboard finishes. The exposed portions of the woodwork is mahogany, rubbed to a dull finish, while the unexposed portions, such as cord racks, are of oak. The sections are completely closed at the rear by removable wooden

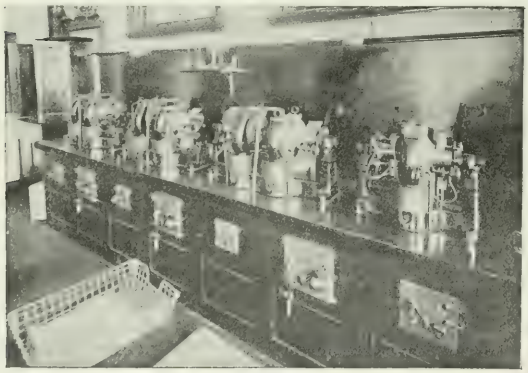


FIG. 3.—CHARGING AND RINGING MACHINES, COURTLAND EXCHANGE.

panels which, when taken out, expose the cabling and all other parts to view.

The connecting rack for each section, and the running box for the cables leading to the connecting rack, and also the line and supervisory relays, are carried on the rear of the switchboard framework. The supervisory relays are of dust proof pattern, and are not enclosed, while the line relays are enclosed in dust proof boxes, containing the entire group of each section. A view of the main operating room, showing this switchboard, is given in Fig. 5. The layout of this room, and the supporting columns in its center, make it almost impossible to do this board justice in the photograph, because both ends of the board are necessarily cut off, and some of the intermediate portions are obscured.

Each of the 17 local sections is provided with a capacity of 300 answering jacks and line signals, and a present equipment of 260. Each of the incoming trunk sections is equipped with 120 incoming trunk lines, 40 to each position. Each of the 19 sections is also provided with 4060 multiple jacks, and with an ultimate capacity for 6000. The incoming trunk lines terminate in cords, according to the latest practice. All of the local cord circuits are provided with a double supervisory system, by the means of which a supervisory lamp is placed under the control of each subscriber connected. That is, when a connection is made between two subscribers, each of the two lamps belonging to the pair of cords is under the control of the subscriber to which that cord is connected.

There are three keyboards, and three operators' positions to each section, the jack frame being divided into six panels. The key shelves are made of five-ply mahogany, while the plug shelves, which are also of mahogany, are provided with a layer of heavy belt leather, which takes the wear off the plugs dropping into their seats. The vacant spaces on the face of the board are filled with ebony panels, which harmonize in color with the hard rubber faces of the jacks. The finishing stile strips are of brass, finished in black oxide, and carry the designating numbers of the jacks. The arrangement for lighting the face of the board is clearly shown in this picture.

The manager's and chief operator's desks are located in the center of the exchange, as shown. The current for the talking apparatus, and for all signaling purposes, with the exception of ringing the subscribers, is furnished by two storage batteries consisting of 10 cells each, of Chloride accumulators, the elements having 11 plates each and are contained in lead-lined tanks. The current is taken from

FIG. 4.—TERMINAL AND DISTRIBUTING ROOM, COURTLAND EXCHANGE.

these batteries by copper bars, having a cross section 3 inches by ½ inch. The battery room of this exchange is shown in Fig. 2, two of the bus-bars leading from the batteries being shown in the far end of the room.

The power equipment of this exchange is shown in Fig. 6. On the right may be seen the charging and ringing machines, which are shown more clearly in Fig. 3. These machines are five in number,

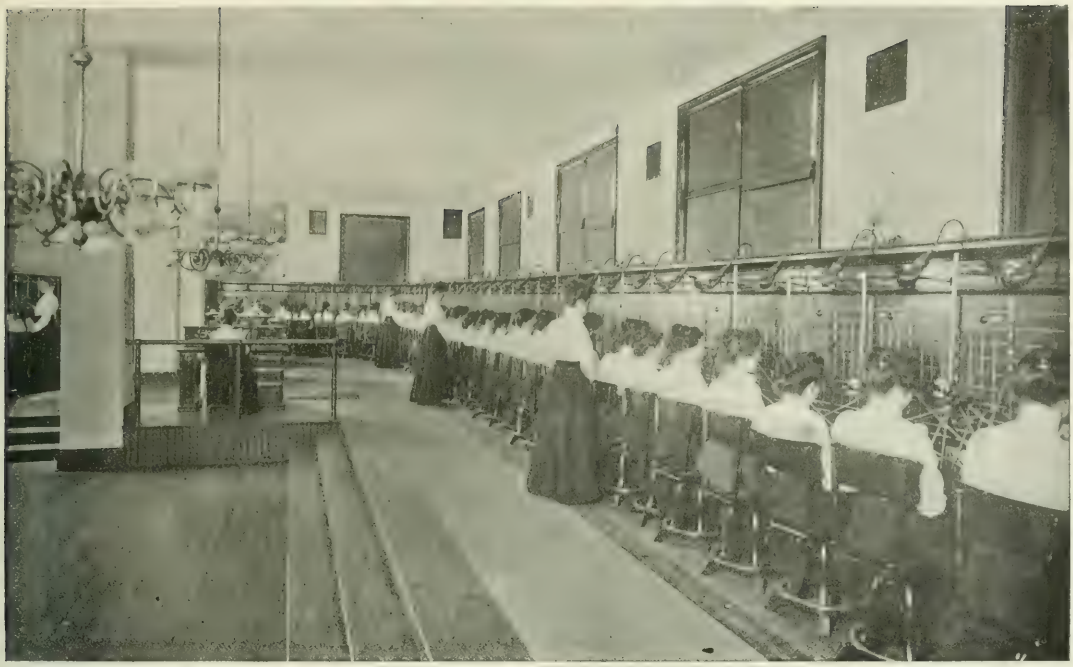


Fig. 5.—Operating Room, Courtland Exchange.

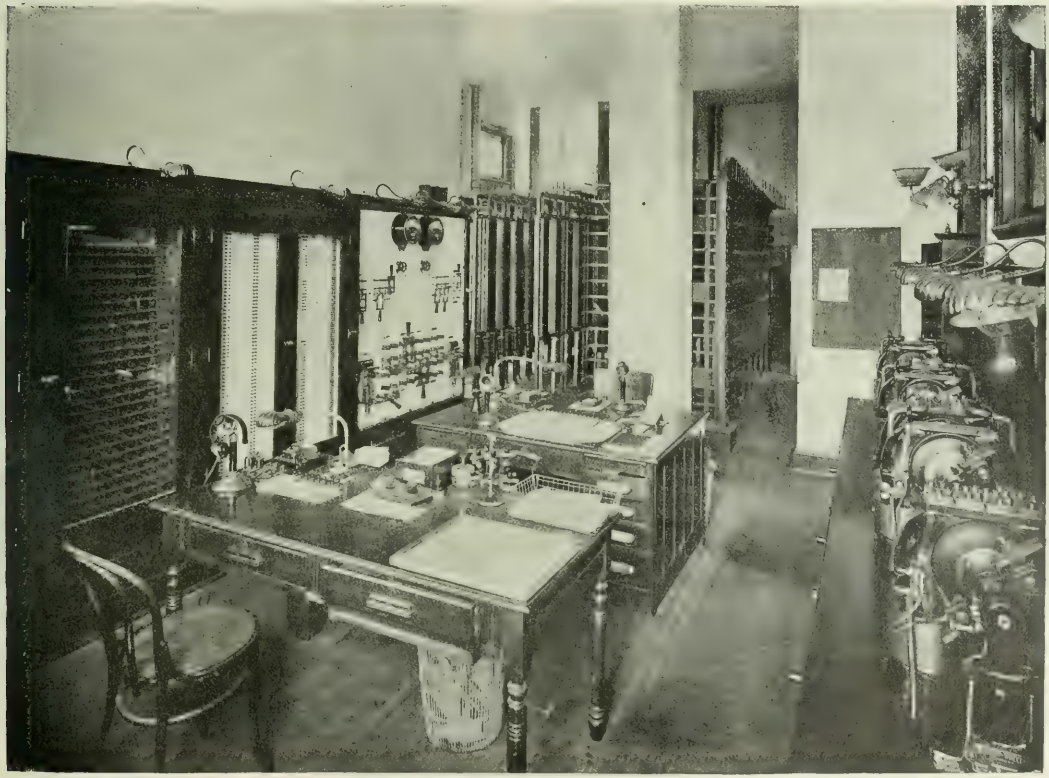


Fig. 6.—Power Equipment, Courtland Exchange.

all of Crocker-Wheeler make. Two of these are motor-generators for ringing, having primaries wound for 220 volts direct, and secondaries giving alternating current for actuating polarized bells. The other three are motor-generators for charging the batteries, having primaries wound for 220 volts direct, and secondaries having sufficient voltage for charging 10 storage cells in series. All of these machines are mounted on a handsome power table, under which is carried a full equipment of starting boxes, field rheostats, etc. On the left of Fig. 6 is shown the fuse board and the power switchboard. The fuse board is of marble, and contains fuses for all leads to the cord circuits. The power switchboard is of Italian marble, and has mounted upon it Weston volt and ammeters, and suitable ammeter and voltmeter switches, two I. T. E. circuit breakers, and a full complement of all copper double-throw double-pole switches for handling the various charging and discharging leads.

The wire chief's and trouble clerk's desks are shown in the foreground of this picture, while a distant view is obtained of the cable terminal rack, and the main distributing board. A clearer and better view of the terminal and distributing room is shown in Fig. 4. At the left of this view is shown the cable heads, which are of the Cook pattern, manufactured by the Sterling Electric Company.

FIG. 7.—REAR VIEW OF SWITCHBOARD, DRUID EXCHANGE.

These are mounted on an iron rack, and the line or shaft cables leading from the subways may be seen entering at the bottom of these heads. These heads are provided with heat coils, and carbon static arresters. The cables leading to the main distributing boards emerge from the top of the cable heads, and are lead in channels furnished in the angle iron structure, to the line side of this distributing board, shown on the right of this picture. From the switchboard side of this distributing board other cables lead, as may be seen in the upper right-hand portion of the picture. These go downward, as shown in the foreground, and pass into the running boxes leading along the back of the sections, as already referred to.

The plan of wiring is as follows: Beginning at the cable heads, from which point the Kellogg Switchboard & Supply Company carried the complete installation, the lines are carried in 21 pair cables to the distributing board. These are made fast to the line terminals on the distributing board. This applies to subscribers' lines, and incoming and outgoing trunk lines, order wires and desk lines. From the distributing board, all subscribers' lines are carried in 21 pair cables to the connecting racks on the subscribers' sections, from which the lines continue to the relays and answering jacks on the local sections. From the first trunk section, the lines are multipled through each of the other sections in 21 pair cables. In a similar manner, the incoming trunk lines are wired from the distributing board to incoming trunk sections. The switchboard cable used throughout is of No. 24 B. & S. tinned copper wire, provided with a wrapping of silk and of cotton, afterwards covered with heavy paper and a cotton braid. The whole is immersed in beeswax, and afterwards polished. The battery leads and power wires are of Okonite, and of suitable carrying capacity throughout. The same applies to the electric light wiring for illuminating the front and rear of the sections. All power wiring is carried in the roof of the sections.

The Druid, Windsor and Henrietta exchanges were also furnished by the Kellogg Switchboard & Supply Company, and as they do not differ materially from each other, only one of them will be described.

Fig. 1 shows a general view of the Druid exchange, which consists of four sections of six-panel switchboard, three of them being for local and outgoing trunk work, and one for incoming trunk work. The three local sections are provided with 40 outgoing trunk lines multipled in every section, 240 answering jacks and signals, and with 720 multiple jacks extending throughout all four sections. The incoming trunk section is equipped with 60 incoming trunk lines, terminating in cords and plugs. The rear of the switchboard is shown in Fig. 7, the closing panels being removed. Several of the floor panels are also taken up, showing the cable run underneath. In the foreground at the right-hand portion of this picture, two of the relay boxes are open, showing the supervisory relays in the upper portion of the boxes, and the line relays below.

The power equipment of this exchange is shown in Fig. 8. The machines for charging and ringing are seven in number, two being 1-hp Wagner alternating-current motors, 60 cycles, 104 volts, so arranged as to drive three ½-hp Roth generators, designed to charge 10

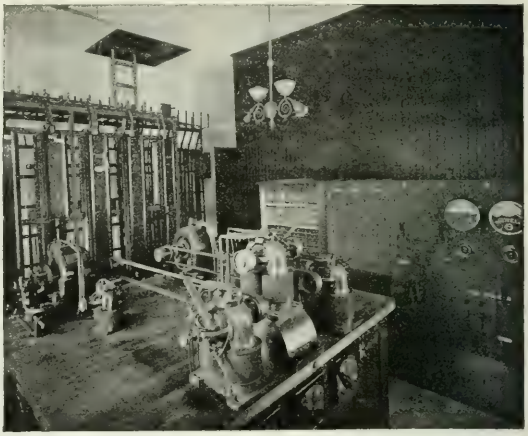


FIG. 8.—POWER EQUIPMENT, DRUID EXCHANGE.

storage cells in series. Besides the above, there are two Roth 1-6-hp ringing machines for furnishing the ringing current. These machines also are adapted to be run by the Wagner motors. The power switchboard and fuse board in this exchange are of slate, provided with Jewell instruments, I. T. E. circuit breakers and suitable switches. Cook terminal heads are used, as in all of the other exchanges. Two storage batteries supply the current for talking and signaling, these being Chloride accumulators, in lead-lined tanks.

The Baltimore & Maryland Telephone Company erected their own buildings for all of the four exchanges, the type of the building erected for the branch exchanges being shown in Fig. 9, which represents the Druid Exchange building, located at the corner of Druid Hill Avenue and Roberts Street. These buildings are well constructed, and arranged particularly for the purpose for which they were built.

Besides the equipment for the four exchanges there are three suburban exchanges, which were also equipped by the Kellogg Switchboard & Supply Company, these being at Catonsville, Roland Park, and Pikesville, and provided with trunk lines for incoming and outgoing trunk work, with all the city exchanges. These, like the city exchanges, are arranged on a common battery plan.

Fifteen positions of the switchboards in the city exchanges are equipped for party-line ringing. Two, four and six-party line rates are being given, which are proving popular, particularly in residence districts. The company has obtained the contract for the entire service of the city departments. No free telephones are given to the city, as the city exacts a pole tax of $2 per year. A private exchange furnished by the Kellogg Switchboard & Supply Company, with a capacity of 300 lines, has been installed by the Maryland Telephone & Telegraph Company, in the City Hall, to which are now connected over 100 telephones and 40 desk sets. The city purchased the switchboard and telephones, and in addition pays an annual rental for the

FIG. 9.—DRUID EXCHANGE BUILDING.

trunk line service and maintenance, amounting to approximately $5,000 per annum.

The toll lines to Western Maryland and Southern Pennsylvania and Delaware towns, include Frederick, Md.; Wilmington, Del.; Westminster, Md.; York, Pa.; Delta, Pa.; Ellicott City, Mr.; Port Deposit, Md., and a large number of other points, so that this company now covers practically the entire territory between Washington, D. C., and Philadelphia.

I am indebted to Mr. S. H. Browne, the chief engineer of the company, for much of the information contained in this article.

The St. Louis Exposition.

Mr. Henry Rustin, electrical engineer of the Louisiana Puchase Exposition Company, under the direction of Director of Works Isaac S. Taylor, began his duties Nov. 26. Mr. Taylor has already invited bids on the work, and it is understood that two firms, either of which is prepared to provide a plant of the dimensions required, have made propositions as to time and price.

The plant will have to provide illumination and power for the intramural railway, for the operation of exhibit machines, and for pumps for cascades, fire protection and water supply, and will be one of the largest in the world. It will have a capacity of about 15,000 kilowatts. This is more power than is used by the Laclede, Missouri-Edison, Imperial and the Transit companies combined. Bids will be received both for individual units of 1000 kilowatts and for the entire plant. The present intention is to put the big power plant as an exhibit in the center of the machinery building. It will be operated there under as attractive conditions as if it were in one corner of the grounds shut off from public view. The boiler plant will have to be kept separate from the main exhibit, both because of the danger of fire and because of the heat.

There is under consideration the firing of the boiler plant by oil from Texas instead of with coal. To supply access for fuel, the boiler house will have to be built near a railway terminal and the oil shipped in tank cars.

Recent Common Battery Telephone Exchange Work in New York City.

By Herbert Laws Webb.

THE New York Telephone Company has lately transferred the service of its Cortlandt Street district to the new common battery exchange, thus completing the conversion begun just three years ago with the opening of the first common battery exchange at Harlem, of the entire Manhattan system to common battery working. The housing of the new exchange has involved the building of an annex to the Cortlandt Street building on its eastern side, three floors of which, each 44 ft. by 22 ft., are occupied by cables, distributing frames, power plant, wire chief's desk and other auxiliary apparatus, and the construction of a new top floor over the old building. The Cortlandt Street telephone building was put up in 1888, and was designed for eight stories only, so that the addition of a new floor to carry a telephone switchboard and its personnel involved considerable structural alteration to the building. The additions to the building and the new exchange were the subject of an interesting illustrated article in ELECTRICAL WORLD AND ENGINEER of Nov. 9, 1901., but there remain a number of technical points to which attention may fitly be drawn at the present time, now that the exchange has gone into full operation.

The new operating room occupies the entire new ninth floor, which is 67½ ft. wide at the base of the U and 120 ft. long in each limb. Each limb or wing of the room is 20 ft. wide, with windows on each side, affording abundance of light, and the two are joined by a bridge at the back of the building. Connection is had with the operators' quarters, which occupy the entire ninth floor of the Dey Street building, by a doorway in the end of the west wing of the operating room, and the bridge affords a short cut to the east wing. The new switchboard consists practically of two entirely separate switchboards, one made up of 30 subscriber sections and the other of 18 trunk sections. This is the modern way of building large switchboards, as the equip-

FIG. 1.—PRIVATE BRANCH EXCHANGE SWITCHBOARD.

ment of subscribers' sections is so different from that of incoming trunk sections that it is no longer the comparatively simple matter it once was to convert the one into the other, and it has been found more satisfactory to separate the two portions of the board, giving each the space to grow in its own way.

The floor plan of the new ninth floor of Cortlandt Street has lent itself to a very effective treatment of the two switchboards, which has been taken advantage of by the New York Telephone Company's engineers and by the Western Electric Company—constructors of the entire plant—in such a manner as to produce a result that is a positively artistic piece of workmanship. On the ninth floor of the annex is the intermediate distributing board, which is necessarily cabled direct to the switchboard. The doorway connecting the annex floor with the operating room is about 30 ft. from the front of the building, therefore this point forms an admirable situation for a cable-turning section from which both switchboards shall spring. The cables are brought out in iron frameworks in the upper part of the doorway and then divide and bend downward into the switchboards in a bold double curve, a very Niagara of insulated wire, but all as

orderly, as solid and as even as the most exacting eye could require. The cable-turning section forms a sort of triumphal arch with a doorway through the center. From its southern end springs the subscribers' board, 30 sections, building from left to right, going first south, then west, then north, the thirtieth section being at the end of the west wing, while from the northern end springs the incoming trunk board, 18 sections, building from right to left, and occupying the remainder of the east wing. A great advantage of this arrangement is that each portion of the board is brought close to the intermediate distributing board, from which all the switchboard cable necessarily springs. The multiple cables go right and left to the multiple jacks in either part of the board; the answering jack cables go to the right directly to the subscribers' sections, as do the outgoing trunk cables, while the incoming trunk cables go to the left to the incoming trunk board. The other various cables, relay, repeating-coil and lamp leads also diverge and go direct to their respective apparatus. In weight, an important item in dealing with the masses of cable used, and in accessibility, the novel arrangement of switchboard and cable-turning section has effected considerable gains.

The new switchboard offers many points of interest, and even a cursory inspection shows how great has been the progress in telephone engineering during the past few years, while the contrast between the new board and the old—the greatest thing of its kind when it was built—is as great as between the latest mile-a-minute automobile and the steam carriage of our ancestors. The gain in compactness is a striking feature. The new switchboard occupies practically the same space as the old, but it contains 50 per cent more jacks per section in a slightly smaller section. The old board contained 44 sections of 6000 jacks each; the new board contains 48 sections of 9000 jacks each. This gain in compactness has been made by employing a small jack; but the employment of a small jack, or rather the placing of so large a board in the space formerly occupied by one of much more limited capacity, has been made possible by the relay system of working. The operation of a connection is now so largely automatic that an operator can handle more calls in a day than formerly, and consequently more answering jacks can be placed in a section, this naturally being the measure of the space a board must occupy. In the new board 320 answering jacks per section are provided, there being three operators' positions at each section.

Another interesting feature of the board that strikingly illustrates the rapid development of the telephone service which set in a few years ago and still continues is that it is equipped for its full capacity from the very beginning. Formerly it was the custom to build a switchboard framework for a much larger number of multiple jacks than it was originally equipped with, the idea being to provide for a relatively slow growth by leaving space for the addition of multiple jacks in the dim future; the original equipment was said to be so many lines, and the "ultimate capacity" so many more. Often, however, this "ultimate capacity" could never be utilized, since it was impossible to find space for the additional answering jacks and keyboard equipment required. The new board is equipped practically for its full capacity from the beginning, and it will be noticed in the pictures of the board that there is no array of spare panels between the multiple jacks and the top of the framework. In a picture of the old Cortlandt Street board illustrating an article in the *Electrical Engineer* for Oct. 15, 1890, the spare panels occupy as much space as the multiple jacks actually equipped. Under present conditions, when the monthly net increase of subscribers is enough to fill up a moderate sized exchange, it is not worth while to put in even a large switchboard only partially equipped, as this would mean additional work and disturbance within a short time, so the full capacity is installed from the beginning.

The relay system of working has often been described, and the general method of handling connections was touched on in the account of the cut-over of the exchange in ELECTRICAL WORLD AND ENGINEER for Nov. 9 last. A number of refinements have been introduced in the Cortlandt Street board, and at the moment it represents the latest stage in the development of the common battery system, and in switchboard design generally. The outgoing trunk jacks are placed immediately above the answering jacks and are all clearly designated by conspicuous labels. A very large proportion of the work of any city exchange being trunked out, it is important to have the trunk jacks easily available and distinguishable, and to do everything possible to accelerate the rapidity of trunk working. The call-wire circuits come to a compact battery of buttons placed at the left of each operator's position. Certain of these call wires lead to toll points, and on pressing one of these buttons a red pilot lamp lights in front of the operator as a reminder that the pressing of that button involves the making of a toll check. At each position there is still another pilot lamp, the lighting of which signifies that the exchange manager wishes to speak to the operator. On receiving this signal the operator presses a call wire button which connects her to the manager's circuit, and that functionary can then speak to all the operators at once, as if he had them gathered in a hall and was speaking from a platform. The object of this arrangement is to trace quickly the cause of faulty connections, cut-offs and so on, and to give general instructions regarding the service. Of course, with the relay system of working, cut-offs are not expected to occur, but neither operators nor subscribers are yet quite automatic, and among 400,000 connections a day, one or two errors from one cause or another are very apt to slip in. These devices show how many ingenious wrinkles the common battery can be called upon to take care of in addition to the general "load" of the exchange.

A notable difference in the general appearance of the exchange is caused by the use of breastplate transmitters instead of the old swinging switchboard transmitters. This is one of the very few items of telephone equipment that America has adopted from Europe. The breastplate transmitter has been in use in several European countries for a number of years, and the advantages of doing away with the suspended instrument hanging in front of the board and of having the transmitter follow the operator in all her movements are so great that, once adopted, the breastplate instrument becomes standard equipment. Beyond the restraint of a conservatism that at first blush seems at variance with the well-known rapid development of telephonic apparatus, but has its solid reasons in the enormous cost of rash experiments in complicated systems, American engineers were not eager to take up the breastplate transmitter because of the well recognized fact that the standard of telephonic transmission generally is lower in Europe than in this country. It was held that the breastplate transmitter would not give as good results in transmission as the standard switchboard solid back, and its adoption was never pressed. The mechanical part of the European breastplate transmitter, also, was not up to American standards. A special design of transmitter has been evolved here, however, which proves thoroughly satisfactory both electrically and mechanically, and now nobody concerned would go back to the old swinging transmitter.

The breasplate transmitter was first tried at the incoming trunk sections of the old Cortlandt Street board, and although the operators at first did not like them, this prejudice quickly disappeared, and after a short experience nothing would have induced them to give them up. Now they are standard equipment, and not only do they greatly improve the appearance of the board by doing away with the swinging instruments and their cords and brackets, leaving the face of the board entirely free, but they add to the comfort of the operator and leave her hands freer for the natural work of manipulating keys and cords. Another advantage of the breastplate transmitter is that it enables each operator to have her individual telephone set complete, an altogether desirable arrangement. By plugging into special jacks fitted in the face of the keyboard the operator connects her transmitter and receiver to the switchboard when she comes on duty, and when she goes off she unplugs and puts the apparatus away in her locker. Since one improvement naturally leads to another, the transmitter and receiver jacks are fitted in duplicate at each position and every supervisor is provided with a transmitter and receiver. A supervisor can, therefore, in a moment plug in at any position where a momentary rush of work is on and temporarily become an overflow operator, fully equipped to aid the regular operator who is overtaxed for the time being. Since there are supervisors, in proportion of one to every 10 or 12 positions, constantly patrolling the board, the little five-minute rushes that occur every now and then in the telephone traffic of a big city are thoroughly well taken care of. Without the breastplate transmitter, it is not such a simple matter for a supervisor quickly and effectively to share the work of a "position."

The subscriber positions are equipped with the regulation combined listening and ringing keys, arranged for selective signaling on party lines. A mechanical signal shows by the display of a small target which station the operator has rung, so that in case it is necessary to ring more than once the operator does not have to rely on her memory as to which station to ring, and runs no risk of ringing up the wrong one.

The incoming trunk sections are two-position sections, and are

designed for the operation of 30 incoming trunk lines per position. The operating of incoming trunks has undergone one refinement after another ever since the adoption of the call-wire double-track method of working. Practically, the only part of the work that is not automatic is the speaking of the orders over the call wire, the assignment of the trunk and the selection of the multiple jack by the receiving operator. This being done, the receiving operator puts the plug into the jack and presses an automatic ringing key which causes periodic trills to be given on the subscriber's bell until he takes down the receiver. That causes the button of the automatic ringing key to resume its normal position. Should the subscriber fail to answer after a liberal period of trills, the trunk operator restores the automatic ringing key by releasing a catch and puts the trunk plug into a signal jack, which results in the lamp on the connecting cord at the subscriber operator's position in the originating exchange winking the notification: "Don't answer." Similarly, if the trunk operator finds that the line wanted is busy she puts the trunk into a signal jack that causes the originating operator's lamp to wink "Busy." When the connection follows its normal course, the subscriber-operator gets the disconnection signals, and as soon as she disconnects from the trunk a disconnection signal lights in front of the incoming trunk cord, whereon the trunk operator promptly disconnects. As during the busy periods of the day there is a mass

FIG. 2.—MONITOR SWITCHBOARD.

of cords up on the incoming trunk sections, and often the plug is a long way off from the cord shelf, the cords are colored red, white and blue, alternately, to minimize the risk of the wrong plug being pulled out when neighboring operators are helping each other. With cords all the same color it is comparatively easy for an operator to mistake the cord to be disconnected, when, as often happens in busy times, it is one of a mass of cords lying under and over each other. Such mistakes lead to cut-offs and are to be avoided by every possible means, as a cut-off is about the most exasperating of telephonic errors. With the colored cords it is easy to trace accurately the particular cords to be disconnected.

The casual visitor to a telephone exchange takes it quite as a matter of course that electric lamps should occupy the place of annunciators for signals, and that magneto generators and batteries should disappear from the subscribers' stations. How it is all done, like all the other mysteries of electricity, is quite beyond him, and to attempt to explain the battery of machinery that lies behind the relay switchboard would be waste of effort on the part of his guide. It is in the department given up to terminals and power plant that the development of telephone engineering becomes really impressive. Not much over ten years ago the terminal room of a telephone exchange contained a few cable heads, many "bluestone" batteries, a most assertive "pole-changer" and one ringing generator driven by a water motor, the whole festooned with wires of all kinds and sizes and varieties of intractability. Then came the Hibbard distributing board (see *Electrical Engineer*, Oct. 15, 1890) to reduce the wiring to order, and a little later the motor generator displaced both the blue-stone batteries and the belt-driven ringer. A few years later the bridging-board with self-restoring drops called for storage battery and charging generator, and the power plant began to assume proportions. At the same time the distributing board was modified and improved and the intermediate distributing board took definite and imposing shape, though still tending to cling to the switchboard proper. Cable heads poked themselves up from the cellar to the top floor and ranged themselves alongside the distributing board, which annexed to itself the protectors that had formerly garnished the cable heads. The next stage was the relay terminal room in all its glory, occupying nearly as much space as the operating room itself and with its tiled floor and array of glistening machinery presenting the appearance of what the French would call a *salle des machines*. The cable heads, too rashly assertive, were all cut off, and the cable conductors joined directly by means of pot-head joints to the cable side of the distributing board. The intermediate distributing board at last found its proper place in the terminal room, adjacent to the main distributing board, thus bringing all the work of cross-connecting into one department. The relay racks came into being, and the storage battery, from the modest two cells required to work restoring coils, grew to impressive size, requiring corresponding increase in

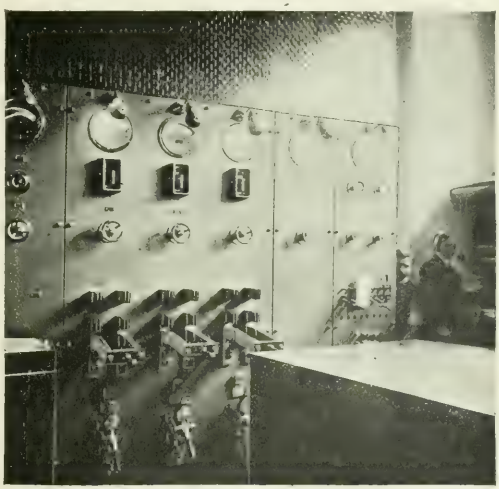


FIG. 3.—MAIN SWITCHBOARD POWER PLANT.

motor generator plant, while the various refinements of automatic ringing, "busy-back" and "don't-answer" signals, testing currents, and so forth, each called for special machinery to furnish the various specialized currents.

The display of machinery in the terminal department of the new Cortlandt Street exchange loses somewhat in effectiveness through the distribution of the appliances among three floors, the seventh, eighth and ninth of the annex recently added to the building. The underground cables come up a shaft in the eastern wall of the building and are directly connected, passing through the ceiling of the seventh floor, by pot-head joints to the main distributing frame on the eighth floor. On the ninth floor are the intermediate distributing board, the relay racks, the power switchboards and the storage battery, which occupies all one end of the room, 22 ft. in width. The generators for charging the storage battery, of which there are three of a total capacity of 55 kilowatts, driven by direct-coupled electric motors supplied at will either from the house or the Edison mains, are distributed among the three floors. A power table of slate in a steel framework carries two motor-generators for ringing and two for supplying special current for signals and tests. The fuses for protecting the relays and coils from heavy currents are all mounted on slate bases. A useful and time-saving wrinkle is the provision of a set of annunciators and alarm bell by means of which attention

is imediately attracted to the blowing of a fuse and the particular fuse blown is indicated by the drop which has been operated.

On the eighth floor is a four-position wire chiefs' desk, completely fitted with testing lines running to various parts of the switchboard and distributing frames, and with appliances for testing lines for trouble. A complete pneumatic tube plant has been installed for transmitting trouble reports between the manager's and the monitor's desks and that of the wire chiefs'. A remarkable feature of this wire chiefs' desk is that it is hinged to the wall at one end and the entire desk can be swung out or back according to whether it is in use or not. The limited space available in the three floors devoted to terminal equipment and power plant rendered desirable this bold treatment of a heavy switchboard, for such the wire chiefs' desk really is. It is probably the first movable switchboard on record, even though its movement is confined to swinging at anchor through a comparatively small arc. The power plant and terminal equipment, notwithstanding the extremely compact arrangement of it all, occupy a total of close on 3000 sq. ft. of floor space, or about half as much as the operating room itself.

The completion of the new plant puts out of service not only the old switchboard, but the old terminal room and distributing board which formerly occupied one-half of the basement of the Cortlandt Street building. This basement, about 100 ft. by 20 (described in the *Electrical Engineer* for Oct. 15, 1890) had gradually filled up with cable heads and distributing frame until it was a veritable cave of the wires, with scarcely room left for another cable to wriggle in. On the night of Nov. 2 a dismal scene of destruction was visible here, as workmen were engaged in cutting away and drawing out the dead ends of cables that were being put out of service as the new branches to the new board came into action. The work of connecting the underground cable system of the district to the new plant involved extensive changes not only in the exchange vaults, but in 19 other manholes in the neighborhood. All of this work was carried out practically without an error, and when the transfer of the service was complete it was found that the largest exchange of the system, comprising, between subscribers' lines, trunks, private wires and other miscellaneous wires, some 10,000 metallic circuits, had been made with fewer actual "troubles" than had arisen from any previous transfer of the smaller exchanges. Of course, since eight other exchanges had been changed over from magneto to relay working, and three new relay offices had been connected to the underground system, the staff had had some practice, but still the record is a fine one, both on account of the magnitude and immense detail of the work involved and the thorough success of the result. The enthusiasm of the men concerned in actually carrying out the work was a fine thing to see. One of the engineers in charge of the cable work told me that two of his splicers who were not required on the cut-over had offered to work all night without pay, so eager were they to share in the great job, and a foreman who had been told that he would not be needed was found in his shirt sleeves helping to pull out dead lengths of cable. It reminded me of old submarine cable days when the whole ship's company would sit up to the gray dawn to take part in lowering a "final splice" overboard.

Another interesting fact relating to the staff is that the whole Cortlandt Street operating force begged, as one woman, to be allowed to take up the working of the new board from the very beginning. Previous practice had been on starting a new relay exchange to draft a force of experienced operators from other relay offices. The change was extreme from the old magneto board to the new common battery board, and the very fact that the working of the latter is so simple makes it all the more easy to make mistakes, while there was the general difference in the style of the operators' equipment also to be considered as a factor. However, such enthusiasm on the part of 150 earnest and hard-working young women was not to be resisted. The whole day force turned up for duty on Sunday morning, the night force having already seen the new board's first gleams of activity as the transfer was made. Sunday, therefore, when the Cortlandt subscribers were at church (or at golf), gave the Cortlandt operating force opportunity for a full dress rehearsal, as it were, in anticipation of the crowded "first day" that was inevitable on the morrow. This opportunity was availed of to become familiar with the new equipment, the arrangement and numbering of the jacks and all the details that differed so widely from those of the old board, which had been working at full pressure (in fact, at forced draft, since everybody tries to do a day's work in three hours on Saturday), only the day before. The result justified fully the enthusiasm of the operators and the judgment of those who allowed it to have sway. The first week's work gave five exceptionally busy days, the day before and the day after election day naturally giving far above normal traffic, yet everything went as smoothly as—well, as a relay exchange well operated, and for the whole week there were but two written complaints bearing on the Cortlandt Street service to be dealt with by the traffic department.

The new switchboard, which was all ready for business early on Sunday morning, but naturally had little or no business to do on that day, had its first real day's work on Monday, Nov. 4, the day before election day. That day, coming between a Sunday and a legal holiday, was, as expected, a record breaker, and gave the largest volume of telephone traffic that Cortlandt had had in several months. The new plant did itself proud in every respect, and under as hard a test as could be wished for came out with flying colors, for the record of troubles and complaints was actually smaller than had been experienced for a long time; in fact, the new board worked from the beginning exactly as if it had been long in use, and had thoroughly struck its gait, and by noon of Monday the manager of the exchange serenely stated that there was no "new" board, that the exchange had settled down to work with all the steadiness of an old and practiced hand.

Another Automatic Telephone Exchange in Massachusetts.

In November, 1900, the first automatic telephone exchange in Massachusetts went into operation at New Bedford, and a description of that system appeared in these columns Feb. 9, 1901. It is now possible to present the financial and physical facts relative to the second exchange of this type in the State, namely, that at the neighboring city of Fall River.

This second exchange, like the first, has been constructed and is operated under license of the Eastern Automatic Telephone Company, of John Hancock Building, Boston. The company last named is in turn the exclusive representative in the States of Massachusetts and Rhode Island of the Strowger Automatic Telephone Exchange Company, of Chicago. Mr. Vinton A. Sears, vice-president of the Boston company just named, is also one of the directors in the local telephone company at Fall River. This latter company is organized under Massachusetts laws, with an authorized capital stock of $135,000, of which $130,000 has already been issued. Work on the Fall River automatic system began in January, 1901, and service to subscribers commenced in September last. At this writing 615 subscribers are served by the exchange, and additions are rapidly being made.

A fireproof building of brick, one story in height, with basement, and about 38 by 60 ft. on the ground, has been erected by the Fall River Company for the exclusive use of its exchange. The ground floor of this building is of concrete arches between steel beams, the roof is tar and gravel, supported by steel beams, and the interior columns are iron. On the interior the building is finished with glazed brick to some feet above the floor. The cost of this building has been about $11,000. All telephone cables pass from the switchboards and apparatus on the first floor to the basement of the exchange building, and thence through a brick subway to the ends of the conduits under the street. Vitrified clay conduits to the length of 120,000 ft. have been laid in about five miles of trench. Manholes to the number of about 60 are provided to give access to the conduits at intervals of somewhat less than 400 ft. along the trenches. The conduit thus far installed has cost approximately $25,000 in position. From the ends of the conduits, cables are run overhead to distributing poles, and thence circuits are carried to subscribers. The telephone company has found it unnecessary to erect new pole lines within the city limits, because of a contract under which they have the right to use the poles of the local street railway and lighting companies. In order to connect the Fall River exchange with that at New Bedford, a new line of 35-ft. poles will shortly be erected over the intervening distance of about 12 miles.

This long-distance line will carry at first six or ten wires of No. 10 hard-drawn copper. The clay conduits are all of the multiple duct type, and are large enough for 200 pair cables. Eight cables leave the exchange by way of the basement and the brick subway previously mentioned. Four of these cables contain 150 pairs of wires each, and the other four contain 100 pairs each, making 1000 pairs in all. The entire amount of cable thus far used includes 6500 ft. of 150 pairs, 15,000 ft. of 100 pairs, 20,000 ft. of 50 pairs, 10,000 ft. of 25

pairs, and 5000 ft. of 10 pairs. These cables were all installed by the manufacturers under contract. At the exchange the first floor is devoted to the office and switchboards, and the basement partly to battery and storerooms. The switchboards on the first floor are adapted to receive instruments for 2700 subscribers, the dimensions of the room being 35 by 41 ft.

As fully pointed out in the matter above mentioned on the New Bedford exchange, each subscriber in the Strowger automatic system has an automatic instrument provided for his especial use on the switchboard at the exchange. This instrument takes the place of manual operations in connecting and disconnecting a subscriber to numbers that he calls, or by which he is called. At Fall River, energy to work these automatic instruments is supplied from a storage battery in the basement of the exchange building. This battery consists of 50 cells with 80 ampere-hour capacity, and 50 cells with 20 ampere-hour capacity. Energy to charge these batteries is drawn from the public supply mains. A motor-generator of ⅓ horse-power capacity furnishes the current for bell ringing. Connections are so made through an automatic relay that this motor-generator stops operation during the night when no calls are being made, but immediately starts when any customer makes his connections for a call.

One of the strong arguments in favor of the Strowger automatic system is the low expense of operation at the exchange. This feature is well illustrated in the present instance. The entire care and operation of the exchange at Fall River, serving 615 subscribers, devolves on a single attendant, and the number of subscribers may be increased to 1000 without additional help. This attendant has been connected with telephone work only two years, and is paid a salary of $80 per month, thus showing that the details of the system may be mastered in a moderate length of time.

It seems in this automatic system that the expenses of operation and the fixed charges go up much more nearly in direct proportion to the number of subscribers, than at the higher rates of increase so well known in manual systems. Certain it is that the increase of operating expenses with the number of calls made by subscribers goes on very slowly in an automatic exchange, compared with the like increase of a manual system. This last fact explains the very low rates that automatic exchanges are able to make for unlimited service. At Fall River a subscriber to the automatic system gets a long-distance instrument, a private line and unlimited use as to the number of calls for $36 per year in a business house, or $24 per year in a residence. The rates of the local Bell company at Fall River are said to be $93 and $72 in business houses and residences, respectively, for similar service.

The cotton industry is the leading one at Fall River, and 27 manufacturing corporations in this line are using from one to five telephones each on the automatic system. Practically all of the cotton and cloth brokers, and mill supply houses are also connected with this system. The secrecy incident to the automatic system is evidently appreciated by the physicians of Fall River, 55 of whom are connected to its service.

These important exchanges at New Bedford and Fall River are only the beginning of automatic service in Massachusetts.

At Springfield, in the same State, the Hampden Automatic Telephone Company has already begun the construction of its underground system, and will have an exchange ready for operation in due time.

For the Fall River system the clay conduits were furnished by the American Vitrified Conduit Company. The cables were made and installed by the Standard Underground Cable Company. The storage batteries are of the "Chloride" type, made by the Electric Storage Battery Company. The Holtzer-Cabot Company furnished the motor-generator. All of the automatic telephone apparatus was manufactured by the Strowger Automatic Telephone Exchange Company, of Chicago.

As the automatic exchange employs electrical energy to perform work that would otherwise be done by human hands, it may be asked how the cost of this energy compares with the wages of telephone girls for equivalent work. At the Fall River exchange during the month ending Nov. 27, 76.2 kilowatt-hours were supplied to the storage battery that works the magnets of the automatic instruments. This energy was billed at 10 cents per kilowatt-hour, less 10 per cent, making a net charge of $6.86 on this score. The motor-generator that does the bell ringing absorbed 54.2 kilowatt-hours during this same month, costing at the rate just named $4.88. It does not appear that the consumption of energy by the motor-generator for bell ringing is any greater in the automatic than in a manual system. Considering only the energy supplied to the storage batteries at a cost of 686 cents for the month, it seems that this cost amounted to little more than one cent per subscriber per month, as the number of subscribers was 615 before the end of the month. The total cost of energy at the exchange for all purposes was $11.74, or less than 2 cents per subscriber connected for the month. All of the subscribers connected with this exchange are on unlimited service, and any reasonable estimate of the wages of telephone operators to do equal work is sure to be far in excess of the $6.86, or even of the $11.74, the cost of bell ringing as well as of battery charging.

The Economic Design and Management of Telephone Exchanges—I.

By Arthur V. Abbott, C. E.

TELEPHONIC DESIGN as one department of the great field of electrical engineering has had few exponents, and so far as the writer is aware, there has been no connected exposition of the principles which govern the mutual relations of the various parts of a plant necessary to telephonic service on a large scale, in such a manner as to enable the engineer to so proportion the quantity and quality of the essential apparatus as to produce an installation that will give the best service with a minimum initial investment, and aid the operating manager to so prosecute the business as to insure satisfactory service with the least annual expense.

The reasons for this absence of literature are not far to seek. Telephony as an art is less than a quarter of a century old, and those engaged therein have had to feel their way step by step, usually so handicapped by the demands of a business that was increasing too fast for experience to overtake, as to lack the time and opportunity to record the lessons that actual practice inculcated. Then, for the best part of its present lifetime, the telephone has been under the control of a management that, while it has usually prosecuted the development of the art in a most careful and praiseworthy manner, has steadily indulged in what appears to the author the mistaken policy of repressing free discussion of the subject. This state of affairs is fast disappearing. With the independent movement, exchanges are springing up in each town all over the country, and each state is organizing mutual telephone associations at whose frequent meetings a full and frank interchange of views and experience is exchanged, that the technical press immediately places at the service of those interested, thus imitating the broader and more liberal methods of other electrical interests.

During the experience of a decade in the engineering field of telephony, the writer has had an opportunity to watch the operation of what appear to be some of the fundamental principles of the economic design and management of telephone exchanges. At best these observations can only cover a small fraction of even present telephonic experience, and deductions therefrom must be accepted with the greatest caution, and be subject to extreme modifications both in place and in time. With such restrictions, these notes are now offered for the consideration of those who are, perhaps, in an earlier stage of experience, in the hope that in some cases, at least, they may serve as a guide of what not to do.

THE FACTORS IN THE PROBLEM OF DESIGN.

An attentive observer at the Philadelphia Centennial Exposition could have noticed a fine wire extending along one of the galleries of Machinery Hall. The ends of the wire terminated in curious trumpet-shaped pieces of apparatus, placed in little enclosures situated at opposite sides of the building, wherewith a careful listener, located at one end of the wire, aided by acute hearing, and the judicious use of the imagination, might understand articulated sentences shouted into the apparatus at the other end. Such was the first public exhibition of the telephone.

By means of the invention of Professor Bell, the long-sought electrical transmission of speech became an accomplished fact, and during the quarter of a century which has since elapsed, electrical arachnida have been so industriously spinning a copper net over the continent, that in the United States alone, there are approximately a million miles of telephone wire, bringing into daily speaking relations about two and a half millions of subscribers; that with 3,000,000 telephones, annually exchange nearly 4,000,000,000 messages, while for the prosecution of this business some tens of thousands of employes are needed.

Though Professor Bell's discovery richly merits the distinction of

being the keystone of the stupendous telephonic edifice that has since been reared, yet the present value of the telephone and its influence in business and social intercourse depend quite as much on other and auxiliary apparatus that, voussoir-like, supports and sustains the key, and is equally necessary to complete the magnificent structure. Bell's magneto telephone supplied an instrument for mutually interconverting sound and electricity—absolutely nothing more. But to render inter-communication practical, calling signals were needed, for, although the telephone could talk, its voice was too feeble to gain notice, and such a contrivance was required as would at once attract the attention of those in the vicinity of the instrument, without requiring watching, and also one that would be perfectly reliable and need no attention to keep in constant repair. Without an exception, all forms of signals for subscribers, excepting the audible one, have proved to be failures, and while multitudes of devices involving the use of the receiver or an electro-magnetic tuning fork arranged to emit a musical note have been tried, all have been relegated to obscurity save the familiar call bell.

In early days the old-fashioned vibrating bell, with battery and push button was immediately at hand, and gained a widespread introduction; but the battery was inconvenient to maintain and the bell contacts got out of order, so the magneto bell, containing no contacts, operated by a small electric hand dynamo, displaced in the race for survival, the electro-chemical signal.

Experience soon proved that the magneto telephone was exceedingly inefficient in the transmission of speech, as it could only be used over short lines, and even then necessitated the expenditure of much lung power at the sending end. No sooner did Bell's instrument appear than a host of experimenters set to work, and presently the microphonic inventions of Berliner, Gray, Hughes, Edison and Blake completely displaced the Bell telephone for all purposes of transmitting speech. The Bell type as a receiver, however, still holds undisputed sway in almost the identical original form. So by the schooling of experience a telephonic outfit for the subscriber has been refined to a magneto signal, a battery transmitter and magneto receiver.

In addition to talking and signaling apparatus for the telephone user, a path over which electrical energy could travel between correspondents was required, for in early telephone days Hertzian waves were entirely unknown, and even to-day their telephonic possibilities are of the remotest. Hence the unsightly aerial lines which grew like mushrooms, exhibiting with their crooked knotted poles, top-heavy with almost impenetrable cobwebs of wires, and loaded with wrecks of innumerable kites, many other cryptogamic resemblances. Gradually, however, the open-wire line evolved into the aerial cable, and from the aerial cable developed the much more satisfactory underground system that now only betrays its presence by periodically recurring upheavals of the streets, and a chronic disease of city pavements. In the beginning, each person was compelled to have a separate line extending to every other with whom conversation was desired, though with the first handful of telephones installed, the absurdity of this method from both the standpoint of expense and intricacy was demonstrated. To reduce the number of wires to a minimum, only a single one was strung for each pair of communicants, Mother Earth being used as a common return, but like all garrulous gossips she caused trouble by failing to hold her tongue, creating no end of domestic disturbance by surreptitiously informing Mrs. X. what Mrs. Y. had ordered for dinner. Then when the electrical railway, and electric light made their appearance conversation of all kinds was so interjected with such a hissing and spitting that telephonists were fain to immediately convert each line into a complete metallic circuit.

As an escape from the impracticability of a wire for each pair of talkers, came the germ of the modern exchange in the idea of bringing all lines to some central point. At first the attendant carefully and laboriously wrote out the message that the calling party wished to transmit, summoned the desired correspondent and yelled the message into a plain magneto-telephone (for in those days there were no solid backs), this performance requiring a sufficient expenditure of lung power to enable the recipient of the message to receive the same independently of the telephone, provided he happened to be within a few blocks of the office. But this plan limited the use of the telephone to messages which were purely mandatory, and as people wanted to converse with each other, some means of interconnecting different lines was needed. The old telegraphic device of interlaced brass strips was the next step in advance, by means of which, with the aid of plugs fitted into holes in the strips, any pair of lines could be promptly joined together. This plan worked with fair success until the number of subscribers so increased as to require a greater space for the strips than could be covered by the arms of four operators seated at a square table. At this point the invention of the spring jack, and flexible cord terminating in a metallic plug, whereby any two jacks each attached to a subscriber's line could be quickly and surely connected, afforded immediate and seemingly permanent relief. But the increase in business has been so rapid that the ingenuity of inventors has been taxed to the utmost to reduce the jack to its least dimensions, in order that all the subscribers brought to one office could be placed within an arm's reach of the operator. Hand in hand with the evolution of the spring jack and connecting cords, the development of central station signals has taken place, for the switchboard requirements are very different from those of the subscriber. At the office an attendant is supposed to be constantly on duty to watch signals, but it was essential that the party calling should be plainly identified—a function entirely unnecessary at the subscriber's premises. The call bell was tried, but found too bulky and indistinctive. The electromagnetic annunciator in the form of the familiar hotel apparatus equipped with a falling shutter, or drop whereby a number painted thereon could be displayed at the subscriber's pleasure, reigned supreme for more than a decade, but the decreasing size of spring jacks with which the signal must be associated, and the demands for service that should be surer and more prompt, has consigned the drop to the scrap heap, and substituted therefor a miniature incandescent lamp, that is now universal in modern switchboards. So, from a little table in a small room in Devonshire Street, Boston, to which a half dozen magneto telephones were connected by iron wires strung in streets, the modern telephone system of the country has evolved, counting its subscribers by millions, and talking with ease over half the continent.

Every telephone plant, therefore, may be structurally divided into three separate parts, that perform entirely different and separate functions, the sum of which is necessary to the prosecution of the business. These parts are:

First.—*The subscriber's station,* containing apparatus to enable the user to transmit signals to and from the office and to transmit and receive conversation.

Second.—*The line,* comprising the necessary wire plant to supply electrical communication between each subscriber and the central office, and between different central offices.

Third.—*The central office,* comprising apparatus capable of performing the following functions:

First.—(a) To permit any subscriber to call the attendant at all times.

(b) To permit any subscriber to give necessary instructions to the attendant.

(c) To permit the attendant to ascertain whether any subscriber is engaged in conversation without causing interruption.

(d) To permit the attendant to call any disengaged subscriber.

(e) To permit the attendant to connect together any two parties for conversation.

(f) To notify the attendant at once when conversation is completed.

Second.—To enable attendants to perform the same functions between different offices.

The *Economic Design* of a *Telephone Exchange* is such a selection and arrangement of apparatus and appliances for each of the factors thus defined, and such a mutual adjustment of one to the other, as to enable the particular plant under consideration to give the best service with the least initial investment. The *Economic Management* of a *Telephone Exchange* is such a regular manipulation of the plant as shall secure the best service with the least *continued* annual expense.

In the consideration of the three telephonic factors taken in the preceding order, it is most convenient to commence with the central office as a center and proceed centrifugally outward to the subscriber. Telephonists, however, have a language of their own, partly composed of words and phrases peculiar to the art, and partly of expressions current in electrical and mechanical engineering, to which a specialized meaning, different from that ordinarily conveyed, is attached, and even between experts the same terms are used with varying meaning. It is well, therefore, before proceeding to the consideration of central station design, to rehearse the more common telephonic definitions in order that in future, paragraphic brevity may be combined with perfect definiteness of statement.

Theory of the Edison Nickel-Iron Cell.

BY E. F. ROEBER, PH.D.

I HAVE read with much interest the communication of Mr. Woolsey McA. Johnson, published in your issue of Nov. 2. Mr. Johnson's arguments are quite interesting, but do not appear to be conclusive. He agrees that there will be concentration changes at the electrodes, but he claims that such changes would have small effect on the voltage, and that the steady drop of the voltage during discharge could not be accounted for by the influence of the variations of concentration upon the potential differences between the electrodes and the solutions. His argument is as follows: "The e. m. f. of the nickel superoxide plate against hydrogen would be at different concentrations

$$e_1 - e_2 = \frac{0.058}{2} \log \frac{p_1}{p_2}$$

where p_1 and p_2 are the aqueous tensions of the caustic solutions. A similar formula comes in for the positive plate. This would show that the change from a 20 per cent solution to a 1 per cent solution would make very slight difference in the voltage of the cell (not much over 0.03 volt)."

This argument is not altogether clear. There is no reason apparent why Mr. Johnson should speak of the e. m. f. of the nickel-superoxide plate "against hydrogen." So-called normal electrodes, like the hydrogen electrode (platinized platinum saturated with and surrounded by hydrogen) may often be applied to advantage in scientific researches, but in the present case the hydrogen electrode would introduce only complications. For e_1 would then be the e. m. f. of the combination: nickel superoxide electrode, 20 per cent caustic potash solution, hydrogen electrode, and e_2 the e. m. f. of the combination: nickel superoxide electrode, 1 per cent caustic potash solution, hydrogen electrode. Hence the difference $e_1 - e_2$, as defined by Mr. Johnson, would not give the variation of the potential difference between the nickel superoxide plate and the solution alone, but as well as the variation of the potential difference at the hydrogen electrode, and the variation of the e. m. f. at the hydrogen electrode, is of no interest whatever in the present case.

What would be important to calculate is evidently the difference $e_1 - e_2$, where e_1 is the potential difference between a nickel superoxide electrode and a 20 per cent *K O H* solution, and e_2 the potential difference between a nickel superoxide electrode and a 1 per cent *K O H* solution. Now, this difference, $e_1 - e_2$, may indeed be represented by the formula, given by Mr. Johnson, as a consequence of Nernst's theory of the potential difference at a "reversible electrode"; but p_1 and p_2 have then a peculiar meaning, and when this is clearly understood, it is impossible to use the formula for deducing the special conclusion given by Mr. Johnson. To prove this claim, I will give a very brief analysis of Nernst's formula, as far as necessary for the present case.

Nernst's theory deals with the e. m. f. produced at the boundary surface of an electrolyte and a "reversible electrode." What is meant by a "reversible electrode" can best be explained by a few examples. When the transport of $2 \times 96{,}540$ coulombs from a copper electrode to a copper sulphate solution is combined with the passage of one gram atom of *Cu* from the electrode into the solution; and when the transport of the $2 \times 96{,}540$ coulombs in the opposite direction is combined with the deposition of one gram atom of *Cu* from the solution to the electrode, the copper electrode in the copper sulphate solution is called reversible in regard to the *Cu* ions. In the same way, a zinc electrode in the solution of a zinc salt is reversible in regard to the *Zn* ions. A mercury electrode, covered with a layer of calomel (Hg_2Cl_2), in connection with a solution of a chloride, is reversible in regard to the Cl ions.

When one gram molecule of a gas is brought from the pressure p to the pressure $p - dp$, the work performed is

$$v\,dp = \frac{R\,T}{p}\,dp;$$

the work corresponding to the change from the pressure P to the lower pressure p_1, is, therefore, for one gram molecule,

$$R\,T\,l\,\frac{P}{p_1}$$

and for one gram equivalent

$$\frac{R\,T}{n}\,l\,\frac{P}{p_1}$$

where n is the valency and l represents Naperian or natural logarithms.

According to Van't Hoff there exists an analogy between the laws of pressure of gases and those of osmotic pressure in solutions. Hence the last equation also represents the work corresponding to the change of one gram equivalent of an ion from the osmotic pressure P to p_1 in a solution.

Now consider an electrode reversible in regard to the cation (like copper in copper sulphate). Let 96,540 coulombs pass from the electrode to the solution, so that $\frac{1}{n}$ gram molecule of that kind of ion, in regard to which the electrode is reversible, passes from the electrode to the solution, and is brought from what Nernst calls the "solution tension" of the electrode to the osmotic pressure of the same ions in the solution. The work performed is then also represented by the last formula, if P now means the solution tension and p_1 the osmotic pressure in the solution of that kind of ions, in regard to which the electrode is reversible. The work performed is also the product of the number of coulombs and of the potential difference e_1 between the electrode and the electrolyte, so that, after some transformations, we get for $T = 290$ (17 degs. C.), the potential difference e_1 in volts, or

$$e_1 = \frac{0.058}{n} \log \frac{P}{p_1} \qquad (1)$$

where log represents common logarithm, P the solution tension and p_1 the osmotic pressure of that kind of ions, in regard to which the electrode is reversible.

Now take a case exactly like that just considered, except that the osmotic pressure of the ions in regard to which the electrode is reversible, is different from before—say, p_2 instead of p_1. The e. m. f. between electrode and solution is then

$$e_2 = \frac{0.058}{n} \log \frac{P}{p_2};$$

hence the difference of the e. m. f.'s in the two cases

$$e_1 - e_2 = \frac{0.058}{n} \log \frac{p_2}{p_1} \qquad (2)$$

where p_1 and p_2 are the values of the osmotic pressure of that kind of ion, in regard to which the electrode is reversible. We have developed this formula under the assumption that the electrode is reversible in regard to the cation. If it is reversible in regard to the anion, the following formula is obtained, which differs from (2) in the sign,

$$e_1 - e_2 = \frac{0.058}{n} \log \frac{p_1}{p_2}$$

The osmotic pressure of a kind of ion is proportional to the concentration of the same kind of ion, so that instead of the ratio $\frac{p_2}{p_1}$ in (2) we can write $\frac{c_2}{c_1}$, where c_1 and c_2 are the concentrations *of that kind of ion, in regard to which the electrode is reversible.*

Mr. Johnson gives the same formula, but says that p_1 and p_2 are "the aqueous tensions of the caustic solutions." This is not clear; but he evidently means the osmotic pressure of the K ions or of the O H ions. This osmotic pressure is proportional to the concentration of K O H; hence, under the assumption that the one K O H solution is 20 times more concentrated than the other, he gets

$$e_1 - e_2 = \frac{0.058}{2} \log 20 = 0.038 \text{ volt}$$

"not much over 0.03 volt." This conclusion is wrong, because the nickel superoxide electrode cannot simply be assumed to be reversible in regard either to the K ions or the O H ions.

Mr. Johnson's conclusion would be right if we had to deal with copper in copper sulphate, for the ion in regard to which the electrode is here reversible is copper, and the osmotic pressure of the copper ions is in this case directly proportional to the concentration of the copper sulphate solution. The difference between the e. m. f. at a copper electrode in a 20 per cent sulphate solution and the e. m. f. in a 1 per cent solution, would, therefore, be represented by equation (2), where, instead of the ratio of the osmotic pressures of the Cu ions, the ratio of the concentrations of the copper sulphate solution

would be used (always assuming, for the sake of argument, that the theory of solutions which is strictly correct only for very dilute solutions, would also be correct for these more concentrated solutions). In the same way Mr. Johnson's conclusion would also be right for zinc in zinc sulphate, or for a calomel electrode in contact with a chloride solution. But the case of the Edison cell is entirely different. There we have to deal with a nickel superoxide electrode, and with an iron electrode in a solution of hydroxide of potassium. The case is also different with the lead cell, where there are lead peroxide and lead in a sulphuric acid solution. To apply Nernst's theory to these latter cases, it is first necessary to fix exactly the ideas as to the kind of ion in regard to which each electrode is reversible.

There are two different theories of this type for the lead cell, the one developed by Le Blanc, the other by Liebenow. Both assume that the lead electrode is reversible in regard to bivalent positive Pb ions. As to the peroxide electrode, Le Blanc assumes it to be reversible in regard to fourvalent positive Pb ions, while Liebenow assumes it to be reversible in regard to bivalent negative PbO_2 ions. With these assumptions, it is possible to apply Nernst's formula (1), in which, of course, p_1 is the osmotic pressure of that kind of ion, in regard to which the electrode is assumed to be reversible (Dolezalek, *Zeitschr. f. Elektrochemie,* 1899, May 25; Abel, *Zeitschr. f. Elektrochemie,* 1901, June 27). This leads to equations representing the e. m. f.'s as functions of ionic concentrations of hypothetical kinds of ions, in regard to which the electrodes are reversible. Later on, the law of chemical mass action enables one to pass from those hypothetical ionic concentrations to the measurable concentrations of sulphuric acid. Both Liebenow's and Le Blanc's theories lead to the same results, and which are in agreement with the facts. The method just indicated is somewhat long, but is the only correct method to apply Nernst's formula (1) in such cases. To apply it to the problem of the Edison cell, it would, therefore, be necessary, first, to form exact ideas as to the kind of ions in regard to which the electrodes are reversible, and then to apply formula (1), where P represents the solution tension and p_1 the osmotic pressure of these ions.

Mr. Johnson's argument thus breaks down and the question of the influence of concentration changes at the two electrodes upon the e. m. f. of the Edison cell is still an open question. I also believe that the other question taken up by Mr. Johnson, concerning the effect of changes in the internal resistance, can be answered successfully only by experiment, as it seems to me impossible to devise a *priori* an exact mathematical theory, taking into account all the various influences which bring about a change in the internal resistance.

An Association of Ohio Farmers' Telephone Companies.

The Geauga County Telephone Association, which was formed as an association for mutual benefit by five exchanges in Geauga County, has been reorganized and made stronger by the admission of the Chagrin Falls Telephone Company, of Chagrin Falls. The association is unique in several respects, and it represents what is probably the most complete system of farmers' telephone lines in the country. The original association was formed in 1898 by the Bainbridge Telephone Company, the Chardon Telephone Company, the Burton Telephone Company, the Stafford Telephone Company, of Newburry, and the Claridon Telephone Company. The companies were independent of one another, but under the association agreement the subscribers of one exchange was permitted to talk to subscribers of all the other exchanges without extra charge. Under the reorganization, the advantages are increased, since the Chagrin Falls Telephone Company has connection with Cleveland and the long-distance lines of the United States Telephone Company, thereby giving the association the benefit of the long-distance service. The subscribers in the most remote portion of the county will be enabled to talk to Cleveland subscribers at the Chagrin Falls rate, 10 cents. At present the telephones of the association number over 1000, divided as follows: Bainbridge, 150; Chardon, 355; Burton, 150; Newburry, 150; Claridon, 50; Chagrin Falls, 220. Since the entire population of Geauga County is only about 14,000, it is evident that the lines of the association reach nearly half the homes in the county. New officers of the association were elected as follows: Charles Post, Bainbridge, president, and H. C. Tuttle, Burton, secretary. It is the intention of the association to make important extensions of the toll service and lines will be built into eastern Cuyahoga County, northern Portage County and northern Summit County. It is probable also that other towns in these counties will be admitted to the association. One of the greatest benefits of the association is that all materials and equipments are purchased in bulk and are standard, thereby effecting a great saving to the different companies.

The Debt of Electrical Engineering to C. E. L. Brown—IV.

By B. A. Behrend.

THE LAUFFEN TYPE GENERATOR.

THE first and most needful step was to make a generator that could be used equally well for single-phase and for polyphase currents. Thus Mr. Brown invented and designed the "Lauffen Type" represented in Figs. 18 and 19.

In his Frankfort lecture of Feb. 9, 1891, Mr. Brown thus describes the main principles that guided him in creating this construction. "The generator must be an alternating-current dynamo, whose tension we will choose as low as possible, for thus such a dynamo can be made a *machine* in the fullest sense of the word. This will be clear if I adduce as illustration the winding of the armatures of the dynamos designed for supplying three-phase currents to the Oerlikon Tool & Engine Works, which consists of copper bars 30 mm. thick, which are insulated with paper tubes. It may surprise you to hear that the winding of a dynamo may consist of thick, solid copper bars, but this construction becomes possible if these bars are lodged in closed slots in the armature iron, a construction which I used as early as 1885 in my ordinary direct-current dynamos. If you consider an armature of 40 volts consisting of solid bars firmly held in

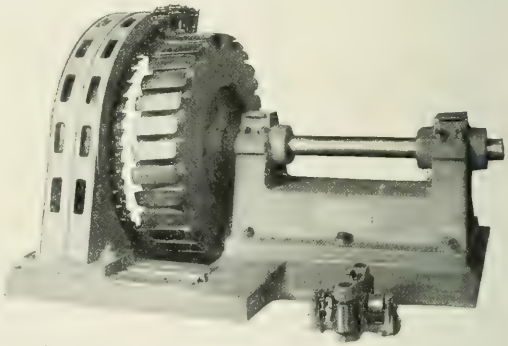


FIG. 18.—300-HP GENERATOR FOR LAUFFEN-FRANKFORT TRANSMISSION, 1891.

an iron core, you must admit that this machine will satisfy the severest claims on safe and dangerless operation."

At the outset of this article we quoted Professor Amsler Laffon's words that the success of Brown's dynamos must be ascribed to his "ingenious though simple" constructions, and the truth of this saying is borne out by the machines illustrated in Figs. 18 and 19. The magnet-wheel is overhanging, the exciting current is led to the field coil by two copper wires that run like belts on the slide rings. The armature can be moved aside to expose itself and the field. The armature winding of these machines consists of round bars, one bar per pole and per phase, which are connected in Y. In the photograph the form of the end connectors is clearly visible. This latter construction also originated with Mr. Brown.

The field coil consists of one circular bobbin placed between the two steel rings with pole projections. This construction, which found numerous imitators, did not prove so successful as its ingenious simplicity might suggest, the reason being the great field leakage. Brown soon became alive to this inherent defect of his machine, and he at once discontinued building it, while his followers, with the imitativeness of our species and with the inertia characterizing the human mind, did not even see its seeming advantages until its inventor had long discarded the construction.

The effect of leakage in the Lauffen type shows itself in making the short-circuit curve bend off at high saturations so that doubling the exciting current, for instance, does not increase the short-circuit

current more than about 25 per cent. The saturation curve being almost parallel to the abscissa, owing to the leakage, it follows that with increasing excitation the drop is not diminished as it is in machines with small leakage. Thus it happened that machines built after the Lauffen type and operating on an inductive load, did not give the calculated terminal volts, however much the exciting current might have been increased. To grasp these facts, so important and yet so long persistently misunderstood, is one of Mr. Brown's greatest achievements, or, we had better say, the fact of his understanding it at a time when most electricians were floundering from one chaos of prejudices into another, and vacillating from one type to another, led of necessity to the start that he soon obtained over them.

In October, 1891, Mr. Brown left the Oerlikon Company after having been their designer and director for six years. For Mr. Brown is proud of calling himself a designer, as it is his superior designing ability that established the high reputation of the Oerlikon Company, leading not only in design but also in workmanship; and those who admire the work of Brown cannot fail to yield their appreciation and esteem to Colonel Huber, the president of the Oerlikon Company, for having been wise and large-minded enough to have seen the worth of the young director of his plant. For it doubtless redounds greatly to the credit of a man's intellect who, in an executive position, is capable of discerning between the shallowness and tall talk of the bully and the more modest claims of the truly able man. That the designer, aside from questions of organization and

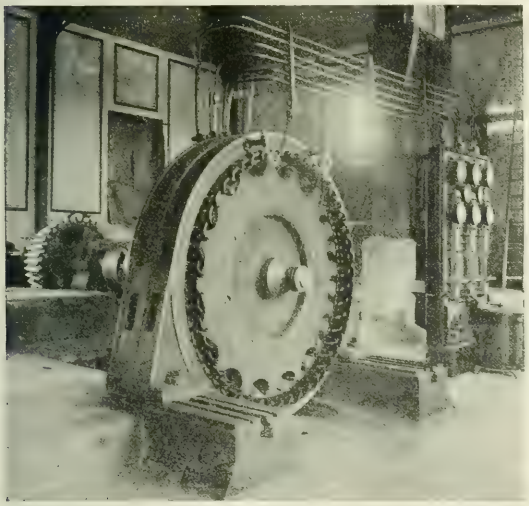


FIG. 19.—300-HP GENERATOR FOR LAUFFEN-FRANKFORT TRANSMISSION, 1891.

management, in large measure makes and unmakes a concern, has been experienced by many a large concern during the past ten years.

In his new works at Baden Mr. Brown devoted all his energies to the practical development of alternating-current machinery. We have seen that Brown had already recognized the inherent faults of his Lauffen type. With keen penetration he took up the revolving field alternator and made it the successful machine that this type is now acknowledged to be all over the world. The condition in which Mr. Brown found the revolving field machine when he began to improve it, was not a very encouraging one. Indeed, these machines were then such freaks that it was hard for a man to see which was the armature and which was the field, as the former had tremendous holes filled with wire, while the latter contained only a few thousand ampere turns, so that the amount of copper on armature and field was almost the same. As a great advantage of these machines was put forward that the danger of their burning out was diminished to a minimum since the short-circuit current did not exceed—often it did not even equal—the normal current of the machine. A certain popular saying about the fox and the sour grapes he could not get, intrudes itself somewhat involuntarily upon the modern designer when he listens to such claims. These machines were very wide, they had poor ventilation, they had a small pole-pitch and a large air-gap; in short, they were the embodiment of all the errors that designers could make. In the hands of Mr. Brown the revolving field generator received its modern form and shape, as we will illustrate by two splendid designs, viz., Brown's design for the Cataract Construction Company, Niagara Falls, and for the Frankfort Electric Central Station, Germany.

In Fig. 20 we give the design of the 3500-kw generators that Mr. Brown submitted to Professor Turettini successively on April 1 and Sept. 20, 1892. This machine was designed to give two-phase current

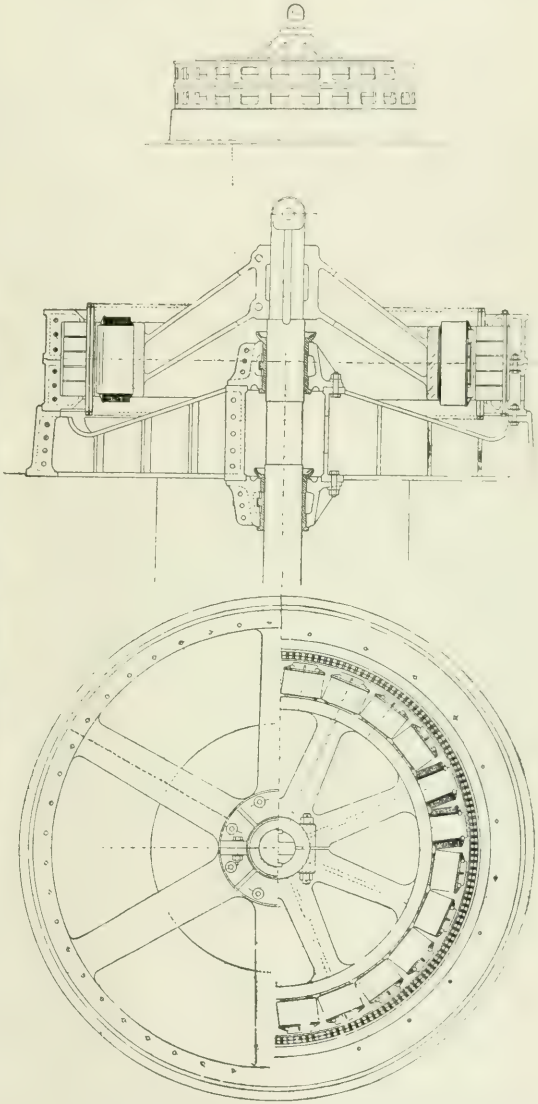


FIG. 20.—BROWN'S DESIGN FOR 3500-KW GENERATORS FOR CATARACT CONSTRUCTION COMPANY, 1892.

of 50 cycles at 3000 volts and 582 amperes. The speed of the generator was 250 r. p. m.

This design is in all respects a modern one. The diameter of the revolving field, which is a single steel casting, is 300 cm., hence the surface speed is nearly 40 m. per second, or 7800 ft. per minute. The total width of the armature iron is 60 cm. There are eight slots per pole, four per pole and phase, each slot containing two conductors. The total flux per pole is, therefore, 14×10^6. The section of the pole

is $20 \times 55 = 1100$ cm²; thus the induction in the pole bottom with 20 per cent leakage comes out to be 15,300 per square centimeter. The ventilation of the armature is very carefully attended to, which would have permitted the making of the machine as small as it was proposed. For the interest of the comparison it may be mentioned that the present Niagara generators, designed by the Westinghouse Company, have a diameter of 262 cm. and are 90 cm. wide.

Mr. Brown intended to make the field coils of these high-speed machines of copper strip wound edgewise upon the poles, a construction that he put into practice a little later in 1893 on a 600-hp single-phase generator in Lucerne, while the 525-kw single-phase generators for Frankfort were the first to draw general attention to this "ingenious though simple" construction.

Perhaps the first to use copper strip wound on edge was Mr. Sebastian Ziani de Ferranti,[1] who recently wrote to the author: "I first used copper winding on edge for field magnets (of disk alternators) in the year 1883. This particular machine was fitted with a zig-zag armature and was a low-tension alternator. The field magnets were not wound with separate coils, but the strip was wound on edge in the form of a zig-zag. No insulating covering was used on the strip; one layer was divided from the next by means of little insulating pads, and the strip was held in position on the magnets by means of four wooden wedges per pole driven in at the corners between the iron magnets and the copper winding. This field winding was in consequence air-insulated, and had most perfect insulation of air round every part, and also exposed the greatest possible radiating surface that could be obtained in the space available." Mr. Ferranti applied the edgewise coil in 1890 to his mercury meters, and in 1893 to a revolving field generator with circular poles made of cast steel, with pole faces forged in one. This machine is installed in Portsmouth, England.

A Telephone Money Order System.

From time to time efforts have been made to engraft upon the ordinary telephone service various features of information or amusement that the public is supposed to need. Many years ago in this country, the time system of a Southern jeweler was taken up by capitalists interested in the Erie Telephone Company, but after a pretty thorough trial it was dropped from all the Bell circuits, there being then no others available. So far as could be learned, the time system, while ingenious and practicable, was a nuisance, and since that period the Bell telephone managers have been very chary about introducing auxiliaries and accessories, shying even at sanitary mouthpieces. The desirability of repeaters and of recording devices is admitted, but none are available at this moment, and they are regarded more in the light of parts of the apparatus than as extraneous means of earning extra income. The Budapest telephone newspaper is a good illustration of the extent to which this kind of service can be pushed, but it has quite failed of imitation elsewhere, although in some cities in Europe various forms of entertainment can, it appears, be switched into any house on payment of the tariff. In this country one hears occasionally of people listening to sermons, or giving evidence, or getting married, or being called in the morning, by the telephone; but outside of fire alarm work, there is little telephone service here of the nature now proposed by *Printers' Ink*, in the nature of a telephone money order system. The plan suggested recently by our excellent contemporary is as follows:

There is a well-defined demand in large cities for a telephone money order system. People who live in New York and Chicago and other communities of "magnificent distances" transact a great volume of business by telephone, and even telegraph. In the ordering of theater seats, concert tickets, sleeper berths, railroad tickets, staterooms and other things that can be secured by telephone the main difficulty is the transmitting of money. Seats and tickets are often forfeited when not claimed upon the minute by parties who have no accounts with theaters, and it is next to impossible to convey money by any convenient, inexpensive method. If a reliable system of stations were established where money could be paid and transmitted by telephone it is likely that urban telephone money order business would be greatly increased. Improved money order systems have done much to increase the volume of trade in the rural districts of the land, and there is no reason why they could not be made to do as much for the cities.

In order to ascertain what there is of value in this suggestion, we have brought it to the attention of a number of well-known telephone managers and engineers in this country, and some of their replies are given below. Mr. W. D. Sargent, vice-president of the New York & New Jersey Telephone Company, one of the oldest and most experienced telephonists in America, says: "The prime function of a telephone company is to furnish wires and apparatus for the purpose of oral communication to all who may apply for it. At the present time, when the business is in process of development, I do not think it would be wise or expedient for telephone companies to attempt any side business. No doubt they will do so in the course of time. We have never done anything in the line of your memorandum. We do not even receive, transmit or deliver written messages. I understand the transmission of money orders by telegraph is a profitable business to telegraph companies, and there is no reason why it cannot be done just as well by telephone by any financial combination that would choose to use the wires for that purpose." Another veteran, Mr. E. B. Baker, general superintendent of the Southern New England Telephone Company, says: "I do not know of any instance where this has been adopted by telephone people, although I have often considered the matter of purchasing theater tickets and steamship staterooms for our subscribers located in adjoining exchanges, the subscriber paying the ordinary telephone tolls and messenger charge in addition to the price of the tickets. I think this would be perfectly feasible, besides being an accommodation to the public, and I do not see why the same could not be followed out in regard to money orders." Mr. U. N. Bethell, the general manager of the New York Telephone Company, who was formerly in Brooklyn and lately has had the Washington Bell system entrusted to his care, writes us that the suggestion is "a very interesting one," and adds: "Nothing of the kind has ever been attempted within my knowledge, and no feasible way of carrying such a business on occurs to me." Mr. Angus Hibbard, general manager of the Chicago Telephone Company, remarks: "I do not know that I have any opinion on the matter referred to in your note which is worth anything. It seems to me that in a large telephone exchange local transfers of money can be, and undoubtedly are made through persons or companies acquainted with both parties, making unnecessary the establishment of any particular office or point at which such transfers should be made."

Mr. A. V. Abbott, who was formerly with the Chicago Telephone Company as its electrical engineer and is now actively following his profession in Cleveland, sends us the following thoughtful letter: "Relative to the transmission of money orders by telephone as suggested by enclosed slip, the idea is certainly a novel one, at least so far as my knowledge is concerned, as I never heard of it being previously suggested. In some cases this might afford a convenience to telephone users, but it appears to me that the complications would be so great that the service might become too expensive to be desriable. If the system would be universally extended it would practically amount to requiring a telephone company to open an account with all subscribers, and then each subscriber would have to guarantee all sums transmitted over his instrument. A service of this kind might be popular in connection with long-distance lines in the transmission of money from town to town, and as the volume of this business would necessarily be quite small I am not sure but that it might become a valuable feature for the larger pay stations such as would be located in the downtown exchanges in New York City and Philadelphia and the larger cities, but I should fear, on the whole, that the bookkeeping complications would be prohibitive for anything excepting a few of the largest offices."

Mr. C. H. Judson, of the progressive Twin City Telephone Company, of Minneapolis, Minn., says: "Concerning the demand for a telephone money order system, I am certain that something of this kind in the large cities might prove of great utility. As to the manner of putting this into operation it does not seem to me that it would be at all difficult. A telephone company should be just as

[1] From a letter of Mr. C. E. L. Brown to the writer I wish to publis hthe following paragraph:

"There is a great deal of truth in your remark as to there being very few men who are capable of properly criticising a design. This is a thing I have noticed over and over again, and it has always been a puzzle to me that there should be such a comparatively small number of men—even among engineers—who thoroughly and instinctively comprehend the points of a well thought-out design, and to whom such a design is a source of real pleasure analogous to that felt by any connoisseur for a work of art.

"I would just point to a man whom I regard as being an exceptionally fine designer, namely, Mr. Ferranti. I have met very few people indeed who had the slightest idea of the beauties of his designs."

able to transmit small amounts of money in this way as a telegraph company, except in that it would require some kind of a check to be certain that responsible parties were making the orders. This, however, should not be difficult. We have not felt the need of anything of this kind thus far in Minneapolis or St. Paul, since our population has not reached the point where parties living at a distance from the theaters cannot have some one conveniently located make their arrangements. Of course, in cities like New York and Chicago, or Philadelphia, where it would not be possible for people living in the suburbs to send any one personally to the ticket office the system should be valuable. I should be very much interested in reading the opinions of other telephone men on the subject, since perhaps they may make suggestions that will give us ideas that would enable us to utilize the service in our own exchanges." Somewhat on the same lines, President S. P. Sheerin, of the New Long Distance Telephone Company, of Indianapolis, Ind., says: "In reply, permit me to say that, while we have no regular system—not having as yet inaugurated it, because of the multiplicity of other things claiming our attention—we do a limited amount of this business. We will buy theater tickets for any of our friends throughout the State, and make any other such purchases or payments for them as they may desire. We intend, just as soon as we can give it sufficient time, to organize a system of this kind, in a very complete way." Mr. G. H. Metheany, manager of the Lima (Ohio) Telephone & Telegraph Company, remarks: "I believe that if a safe system were devised and put in operation a good business could be developed. I do not know that anything of the kind has ever been attempted." Mr. W. H. Eckert, a veteran telephonist and now president of the Knickerbocker Telephone & Telegraph Company, of New York, also says: "The idea is a new one to me, but I think it is a good one, provided a plan can be devised whereby the company transferring the money will be protected against loss."

One of the most interesting replies received is that from Mr. W. H. Durin, the secretary and treasurer of the Cedar Rapids & Marion Telephone Company, of Cedar Rapids, Iowa, who says: "I have never known of anything of that nature being attempted. I have frequently been called upon by some of our small outside towns to deliver money to some party at our central office. This we have done repeatedly upon being assured by the operator at the rural town that the money had been deposited with them. This money was then sent to the central office, either by draft or check, or was charged as messenger against the call, and was sent together with tolls and messenger collected for the month, at the close of the month. I am confident that if a system of telephone money orders was devised and properly advertised, especially in the large cities, it could be made a very lucrative branch of the business. I am also quite sure that many towns within a radius of 50 miles would adopt this system in payments to wholesale houses in preference to bank drafts."

Senator C. W. Kline, of the Inter-State Telephone & Telegraph Company, of Hazleton, Pa., writes us as follows: "I have not had time to give the matter a great deal of thought, but it strikes me that the system might be very valuable and a great accommodation to the subscribers locally. The only doubt there is in my mind as to the successful carrying out of the matter on a large scale is the fact that the independent telephone system so far is not yet cohesive to a large extent. The consolidated telephone companies of Pennsylvania could cover their territory from Philadelphia to Scranton and Carbondale all right, and they could locally control the matter, and it would be possible to make it work very successfully locally in cities embraced on the system. But if you want to carry it on on the same basis as a telegraph money order system or an express money order system, you would have to have agents in all the territory, which would not be possible for the independents as yet, except as to the territory they embrace. It strikes me this would be of great value to the business public." Mr. C. E. Stinson, general manager of the Rochester (N. Y.) Telephone Company, says: "This is something I have never given any thought to, and, therefore, I am not in a position to give an opinion as to its desirability. I should imagine, however, that a telephone money order system would be very convenient on certain occasions." Mr. C. E. Wilson, of the Keystone Telephone Company, of Philadelphia, says: "I have never heard of any way that money could be transmitted safely by telephone. I do not see how the transaction could be properly checked so as to make the delivery to the right person sure."

The difficulties are also uppermost in the mind of Secretary W. S. Holloway, of the Massillon (Ohio) Telephone Company, who says: "It does seem that we ought to be able to devise some way to handle this business, but I can conceive of no safe way to do it for this reason: Any one who was familiar with the manner of doing business could go in and work a message through just as expertly as the agent. The only way it could be done, absolutely safely, is to have a circuit especially for money order business, with no one but agents of the company having access to it." Mr. C. A. Brown, the well-known telephone patent expert, of Chicago, formerly New York manager for the Western Electric Company, says: "I can see many difficulties in organizing a telephone money order system, and the good to be gained by such a system, I should say from observation, is not worth the effort. Railroads, theaters, steamship lines, dry goods stores, etc., will accommodate patrons by accepting orders given by telephone."

A comparison with the telegraph money order system is instituted by Mr. J. B. Ware, general manager of the People's Telephone Company, of Detroit, and president of the Michigan Independent Telephone Association. In an interesting letter he says: "I know of no case where such a system has been established. There have been numerous instances where, as purly a matter of accommodation, money has been sent by telephone. I recognize that this would be of great advantage in exceptional cases. It is quite difficult, in my judgment, to establish a system which would be reasonably safe for large companies. For small companies such a system could be worked without great danger of loss, owing to intimate acquaintance which the officials have with the various managers and toll operators belonging to the system. I recognize that the expense of sending money by telegraph is very much larger than seems reasonable to those not connected with the telegraph companies. If a telephone money order system can be arranged, which is reasonably safe to the companies, business can be conducted so as to furnish the patrons with such service at rates very much less than now given by the telegraph companies, in my judgment."

One of the most practical communications on the subject is that of Mr. S. M. Strong, superintendent of the Akron (Ohio) People's Telephone Company, who, like Mr. Durin, of Cedar Rapids, Iowa, has actually furnished such service as is proposed. He says: "I beg to state that while manager of a plant in a neighboring city I frequently, as an accommodation to some subscribers who wished to get money to friends in the country at points not reached by telegraph, would telephone to the agent authorizing the payment, and then remit by personal check. In this way the money was delivered immediately. It should be possible to work out a plan by which money could be rapidly transferred and remittances made to the general office the same day. It would, of course, be necessary to have some checking system which would guard against loss, and the money would have to be paid in to the central or branch offices before transmission. A rate double the amount of toll on sums less than $25, and additional charges for larger amounts, would pay a fair revenue and be satisfactory to the sender under ordinary circumstances. In addition to this, the matter of accommodation to the subscriber should be a large factor in deciding the question of advantage."

M. Berthelot's Jubilee.

The jubilee of M. Berthelot's career as a chemist was celebrated November 24 in the grand amphitheater of the Sorbonne at Paris. President Loubet and several members of his cabinet were present to join a great body of savants in doing honor to the great chemist and ex-premier. The eulogies pronounced in his presence were probably very trying to M. Berthelot, who is a man of great modesty, both personally and mentally. As an illustration of the latter trait an American student relates a characteristic incident. During a lecture on electro-chemistry Professor Berthelot was writing some formulas on a blackboard, the significance of which the student failed to catch. In turning toward his class the professor happened to notice the perplexity of the young man as betrayed by his countenance, and stopping his demonstration he went carefully over the work on the blackboard. The results apparently checked, but again noticing the puzzled expression of the student, the professor, much concerned, stepped toward him and asked if he would kindly point out the error he had detected in the work. With the simplicity of mind so often associated with the highest attainments, the great savant assumed that the failure to understand was due to an error on his part rather than to lack of perception on the part of the student.

The Telephone in Texas.

There is probably no State in the Union in which there has been greater development in the matter of building telephone lines and telephone exchanges during the past ten years than has taken place in Texas during that period. There is now hardly a hamlet of a few hundred population that does not have its long-distance telephone connection with the outside world, and in many instances these small places have their own independent exchanges. The building of telephone lines has extended to the remote ranches and towns in the far western part of the State, where there is a sparse and scattered population, and the distance between the several communities is simply enormous. The wealthy ranchmen, however, when they cannot secure connection with some company's lines, put in telephone systems of their own, as they are found to be almost indispensible in the transaction of business. In the thickly settled portions of Northern and Central Texas there is a network of telephone wires connecting the thriving towns and cities.

The Southwestern Telegraph & Telephone Company entered Texas a number of years ago, and its business now extends to almost every part of the State. It has many thousands of miles of long-distance lines in Texas and Arkansas, and at the present time it has no competition of any moment in that branch of the telephone service. It operates large telephone exchanges in Austin, Galveston, San Antonio, Houston, Waco, Dallas, Fort Worth and many towns of smaller sizes scattered throughout the State. During the past two years this company has greatly extended its toll lines, and has made many important improvements to the extensive system in Texas. Its headquarters are at Austin, where it owns a handsome general office and a local exchange building. Colonel E. K. Baker, the general manager of the company, states that plans for the future extensions of the long-distance lines and additional improvements of the system will be carried out as rapidly as possible.

The independent telephone movement has had a remarkable growth in Texas during the past few years. It is conservatively estimated that the aggregate capital stock of the independent telephone companies now operating in that State is not less than $5,000,000. It is a remarkable fact that during the eleven months of the present year the charters of 30 independent telephone companies, having an aggregate capital stock of $1,954,850, have been filed for record in the Secretary of State's office at Austin, Texas. The purpose of each of these companies is to do business in competition with the Southwestern Telegraph & Telephone Company. Two of these independent companies have a capital stock of $500,000 each, and they are both composed of the same interests so far as the holders of the principal stock is concerned. They are the Commercial Telephone Company, which has its principal office at San Antonio, and the Indianola Telephone & Telegraph Company, which has its headquarters at Sherman, Texas. It is understood, however, that the latter company, in addition to operating in North Texas, will also cover the Indian Territory field. Another independent telephone company, which filed its charter in the Secretary of State's office some time last year, and is, therefore, not included in the amount of aggregate capital stock heretofore given, is the Lone Star Telephone Company, which has its principal office at Austin. The principal stockholders in each of these three companies are Ohio capitalists, Mr. C. N. Haskell, of Ottawa, Ohio, being at the head of the respective companies named. In addition to these three large corporations Mr. Haskell and associates are the incorporators of companies of smaller capital stock which are now establishing exchanges at Austin, Temple and many other cities and towns of the State. They are already operating a large exchange at San Antonio, and are expending a vast amount of money in Texas in their long-distance lines and numerous local exchanges. At Austin, where the headquarters of the Lone Star Telephone Company are located, they have purchased and remodeled a large frame building for their general offices and local exchange. The construction work of the Austin, San Antonio and other systems of the so-called Haskell syndicate in that State is of the very best character. Underground conduits are used in all these cities and none but the best material is used in whatever work is done.

The Commercial Telephone Company, of San Antonio, which was incorporated by Mr. C. N. Haskell, of Ottawa, Ohio; Mr. H. M. Aubrey, of San Antonio; Mr. J. E. Boynton, of Waco, and Mr. Z. B. Campbell, of San Antonio, filed an amendment to its original charter in the Secretary of State's office at Austin a few days ago, in which it is provided that it shall do business in 33 counties of that State.

The following is a complete list of the telephone companies which have been organized and chartered under the laws of Texas during the period beginning Jan. 1, 1901, and ending Nov. 25, 1901; also the capital stock of each company and the location of its principal office:

Fayette County Telephone Company, of La Grange, Texas; capital stock, $5,000. Austin City Telephone Company, of Austin, Texas; capital stock, $200,000. Wichita & Charlie Telephone Company, of Wichita Falls, Texas; capital stock, $15,000. Davilla Telephone & Improvement Company, of Davilla, Texas; capital stock, $10,000. Preston Bend Telephone Company, of Preston, Texas; capital stock, $5,000. Southwestern Telephone Company, of Beaumont, Texas; capital stock, $50,000. The Proffitt Telegraph & Telephone Company, of Seymour, Texas; capital stock, $10,000. Grayson County Telephone Company, of Sherman, Texas; capital stock, $150,000. Bell County Telephone Company, of Temple, Texas; capital stock, $12,000. Clarendon Telephone Company, of Clarendon, Texas; capital stock, $3,000. Southern Telephone Company, of Lake Creek, Texas; capital stock, $8,000. Bellah Telephone Company, of Fulda, Texas; capital stock, $2,100. Wichita Falls Telephone Company, of Wichita Falls, Texas; capital stock, $10,000. Richardson Telephone Company, of Richardson, Texas; capital stock, $750. Tyler Telephone Company, of Tyler, Texas; capital stock, $40,000. Texas Telegraph & Telephone Company, of Kemp, Texas; capital stock, $20,000. Beaumont Telephone Company, of Beaumont, Texas; capital stock, $60,000. Brazoria County Telephone Company, of Columbia, Texas; capital stock, $1,000. Alpine-Terlinga Telephone Company, of Alpine, Texas; capital stock, $1,000. Southern Independent Telephone & Telegraph Company, of El Paso, Texas; capital stock, $200,000. Emory Telephone Company, of Emory, Texas; capital stock, $1,000. Goldthwaite & Temple Telephone Company, of Goldthwaite, Texas; capital stock, $25,000. Commercial Telephone Company, of San Antonio, Texas; capital stock, $500,000. Orange Telephone Company, of Orange, Texas; capital stock, $5,000. Indianola Telephone & Telegraph Company, of Sherman, Texas; capital stock, $500,000. Mansfield Telephone Company, of Mansfield, Texas; capital stock, $4,000. Trans-Texas Telephone Company, of Caldwell, Texas; capital stock, $10,000. The Citizens' Telephone Company, of Lone Oak, Texas; capital stock, $4,000. Williamson County Telephone Company, of Taylor, Texas; capital stock, $100,000. Texas Telephone Company, of Wichita Falls, Texas; capital stock, $3,000.

The rates charged by most of these independent companies are much below those of Bell companies.

The Telephone Situation in Michigan.

The city of Grand Rapids, Mich., has been for upwards of five years the main battlefield in the war between the independent telephone interests and the Bell interests, or their successors in the Michigan field, but never has more interest been awakened by the conditions or more attention been riveted upon the situation than at present. Two strong interests have been holding their own in the Michigan field for some time, the Michigan Telephone Company, of which the Erie Telephone & Telegraph Company holds about 37,000 shares, on the one side, and the Citizens' Telephone Company, of Grand Rapids, and its allied interests on the other. The particular interest that centers around the situation at this time grows out of the fact that parties swinging a great deal of local capital have secured an option upon 27,000 shares of the Michigan company stock held by the Erie syndicate, and developments are looked for.

A little more than a month ago Dudley E. Waters, a Grand Rapids capitalist who had held some stock in the Michigan company, terminated successfully some negotiations conducted upon a visit to Boston by securing the option referred to, having interested with him Clay H. Hollister, a banker of Grand Rapids. It appears that it was the purpose of the local capitalists to effect a consolidation of the rival interests, the Michigan company and the Citizens' company. It is known that the Citizens' company received a proposition to purchase the controlling interest in the Michigan company, or the bulk of the shares covered by the option, and declined to do so. An official of the Citizens' company stated a few days ago that there are no negotiations pending, and that the independent company is not ready to buy or sell. However this may be, the option, which was for 30 days, expired Nov. 18, and since that time Mr. Waters has been in Boston for the purpose, it is claimed, of negotiating for another one.

The Michigan company has done a lot of extension and improvement work in the last two years, and claims to have three times the

number of subscribers in the State that it had at the beginning of that period. Toll lines have been extended in all directions, and cables have been laid across the straits to reach the upper peninsula. New exchanges have been built and occupied, and the one in Grand Rapids, a Western Electric Company lamp signal board, is one of the handsomest and most modern in the country. The board in the Detroit exchange, which takes care of 5400 actual subscribers, is said to be the largest continuous telephone switchboard in the country. There are two sub-exchanges in Grand Rapids, and the latest directory shows more than 4200 subscribers. These improvements, of course, have been expensive, and it is understood that the Michigan company is at present laboring under a heavy indebtedness. It is claimed that the indebtedness exceeds $7,000,000, and that the interest account of the company aggregates $370,000. The current rates in Grand Rapids for Michigan telephones at present are $24 for business houses and $12 for residences. The independent interests hold that under the contracts the Michigan company has for the use of the Bell apparatus no money can be made at these rates, but, of course, this is disputed by Michigan company officials.

The Citizens' company commenced doing business in July, 1896, with 400 telephones, although it had 1,600 subscribers listed at the time, but no toll line service. At present it has 3800 telephones in exchange service, and connections with 24,050 State line telephones. Dozens of new exchanges have been built and equipped, other independent companies have been absorbed and the service has been made to cover the State. The toll-line service has been improved and extended until it now reaches every town of any importance in the lower peninsula of the State and several points in Indiana and Ohio. In the past 12 months $175,000 has been devoted to expansion in this direction.

The People's Telephone Company, of Detroit, will be doing business within the next year, it is promised. Already 5000 subscribers there have been secured. This enterprise was largely promoted by one of the directors of the Citizens' company, and is backed by the Everett-Moore syndicate, which holds $1,750,000 of the $2,500,000 of stock in the new company. The Everett-Moore people control the new toll line between Lansing, Jackson, Adrian and Toledo, which, under a recent 25-year contract arrangement, throws the Michigan independent interests in connection with the entire independent system throughout Ohio.

The future is considered full of promise for the independent telephone interests in Michigan, and those who are in touch with the situation do not believe Mr. Water's option on the Michigan company will have any direct effect upon the independent situation. Officials of the Michigan company are fully as sanguine and hopeful as to the future, however, and point to the improvements that have been made in the last two years, and that are now under way, as an evidence of the faith the company has in the business.

Telephonic Identification of Cats.

The following story is told gravely by the *Chicago Tribune:* There was a banquet in Chicago not long ago to which one of the guests, a lawyer, had taken his office cat, a feline being the emblem of the organization that gave the dinner. The banquet was given in the Great Northern Hotel, where the cat the lawyer had taken to the dinner became lost. The next day the lawyer called up the hotel on the telephone, and asked if they had his cat yet. He was told that the bell boys had hunted all around among the cats kept as rat-catchers in the hotel, and that they had finally selected four cats, one of which they felt sure belonged to the lawyer.

"Well," said the lawyer, "I haven't time to come over and pick my cat out. Just hold those animals one by one up to the telephone transmitter and pinch their tails and make them yowl."

One of the bell boys dutifully held up the cats to the telephone, and made each one of the felines give a good, resounding wail. The lawyer dismissed each cat until the third cat was put up to the instrument. It gave one yowl, when the lawyer enthusiastically exclaimed:

"Yes, all right; that's my cat. I know that voice. Send her over right away." So the cat was sent over to the lawyer's office and turned out to be his missing pussy.

Annual New York Meeting of the American Society of Mechanical Engineers.

The annual New York meeting of the American Society of Mechanical Engineers was held at the headquarters of the Society, 12 West Thirty-first Street, Dec. 3 to 6, at which a large budget of papers was read and a number of topics discussed. The only paper relating directly to electrical engineering was one read by Mr. W. C. Johnson on the water power development at Hannawa Falls on the Raquette River, near Potsdam, N. Y. A fall of 85 ft. was developed by building a dam at the village of Hannawa Falls, whereby a pond 2½ miles long, and covering about 200 acres, was formed. From this pond the water is conducted by a canal about 2700 ft. long to a forebay, and thence by penstocks to the wheels. The tail-race extends about 2000 ft. down from the power house. The paper describes in great detail the features of the hydraulic development.

Provision is made for four 1250-hp Leffel waterwheels, to each of which will be direct connected two 350-kw, three-phase, 440-volt generators. At present but one of these sets is installed. The generators are of the revolving field type and have 24 poles, the frequency of the current supplied being 60 cycles. At present there is a double line to Pottsdam, each line consisting of three cables of seven strands each, of No. 10 aluminum wire. The length of the line is 3½ miles, and it is calculated to transmit 375 kilowatts with a drop of 400 volts, thus delivering 4000 volts at Pottsdam. It is intended to lay a 20,000-volt line to the village of Colton, 10½ miles from the station. Part of the power house is occupied by a ground wood pulp mill, the machinery of which, however, is not run electrically but by a rope drive.

In a paper by Mr. C. W. Hunt entitled "Working Loads for Manila Rope," are given several tables based upon experiments with manila ropes, one of which refers to tests with spliced and knotted ropes. All the ordinary cases involving the use of manila rope are covered by the data given in the tables. The principal table gives the working load for different diameters of rope from 1 to 1¾ inches for three gradations of speed as follows: For derrick, crane and quarry work, at speeds from 50 to 100 ft. per minute; for wharf and cargo hoisting, at speeds from 150 to 300 ft. per minute; for rapid hoisting, or speeds from 400 to 800 ft. per minute. The table also gives the medium diameter of sheaves for the different sizes of ropes and speeds.

Mr. J. O. Nixon in a paper describes the Renold silent chain gear which has been designed to obviate objections applying to ordinary sprocket gears. This gear consists of a chain composed of links of a peculiar form, either stamped from a sheet or cut from a drawn bar, and fastened together by shoulder rivets into a chain of any desired width running over cut sprocket wheels with teeth of a shape varying with the size of the wheel. It is stated that this gear is absolutely silent, and may be run at high speeds, and that it is capable of transmitting any amount of power from the smallest to the greatest. In summing up, 17 advantages over other forms of gear are assigned to the one described. Among these advantages are a positive speed ratio, there being no slip; there is no tension in the slack side of the chain, and, therefore, a minimized loss in journal application; it is adaptable to short way on centers and to hot or damp situations; the gear is silent and may be run at high speeds; the initial perfect action is preserved throughout the life of the chain; the load is distributed over all teeth in the machine; it does not require fixed centers; there is no sliding friction on the teeth.

Mr. Albert Kingsbury gave an account of some experiments on the effect of clearance on the economy of a small steam engine. The engine was a horizontal plain slide valve 5 1-6 by 7-inch engine controlled by a shaft governor. Variations in the clearance volume were made by inserting cast-iron rings under the back cylinder head. In testing, the engine was made single-acting by blocking the valve ports at one end. The clearance was varied from 10.82 to 32.5 per cent. The results showed a regular but not great increase in the water rate with increase of clearance. The unsatisfactory conclusion is arrived at, however, that as the increase of clearance was accompanied by an increase in the pressure, corresponding to less complete expansion at release, and also by a decrease in the pressure at the end of compression, the increase in the water rate can only be regarded as a joint effect of increased clearance with decreased expansion and decreased compression.

Professor C. H. Benjamin, of Cleveland, Ohio, gave an account of bursting small cast-iron flywheels. Sixteen wheels, each 24

inches in diameter, were tested, the weights varying from 60 to 123 lbs. The conclusions of the paper are that for wheels of moderate size correctly proportioned, a solid rim is by far the safest form, and will require a speed of 350 to 400 ft. per second to produce rupture. Jointing the arms at the rim and bracing the rim by internal webs have no important effect on strength. Joints in the rims are the principal source of weakness, especially if located between the arms. Hollow rims will permit of a much more efficient joint. The best results were obtained from the type of flywheel devised by Professor Archibald Sharp, of London, Eng., which consists of a cast-iron rim with spokes of steel wire secured tangentially to the hub; by the tightening up the nuts at the rim securing the ends of the wire spokes, the hub is accurately centered.

Professor Benjamin and Mr. Roy A. French gave the result of some experiments with spiral springs. The paper gives a formula for the calculation of such springs, and a table of data for substitution in the formula.

Mr. H. L. Gant described a bonus system of awarding labor, being a system of task work with instruction cards and a bonus. The system is described in minute detail and different forms of cards are reproduced. A card handed with a job to a workman itemizes all the different operations, opposite each of which is designated the time which the operation should take. For example, in the case of lathe work, the items are as follows: The numeral referring to the number of minutes: Chuck, 2.5; fuse end, 4; turn half-way, 12; turn end for end, 5; turn half-way, 12; face end, 4; remove from machine, 2.5. The total is 42 minutes, and should the workman do the job in less than this time he is paid a bonus.

Mr. F. B. Cory described a portable accelerometer for railway testing. The instrument consists of a heavy base having a horizontal cavity, at each end on which is a short vertical glass tube. When the cavity and part of the tube is filled with mercury an accelerating motion will produce a difference of level in the vertical columns, which difference of level will indicate the rate of acceleration.

Mr. Ernest W. Naylor described a new valve gear for gas, steam and air engines. Poppet valves placed in the cylinder head are used, both for steam and exhaust. The valves are operated by electromagnets through the intermediary of a link motion.

Mr. Fred A. Scheffler described a new type of separator and superheater, which consists of a series of wire meshes or screens placed between rings of cast iron, a number of the rings with attached meshings being bolted together with headers to form a separator. The theory of the apparatus is that the small globules of water entrained by the steam are broken up by the first piece of mesh, which action is continued through each successive layer until it is so completely atomized upon reaching the outlet chamber or header that it flashes into dry steam upon the addition of a small quantity of heat, which heat is obtained by the wire drawing due to the steam and water passing through the screens. There are generally from 25 to 30 layers of the mesh and the reduction of the pressure is about 1 per cent, the temperature of the steam being increased proportionately to this reduction.

Mr. F. F. Nichol suggested a new decimal system of measurements, which he called the "Linvolpon system." The suggestion is to adopt ⅛ inch as a basis, 10 of which shall constitute the unit, for which he suggests the name of "Lin." Prefixes used in the metric system would indicate multiples and sub-multiples of this unit. The advantage claimed for this extraordinary system is that it would not necessitate a change of our sizes, but only the names and figures.

Professor F. R. Hutton advanced as a topic of discussion the cost to run trains at high speed. One authority is quoted to the effect that an increase of speed from 40 to 60 miles an hour would raise the fuel consumption by 52½ per cent. Professor Goss says that taking the hours as the unit the increase of power is 225 per cent. Another quotation is that for an increase of speed by 53 per cent there is an increase in coal consumption of 92 per cent. The statement is mentioned that while the cost of running ordinary trains is $1 a train-mile, that of running limited trains is nearly $2.

French Telephone Rates.

A cable dispatch from Paris of Nov. 30 says: The Minister of Posts and Telegraphs, M. Millerand, announces a general reduction in the price of telephone service throughout France. In Paris the rates are reduced from $80 to $60 a year from January. Another reform is the reducing of the charge for pneumatic-transmitted messages—the "petit bleu"—from 10 to 6 cents.

Standardization of Engines and Dynamos.

At the annual New York meeting of the American Society of Mechanical Engineers, held this week, the committee on Standardization of Engines and Dynamos submitted their final report, which covers ten principal points. The report considers only direct-current generators, and these only up to 200 kilowatts capacity. The observations of the committee included in the report are summarized below:

Size of Units.—The endeavor of the committee has been to reduce the number of standard units to the fewest sizes. This will commend itself to all manufacturers as tending to reduce the great number of patterns required to be kept on hand.

Revolutions.—The standard speeds have been chosen after careful deliberation and investigation of the practice of all the engine and generator builders in the country. Permissible variation of speed of 5 per cent above or below the mean speed is provided; an examination of the practice of all the engine and generator builders shows that this covers practically all the machines which may be considered as a standard make at the present time, and assurance has been received from some builders whose conditions differ somewhat that if there is a general agreement upon the scheme outlined, they will be prepared to change their machinery to conform to the recommendations.

Shaft Diameters.—These are the result of careful analysis of the existing practice of all manufacturers and a consideration of all the conditions affecting the diameter of the shaft. The preliminary report which was sent out to the manufacturers elicited only a few adverse criticisms, and these, after correspondence, were withdrawn. In order that the reason for the diameters of shafts recommended shall be thoroughly understood, it is explained that (especially in shafts for side-crank engines) the permissible deflection has determined the diameter. This, in some cases, is larger than would have been necessary for torsion and bending where deflection did not have to be considered. As cases sometimes arise where cross-compound engines or double engines are connected to generators coming within the recommendation, and as such units require considerably larger shafts than those given the tables, it is stated, that the recommendations apply only to engines of usual proportions, with the generator attached at the side of instead of between the cranks.

Length of Generator Along the Shaft.—When it came to investigating the question of length along the shaft (between limit lines) to be provided for the generators, it was found that the practice of manufacturers required provision for two classes, which may be called "long" and "short" generators. It would have been much better to provide for but a single class, with a small allowance for variation, but there is such a marked difference in the lengths for the same power that it was deemed best to make provision for these two classes, so that the engine builders can govern themselves accordingly. It will be noticed that the maximum difference in lengths between the two classes is six inches, which in the small sizes is reduced to five inches. In the case where an engine is to be provided for a generator which falls into the "long" class, but which is only a little over the limit for the "short" class, or one which is considerably less than the maximum of the "short" class, the excess clearance is to be provided for on the side next to the engine; that is to say, the side away from the commutator. The fact was carefully considered that for these varying lengths of generator and shaft the engine builder has to provide different lengths of sub-base, and in order to reduce the expense of patterns here to a minimum, the idea is that these patterns would be made so that the end away from the commutator can be extended the necessary amount, five or six inches, to take care of the increased length of bed. Obviously, this means simply a standard pattern with a standard adjustable end for each unit.

Height of Shaft.—There are two classes of generators to be provided for under this head. Those which are split vertically and those which are split horizontally. The former have a flat base which rests directly upon the flat top of the sub-base, while the latter have feet which take the weight of the generator. In order to arrange that the engine builders' patterns may be reduced to a minimum and still may be stock patterns, which will fit every style of machine, dimensions have been chosen for height of axis of shaft above top of sub-base sufficient to allow for the vertically-split machines, and also, except as stated later, to clear the periphery of the horizontally-split machines. The scheme provides for a main pattern to which patterns for the stools and seatings for both horizontally and vertically-

split generators can be attached before the pattern is sent to the foundry—stools for the horizontally-split machines and rectangular seatings for the vertically-split machines. In the case of the 150 and 200-kw units, a recess is provided for in the top of sub-base to allow the lower part of some horizontally-split generator frames to be accommodated, and so to avoid unduly raising the center of the shaft. In the case of the vertically-split machines and those which are split horizontally and do not need this recess, the top of the sub-base will be flat and continuous.

Width of Top of Sub-Base.—This has been decided by careful examination of existing practice, and the figures recommended will cover the necessities for all sizes of generators.

Armature Fit.—The matter of armature fit received very careful consideration and the recommendation is for what is known as a single fit. The opinions were obtained of manufacturers in respect to the allowance to be made for a pressed fit, and find that allowances of .001 inch for shafts 4 inches to 6 inches, inclusive, and .002 inch for shafts 6½ inches to 11 inches, inclusive, represent the best existing practice. The armature bore is to be the *exact* size given in the table, and the allowance is to be made by the increase of diameter of engine shaft. In order to secure the best results, it will be necessary to work to a definite gauge; to this end it is recommended that the generator builder furnish a gauge the *exact* diameter of the bore and the engine builder make the necessary allowance for the pressed fit, as recommended. This will avoid uncertainty as to the responsibility for the fit.

Overload Capacity of Engines and Generators.—Generator builders are frequently called upon to provide, during short periods, for overloads of as much as 50 per cent, and, in occasional cases, of even 100 per cent. It is evident to every engine builder that to provide an engine large enough to drive the generator under such extreme overload capacities, gives an unreasonably large engine for the rated load, and seriously interferes with the economy with which the power is produced. Bearing in mind that the recommendations are entirely for standard practice, it is recommended that the standard overload rating of any direct-connected unit should not, in any case, exceed 25 per cent of the rated capacity. Under these conditions of overload the economy of the unit should not be expected to be as high as when operated at the rated load. If, under peculiar conditions, a higher overload capacity is demanded, it must be understood that this is a special case not covered by the standard machines, and provision must accordingly be made for meeting this demand.

Brush Holders.—It is recommended that the brush holder rigging shall be supported upon the generator frame. This will commend itself, as it makes the electrical part of the outfit entirely self-contained.

Holding-down Bolts, Keys and Outbound Bearings.—It is recommended that the holding-down bolts, shaft keys for securing the generator hub to the shaft, and the outboard bearings should be furnished by the engine builders. This is in accord with almost universal practice at the present time. The recommendations in these particulars do not cover matters of so great importance as some others; but, if adopted, they will tend to settle certain points about which there has occasionally been dispute and considerable controversy in correspondence. In the table will be found columns showing sizes of shaft keys; also the number and size of holding-down bolts. No lengths are given for keys, as such differences of opinion existed in respect to proper length, that it was thought best to leave

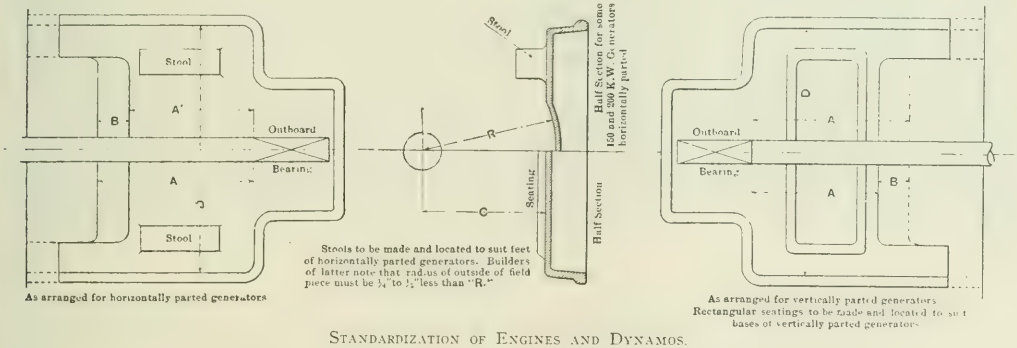
TABLE OF SIZES, SPEEDS AND STANDARDIZED DIMENSIONS OF DIRECT-CONNECTED GENERATING SETS.

(To accompany Diagram.)

Capacity of Unit, Kilowatts.	Revolutions per Minute.	Armature Bore		Diameter of Engine Shaft at Armature Fit.		Space Occupied on Shaft between the Limit Lines		B, Length of Extension Pieces, Inches.	C, Height of Axis of Shaft above Top of Base, Inches.	R, Inches.	D, Width of Top of Sub-Base, Inches.	Key (a Feather).				Holding-down Bolts	
		Center Crank Engines, Inches	Side Crank Engines, Inches.	Centre Crank Engines, Inches.	Side Crank Engines, Inches.	Long Class A, Inches	Short Class B, Inches.					Width, Inches.	Thickness, Inches.	Depth in Shaft at Edge, Inches.	Projection above Shaft at Edge, Inches.	Diameter, Inches.	Number.
25	310	4	$4\frac{1}{2}$	$4 + \frac{1}{1000}$	$4\frac{1}{2} + \frac{1}{1000}$	30	25	5	$23\frac{1}{2}$	Flat.	48	1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$		4
35	300	4	$5\frac{1}{2}$	$4 + \frac{1}{1000}$	$5\frac{1}{2} + \frac{1}{1000}$	33	28	5	25	Flat.	54	1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	1	4
50	200	$4\frac{1}{2}$	$6\frac{1}{2}$	$4\frac{1}{2} + \frac{1}{1000}$	$6\frac{1}{2} + \frac{2}{1000}$	37	31	6	28	Flat.	60	$1\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	1	4
75	275	$5\frac{1}{2}$	$7\frac{1}{2}$	$5\frac{1}{2} + \frac{1}{1000}$	$7\frac{1}{2} + \frac{2}{1000}$	43	37	6	31	Flat.	66	$1\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	$1\frac{1}{4}$	4
100	260	6	$8\frac{1}{2}$	$6 + \frac{1}{1000}$	$8\frac{1}{2} + \frac{2}{1000}$	48	42	6	34	Flat.	72	$1\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	$1\frac{1}{4}$	4
150	225	7	10	$7 + \frac{2}{1000}$	$10 + \frac{2}{1000}$	51	45	6	$37\frac{3}{4}$	$41\frac{1}{4}$	84	$1\frac{3}{4}$	$1\frac{1}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	$1\frac{1}{2}$	4
200	200	8	11	$8 + \frac{2}{1000}$	$11 + \frac{2}{1000}$	54	48	6	$42\frac{1}{4}$	$47\frac{1}{2}$	96	2	$1\frac{1}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	$1\frac{1}{2}$	4

NOTE 1.—Five per cent. variation of speed permissible above and below speeds in table.

NOTE 2.—Distance from center of shaft to top of base of outboard bearing may be less than *C* (to suit engine builder), though not less than possible outside radius of armature.



STANDARDIZATION OF ENGINES AND DYNAMOS.

the determination of the length of key for adjustment by engine and generator builders in each individual case. Sizes of keys have been taken so that standard rolled stock can be employed. It is recommended that the keys be made straight and be used as feathers. They should, therefore, fit accurately on the edges and not on the top. Proper allowance should be made in cutting the keyway in the armature hub, so that there will be sufficient clearance at the top of the key.

In conclusion, the report states that in the course of the investigations of the committee attention was called to a number of points which, from their nature, are not exactly in the same category as those on which recommendations are made, yet are of such importance that they are offered as suggestions for consideration by members of the society, with a view to their adoption if considered sufficiently meritorious. The points are as follows:

With regard to pressing armature on shaft, usually the contract definitely provides by whom this is to be done, but it is suggested that if there is no such provision in the contract, it should be understood that the engine and generator builders shall agree who is to do this work, so as to avoid any dispute when the separate portions of the unit are delivered on the premises.

For convenience in operation and for the information of engine and generator builders, it is suggested that for units up to 75 kilowatts, inclusive, the floor line should come at the bottom of the sub-base; and for units 100 kilowatts to 200 kilowatts, inclusive, the floor line should be 1 inch below the rough top of the sub-base.

In view of the fact that in some cases the distance between bearing and commutator is very small, it is well for engine builders to bear in mind that provision should be made to prevent oil from the bearing getting on the commutator.

Some generator builders have asked that the end of the shaft be drilled and tapped to facilitate, if necessary, the removal or placing of the armature on the shaft at the place of erection; we suggest that this be done.

In some cases generator builders require special nuts, bolts or fixtures for attaching generators to the shaft. Under these conditions it is suggested that the generator builders should furnish all attachments to their apparatus that are not already specified in the report.

The Faller Automatic Telephone Exchange.

An automatic telephone system which marks a decided departure in this branch of telephony was the subject of a patent granted Nov. 19 to Ernest A. Faller, of Baltimore. One striking feature of originality is that instead of providing contacts representing a multiple of all the lines in the exchange at each selector, which so far have formed a necessary feature of automatic exchanges, the inventor provides sets of connecting rods which practically correspond to the connecting cords of an ordinary exchange. In the operation of the system the movable carriage that forms the terminal of the subscriber's line first connects itself to a pair of these rods, this operation corresponding to the insertion of the answering plug into the answering jack; and then the selector comes into play and connects the pair of rods to the carriage terminal of the line wanted, corresponding to the insertion of the connecting plug into the multiple jack. Here, however, there are no multiple jacks. Each subscriber's line has only one terminal, and the selective mechanism first connects the calling line to an unoccupied pair of rods and then connects the line called for to the same pair of rods, the connection remaining locked until a release signal is sent.

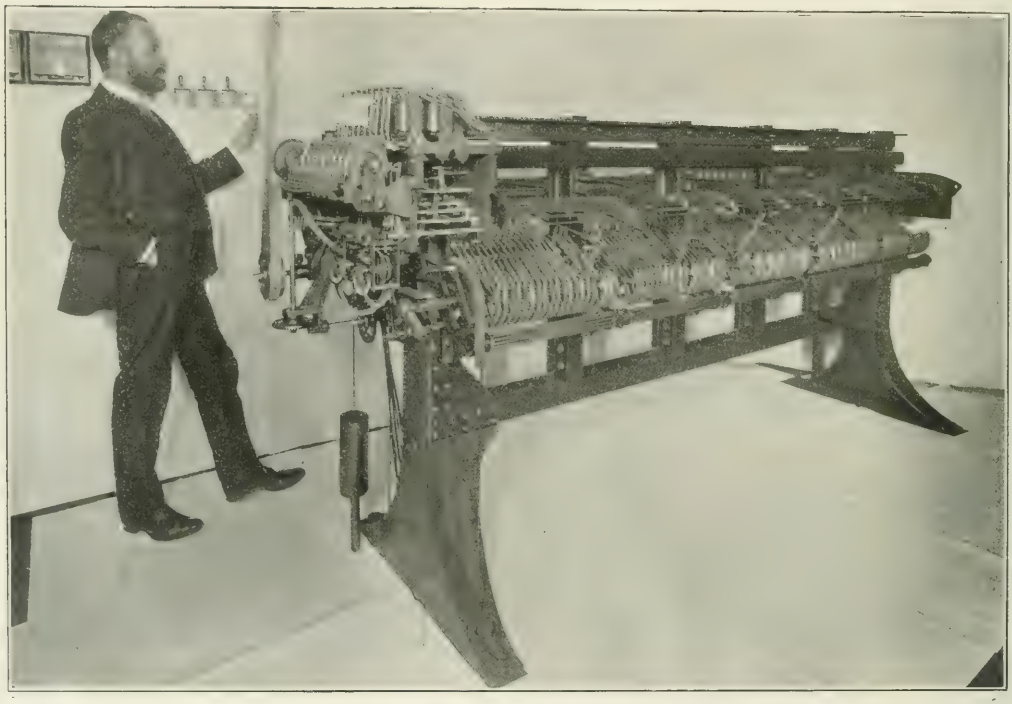


Fig. 1.—Faller Automatic Telephone Exchange.

Automatic means are provided for preventing interference with an established connection and for causing the carriage to take up the first unoccupied pair of rods, and also for returning the carriage to the normal position if no unoccupied pair of rods is available when a call is made, though Mr. Faller considers that this last condition would never arise in practice with an equipment of connecting rods equal to 10 per cent of the number of lines. The system is adapted to be used with common battery transmission. When a connection is established an automatic ring is given on both bells. In what follows the operation is explained in detail.

Fig. 1 shows a 100-line exchange recently completed, and Fig. 2 gives diagrams of connections. This machine illustrated contains a total of 15 electromagnets, 10 of which are clearing-out magnets embraced in the cord circuits. These magnets are visible at the extreme left, i. e., on top of the machine. In no case are electromagnets called upon to do mechanical work, the switching act being performed by power-controlled mechanical devices, dependent in their function

upon controlling magnets. These are partly operated from the subscribers' station, and partly in local circuits. Two more magnets control a selector, two more the operating gear, and one a busy test. These latter are not visible in the illustration.

The power or operating gear is partly visible at the left, it being driven by the belt shown. This power device is common to all the incoming lines, and goes through a fixed cycle of operations for each switch made.

The individual lines terminate in carriages, not visible in the cut. These carriages are adapted to travel under a series of metallic bars, forming the terminals of what would in manual practice be cord-circuits. They carry springs in which the lines terminate, and which are adapted to make contact, with the before-mentioned bars. The toothed sectors for operating the carriages are shown in the illustration, which shows all of them in position of rest except two pairs, one pair of which is shown connected or in talking position, and the other in the act of switching.

Motion is imparted to these sectors by a long lantern pinion. All idle sectors are held out of engagement with this pinion by a lever controlled by a busy wheel. The busy wheel performs the office of individual line drops or indicators, and makes it possible to dispense with individual magnets in the subscribers' lines. The construction adopted makes it impossible to release more than one lever at a time, and consequently prevents all confusion which would otherwise arise from simultaneous calls. As it is, such calls would be handled by the machine in a certain numerical rotation; no calls are lost, no matter how many should be made at exactly one and the same time. This is accomplished through the peculiar arrangement of circuits to be described later. Generally speaking, the operation is as follows:

Normally, all subscribers' circuits are free from ground, and the high resistance ringer is permanently bridged across the metallic circuit. The subscribers' calling device, or sender, is normally open, both as to ground and metallic circuit. The line terminal switch or carriage at the exchange, when in position of rest, causes one of the subscribers' line terminal springs to make contact with what is termed a ground spring. This spring is connected to one of a circle of commutator bars or pins, swept over by a brush.

There are as many sections in the commutator as there are subscribers. The brush is connected through a moving contact with a battery, and an operating magnet from which a line leads to ground The brush is mounted on the busy wheel shaft, and partakes of its rotation. The mechanical interconnection of parts is such that upon the energizing of the magnet mentioned the busy wheel is stopped and the operating gear started. When the operating gear has gone through its cycle, then the busy wheel is again started and will continue to run until the magnet becomes energized again.

At the subscribers' station the before-mentioned sender is bridged onto the circuit and also to the ground. This sender is shown to the extreme left of the illustration, and contains a clockwork which, when started, sends a varying series of electrical impulses over both legs of the metallic circuit simultaneously, using the ground for a return. It also contains a magnet, whose armature normally retains the clockwork until it is energized by current from the exchange. The number of impulses sent corresponds to a number displayed through a window. The subscriber may vary the number wanted, at will, by turning the knobs operating the number dials.

To protect both circuit and exchange against abuse, certain protective devices keep all accessible parts of the sender locked, during the sending of a signal. A sender is shown in upper left hand corner of cut. To call, the subscriber sets his number disks, so that the number he wants appears in the window, and then he turns a button. This is all the operation necessary on his part to cause a switch to be made.

When the switch is completed, he as well as the subscriber called receives a bell signal. They then proceed by taking off their receivers and begin conversation. If the calling subscriber does not receive any bell signal, it means that the line he wants is busy, and he may make other calls, or repeat the first one after a while. When the calling subscriber turned the button mentioned, he caused the sender to ground both legs of the metallic circuit. This caused (through the ground spring) one of the commutator bars or pins mentioned, to become grounded, and, consequently, as soon as the traveling brush reaches that pin a circuit will be established. This circuit includes the operating magnet which, on becoming energized, stops the traveling brush, and starts the operating gear. This in turn drops the calling subscriber's shuttle or sector into engagement with the long lantern pinion shown, and the attached carriage is carried to a point where its terminal springs make contact with a pair of so-called power bars.

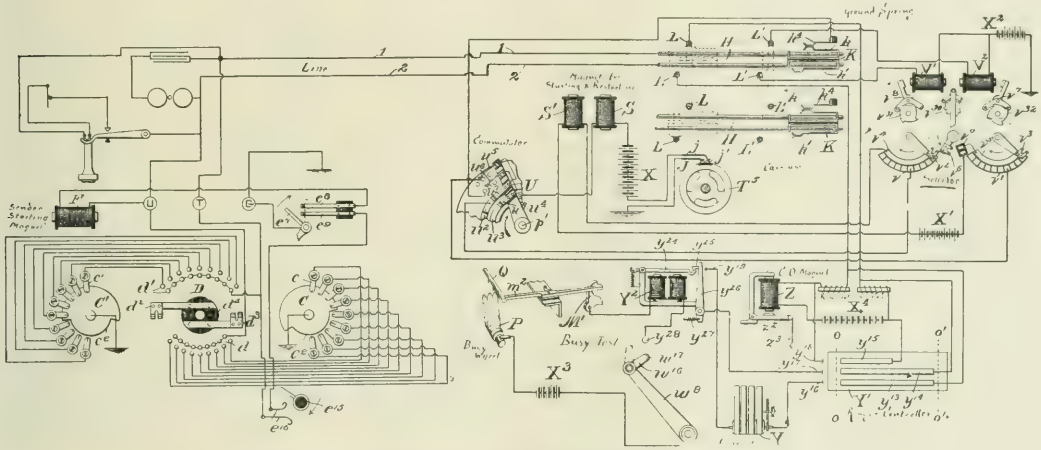


Fig. 2.—Diagram of Circuits, Faller Automatic Exchange.

These power-bars are connected to a pair of magnets controlling a selector, and then to a battery and ground. Current from the battery is consequently sent over both legs of the metallic circuit, with the effect of releasing the sender, which then sends a series of impulses, actuating the selector magnets a given number of times, corresponding with the number to which the sender is set. For details of connection see Fig. 2.

The selector then establishes a local circuit, including a commutator and brush, concentric with the first-mentioned commutator, and the result is that the shuttle of the subscriber wanted is also dropped into the pinion shown. The operating gear then rotates the pinion through a greater or less arc, corresponding with the number of circuits then already established. Immediately afterwards, a rocking lever located behind the pinion, engages a certain tooth of the shuttles, and lifting the pair of shuttles off the pinion raises them far enough to enable their hooked heads to engage a shuttle detent. There are as many of these detents as there are talking circuits, in the case of this machine ten. This corresponds to the usage followed in manual boards, but the ratio can be increased or decreased at will.

As soon as the pair of shuttles are hooked to the detent the circuit is established. The machine then throws a generator on to the circuit, ringing both calling and called subscribers' bells. A timing device controls the length of this signal, which can be varied to meet

different requirements. Upon the subscriber taking off his receiver the clearing-out magnet keeps the switch from clearing out, when the receivers are again hung up, the clearing-out magnet becomes de-energized, and its armature causes the shuttles connected to return to their position of rest.

Referring to the diagram of circuits it will be seen that it does not differ materially from the arrangement of circuits of a manual board; the talking circuit is almost identical, and only the calling and operating circuits are added.

Strange to say, the use of cord circuits in automatic telephone exchanges has apparently never before been attempted, though in manual practice they have driven any other construction out of the field. This was so much the case that the patent on this invention, recently issued, is claimed to broadly cover the use of cord circuits or their equivalents in automatic telephone exchange practice. It is also claimed that no other arrangement is possible whereby simplicity of circuit can be preserved, since it has been considerations of just this character which have led to the universal adoption of the cord and plug arrangement in manual boards. The inventor considers that indifferent results with automatic systems in installations of any size have in the past been due to the fact that the complication of wires and contacts did not keep in proportion with the number of lines handled, but rather increased in a geometrical ratio. This system, even in small units, has less magnets, contacts and connections than a manual board of the same capacity, and the larger the board the greater becomes the contrast between this automatic and the manual.

Another important feature of this new system is a testing device, which constantly tests the subscribers' lines in rotation for both ground, short and open circuit. As soon as any trouble occurs on any one particular line or its instrument the exchange automatically notifies the man in charge of trouble, who can at once on the board detect the disabled line. The rest of the board is not at all affected and remains working, but should the trouble on the line continue the trouble device will at intervals keep on calling the trouble man's attention to the fault until it is remedied. Each line, unless engaged, is subjected to this test once every five seconds, so it will be seen that the protection against disabled instruments is carried much farther than in manual practice, where generally a test is made once a day. This test does not in any way disturb the subscriber; in fact, he is not aware of its being made.

The possibility of the subscriber's senders getting out of order, though remote, has also been taken care of, and in case of such trouble the subscriber has only to press a button on the sender, which will invariably connect him with the trouble man, to whom he can state what is the trouble. He can also, in like manner, obtain information, such as new subscribers' numbers, etc. Line resistance does not affect the station in any way, since the currents on the line do not have to perform any mechanical work at all. Consequently, weak currents can be employed. There is not a single contact in the exchange made by electromagnets. Every contact is established and broken by power, and thus every one can be amply proportioned and made and broken positively. No cord or flexible conductor whatever is used throughout the exchange. There is not, and need not be, any crowding of parts, or any delicate parts, as the limitations of an operator's reach do not obtain with a machine.

The carriages in the machine shown are set on ⅞-inch centers, giving them ample room. As to actual space occupied, the machine will compare favorably with present manual boards, and if it is considered that it can be located irrespective of conditions of light, ventilation, etc., the comparison becomes immensely more favorable still, it is said.

As before stated, the machine shown and described serves 100 lines, but the system was evolved with a view to handle large exchanges and work is now in progress upon the individual sections of an exchange to ultimately accommodate 10,000 subscribers. This will be a trunked or transfer-board, consisting of a number of sections of 100-line capacity each, and two sets of pilot or transfer boards effecting the trunking. Unlike the present multiple board, an addition of sections will not in any way affect the sections installed, or necessitate additional taps into said sections.

Generally speaking, the cord circuits as described are developed into trunk lines leading to a pilot. Other trunks lead from this pilot to other pilots, and from them still other trunks to the individual sections again. Any one circuit of a 10,000-wire exchange is, consequently, built up of the calling and called line and three trunks. It is immaterial whether the entire equipment of the station is concentrated in one place, and in most cases it will be more desirable to have substations scattered over the territory served, as only a fraction of the line total need then be carried from station to station, in no case more than 11 per cent. This is the highest figure of lines ever found in any part of the interconnecting wires of the trunked exchange. The time necessary to make a connection in the exchange is said not to exceed 10 seconds, and with various improvements now contemplated it is expected to be considerably lowered.

No matter what the size of the exchange, a perfectly balanced, metallic circuit will always be obtained, having absolutely no taps or multipled branches anywhere. Simplicity of operation by the subscriber is fully preserved. The subscriber only sets the number wanted, and turns a button. This accomplished, all future operations are performed entirely independent of him. He is notified by his ringer when the switch is made, and then proceeds in the ordinary way by taking down his receiver and beginning the conversation. Hanging up the receiver clears out the connection.

The general method of trunking followed in this large exchange bears a great similarity to that of the so-called limited express system of Sabin & Hampton. A large exchange of that character has been in operation for a number of years in San Francisco, and gives universal satisfaction.

As to simplicity of installation, a few figures may not be out of place. Each section of a 10,000-line board can be completely wired at the factory, so that in installing only 100-line connections and 22 trunk connections need to be made per section of 100. This is all the wiring to be done when the machine is installed outside of the central battery and generator connections, which number 8 in all. Only two operating batteries are needed, no matter what the size of the exchange.

The current consumption is less than with the present multiple boards, as only 1 per cent of the circuits of the exchange, when idle, receive any current at all, and then less than .02 ampere, and that only for a fraction of a second. Variations in the speed of the motor driving the machine do not affect it, as no synchronizing principle is employed.

Automatic means are provided to indicate stoppage of power or current supply, as are also means for instantaneously transferring all the lines served by a section that may become disabled, or which needs inspection, to a reserve one, of which a sufficient number will always be provided in large exchanges.

The inventor is Ernest A. Faller, a native of Guetenbach, Black Forest, South Germany. He is 31 years old, and has been engaged in electrical pursuits on both sides of the Atlantic for the last ten years. The invention is owned in the United States by the Faller Automatic Telephone Exchange Company ,of Baltimore, Md., of which Dr. J. W. Chisholm is president and E. A. Faller secretary.

Some Applications of "Electro-Osmose."

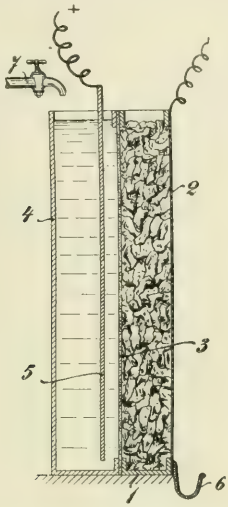
Since the days of Porret it has been well understood that a strong electric current exerts a mechanical effect upon water and solutions of non-electrolytes, transporting them from the anode to the cathode —a phenomenon known as "electro-osmose." If a porous diaphragm be interposed between the electrodes the effect is shown by the accumulation of the liquid around the negative electrode.

It is probable that this principle underlies certain well-defined but little understood manifestations of the current, some of which have been heretofore applied to commercial ends. For instance, several methods of extracting sap from wood seem to depend on this mechanical effect of the current, and the same may be said of the processes recently introduced in France by Nodon and Bretonneau for impregnating wood with various compounds for fire-proofing and other purposes. Such measure of success as has attended the electrolytic tanning methods is probably susceptible of the same explanation.

A few months ago Dr. Graf Botho Schwerin, of Munich, patented a method and apparatus for extracting moisture from comminuted materials of the most varied character—wood pulp, peat, fruits, clay sludge and beet roots—the method consisting in utilizing these materials as a diaphragm between perforated electrodes, the water being discharged through the cathode, and the device comprising a perforated cylindrical cathode, an interior concentric anode, and an intermediate helical blade to advance the material and break

up surface crusts. The latest development in this line, covered by a patent issued Nov. 26 to the same inventor, deals with the problem of the extraction of sugar from comminuted beets or cane.

These materials, as shown in the accompanying diagram, are packed between a copper wire cloth cathode, 2, and a filter-cloth diaphragm, 3, mounted on opposite sides of a box frame, 1. The anode, 5, of zinc, aluminum or other metal capable of forming insoluble salts with the acids of the crude sugar solution, is placed in water in a compartment, 4, exterior to the diaphragm, and into this compartment water is led from the tap 7 to replace that evacuated from the cathode. In operation the current performs a double function; the dissociable salts are electrolyzed, the anions uniting with the zinc or aluminum electrode and being thereby precipitated, while the alkaline bases, together with the non-electrolytes—sugars and soluble albumens—pass out with the water through the cathode to the trough, 6. Although the motorial effect of the current is certainly an expensive substitute for simple pressure as a means for forcing the solvent through the mass to be extracted, the coincident purification by electrolysis may render the method industrially practicable; data regarding the energy consumption are, however, lacking.



CELL FOR EXTRACTION OF SUGAR FROM SACCHARINE MATTER.

The Engine Builders' Association.

The third meeting of the Engine Builders' Association of the Unied States was held at Sherry's, New York City, Dec. 2, and was opened by a short address of welcome from Vice-President W. M. Taylor, of Chandler & Taylor Company, Indianapolis. At the close of Mr. Taylor's address, Professor R. C. Carpenter, of Sibley College, Cornell University, read a paper on "The Evolution of the Shaft Governor," which gave an interesting presentation of the development of the type of governor mentioned. The discussion following the reading of the paper was almost wholly on the subject of engine regulation for the parallel operation of alternating-current generators. Mr. Rites said that while satisfactory results could not be obtained with an ordinary Corliss type of governor regulating closer than about 4 per cent, the shaft type of governor made it feasible to bring the regulation within 1 per cent without incurring hunting. Mr. Samuel G. Neiler said that his experience had been that less than 4 per cent regulation was inadvisable where alternators are direct connected to engines, and pointed out that very close regulation involved a very sensitive governor, which led to excessive variations in angular velocity, and this was the chief trouble in parallel work.

The next paper read was one by Mr. H. M. Norris on "The Premium Plan of Labor Remuneration." Mr. Norris advocated the application of this plan to manufacturing enterprises. The plan consists, briefly, in paying employes the usual day wages and an additional premium for all time saved in the performance of a given operation over the time that the factory records have shown, such an operation previously required; the rate at which he proposed to compensate the workmen for saving in time was one-half of his wage rate. For example, if a workman saved two hours on a given piece of work, he was credited with two hours' time at one-half his day rate of wages. Mr. Norris cited several cases in which large reductions in the cost of given pieces of machinery had been effected by this plan. The paper was discussed at considerable length by Messrs. T. C. Wood, of the Ball & Wood Company, New York; W. M. Taylor, S. N. Bagg, of the Watertown Steam Engine Company, Watertown, N. Y.; Mr. Dick, of Dick & Church, and M. N. MacLaren, of the Ball & Wood Works, at Elizabethport, N. J.

Following the discussion, Mr. M. N. MacLaren read a paper on "Shop Administration," in which he pointed out the advantage of laying out a factory plant in such a manner that future growth would not divide the plant up into several distinct shops nor change the course followed through the shops by work in process of manufacture. This paper was discussed briefly by Messrs. Dick, Gates and Taylor.

Mr. George T. Reiss, of the Niles Took Works, Hamilton, Ohio, then read a paper on "Machine Shop Tools for Engine Builders," in which he described a number of special tools designed for the purpose of economizing both time and the labor of handling large pieces of work. The paper was illustrated by a large number of photographs and half-tone engravings. There was not a great deal of discussion of Mr. Reiss' paper, for the reason that the delegates concurred heartily in all of Mr. Reiss' recommendations. The question of using grinding machines for finishing shafts was discussed to some extent by Messrs. Reiss, Dick, Taylor and Wood, Mr. Reiss explaining that the best method of using a grinding machine is to reduce the amount of work done by it as far as possible; that is, to rough turn the shaft down to within, say, 1-64 of an inch of the finished size and then grind it true.

The closing paper of the session, entitled "From the Consulting Engineer's Standpoint," was read by Mr. Neiler. Mr. Neiler briefly defined the function of the consulting engineer in this country, and pointed out the excellent work that had been accomplished by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers in perfecting standards of manufacture and standardizing methods of testing. He argued that a consulting engineer should not attempt to design apparatus, but should specify machinery that could be furnished by manufacturers without undue hardship. He also pointed out that in order to obtain the best results manufacturers should supply with their bids to consulting engineers complete data regarding their engines, so that intelligent selection can be made. He criticized the practice many manufacturers follow of doing preliminary consulting engineering work for prospective purchasers without charge. Such work, he pointed out, very rarely pays, and usually has to be done over again by the manufacturer who succeeds in landing the order in such cases where an order is actually obtained by any one. In the most of such cases, however, he said, a large amount of engineering information was given to persons who had no idea of buying the machinery concerning which they asked for the information. Mr. Neiler mentioned the offer which had been made by the authorities of the coming exposition at St. Louis to have elaborate tests made of engines exhibited there, and expressed the opinion that engine builders should take advantage of this opportunity.

In the discussion which followed, Mr. Dick said that the Chicago Exposition officials had made very specious promises as to the tests that were going to be carried on, and induced a large number of engine builders to go to great expense for exhibits, but that no tests were made of which anybody had ever heard anything.

With reference to the specifications of consulting engineers, Mr. Dick said that it seemed to him unreasonable for an engineer to require that an engine bought for operation at 100 lbs. pressure should be made able to stand 150 lbs. pressure, and Mr. Neiler explained that it is his practice not to make any such stipulation, except in cases where it is the intention to ultimately raise the pressure in order to run the engine condensing. Mr. Wood said that a feature of consulting engineers' specifications that had always seemed unfair to him was the stipulation of a bond. He thought that the manufacturer took sufficient risk in building an engine and delivering it without any bond from the purchaser as to the settlement of the account. Mr. Neiler said that he never exacted bonds of engine builders,

except where the engine was for a municipality or some State institution, in which case a bond was legally compulsory. After a unanimous and enthusiastic vote of thanks to the authors of the five papers, on motion of Mr. Gates, the session adjourned.

The Association at its second session held in New York on Tuesday, Dec. 3, confined its attention chiefly to discussing the industrial situation, especially in the engine building field, and to electing its officers for the ensuing year, etc. The following officers were elected: Mr. W. M. Taylor, of the Chandler & Taylor Company, Indianapolis, president; Mr. C. O. Gates, of the Russell Engine Company, Massillon, Ohio, vice-president; Mr. D. N. McBrier, of the Ball Engine Company, Erie, secretary, and Mr. C. S. Bonsell, of the Buckeye Engine Company, Salem, Ohio, treasurer. The two new members elected to the Council to succeed the two retiring members were Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Co., New York, and Mr. S. F. Bagg, of the Watertown Engine Company, Watertown, New York.

In the evening the annual banquet was served at Sherry's, at which some 52 gentlemen were present. Mr. Walter C. Kerr acted as toastmaster. Mr. R. H. Edmonds, of *The Manufacturers' Record*, responded to the toast, "The South." He spoke of the great possibilities of that section of the country still remaining undeveloped. Mr. Charles A. Moore responding to the toast on "Reciprocity," urged upon the gentlemen present the necessity of the maintenance of a high tariff for the protection of American manufacturers, and wandered from his subject long enough to advocate strongly an improvement in the American consular service, by sending trained men and paying them enough to enable them to command respect among their neighbors and keeping them there so long as they are competent to fill their positions creditably.

The Hon. Job Hedges responded to the toast, "Successful Builders," but skilfully evaded the subject of his toast, and impressed upon his hearers the importance of their fulfilling their duties at all times as American citizens, in a speech which was listened to with great interest by all present. The toast-master then called for a few remarks from Mr. John A. Hill, of *The American Machinist;* Mr. J. M. Wakeman, of Electrical World and Engineer, and Mr. Louis Cassier, of *Cassier's Magazine*. The proceedings were closed by a few carefully selected stories told by Mr. C. L. Eidlitz, president of the Electrical Contractors' Association, New York.

New Telephone Patents.

The telephone patents of the issue of Nov. 26 number four only, and two of these refer to the same device. Mr. Merritt Gally, of Brooklyn, has discovered that a Hughes microphone will produce variations of resistance even when one electrode is connected solid in the circuit and the second merely lies on it, the variation in the joint resistance of the two carbons when set in vibration having an effect similar to the variation of resistance produced by varying the pressure at a microphone contact. At least this is the explanation of the phenomenon observed by Mr. Gally, which has led him to patent a transmitter based thereon.

The primary circuit has no variable contact, but the electrode or carbon plate is connected solid in circuit with the battery and the primary winding of the induction coil. Resting on this plate is a second carbon plate, attached to the diaphragm. The movement of the diaphragm causes the latter to slide to and fro on the first carbon plate, which is stationary, and so to produce variations in the joint resistance of the two plates, resulting in induced currents in the secondary of the induction coil.

Whether a microphone built on these lines can be as efficient as a granular carbon transmitter of standard type is open to doubt, but that it is operative there can be no question. Mr. Gally, who is his own patent attorney and rather an original hand at drawing specifications, calls the first carbon electrode a "circuit-section," and the second one an "operating-conductor." Upon the diaphragm are two small supports upon which the operating conductor rests to prevent it from damping the vibrations of the diaphragm and through which the motions of the diaphragm are conveyed to the operating conductor. In his first patent Mr. Gally claims the general method of producing induced currents by means of varying the resistance in the primary circuit, according to the method described, and in his second he applies the method specifically to a telephone transmitter. Here he uses an improved "circuit-section" differing as to its conductivity in different parts of its structure. The "circuit-section" is preferably made of moulded graphite, and the "operating-conductor" may be made of any suitable material of high conductivity—graphite, carbon or the like, or preferably of platinum or brass or copper plated with platinum.

Mr. William W. Dean, of Chicago, patents and assigns to the Kellogg Switchboard & Supply Company, of Chicago, an improved granular carbon transmitter. The improvement consists in a supplemental diaphragm designed to prevent "packing" of the carbon granules. The chamber containing the carbon granules is formed by recessing the main diaphragm. The front electrode is attached to the recessed chamber and the chamber is closed by the supplemental diaphragm, which is secured by a ring and screws. The supplemental diaphragm has an opening through which passes the shank of the back electrode. This shank passes through a block and is held to the plate by a nut, the back electrode being thus clamped to and associated with the supplemental diaphragm. The rear electrode is slightly smaller than the chamber and the front electrode, allowing the granular particles to surround it as well as to lie against its face. This transmitter, which in its main idea, reminds one strongly of the Colvin transmitter of some seven or eight years ago, and in its details no less strongly of the "solid back," requires no fewer than 19 claims to set forth its various novel features.

An ingenious protector for telephone lines is patented by Mr. Charles A. Rolfe, of Chicago. A couple of "jump-out" devices, consisting of long metallic rods fitting into sockets secured in a base and held in place by the hooks and a plate against the upward pressure of springs, will break the circuit as soon as a fusible button softens under the influence of heat generated by a coil through the passage of a strong or sneak current. As soon as the button melts or softens, the hook draws away, and the tension on the springs then being released the rods are suddenly withdrawn from their sockets and the circuit is broken. This protector also carries a carbon plate lightning arrester, the plates of which are separated when the jump-out device operates.

CURRENT NEWS AND NOTES.

WIRELESS BALLOONS.—With reference to the reports referred to by us last week about Mr. Marconi's experiments with balloons in wireless telegraphy on the coast of Newfoundland, we are assured by Mr. Cuthert Hall, his representative now here, that the balloons will not, as rumored, carry passenger operators.

MANHATTAN ELEVATED.—It is stated that the new power plant of the Manhattan Elevated Company on East River and Seventy-sixth Street will be ready to deliver current to the Second Avenue line motors next week. Our issue of Jan. 5, 1901, contains an interesting illustrated article on the plant and the track.

ELECTROLYTIC ANODE.—A patent recently issued to Messrs. Hargreaves and Stubbs, of Farnworth, England, covers the latest form of compound carbon anode for use in the well-known "Hargreaves" type of exposed-cathode cell for the electrolysis of brine. As heretofore constructed these anodes have consisted of a series of more or less irregular blocks of retort carbon, bored, and fitted upon a metallic conducting rod, efficient contact being secured by casting lead in and around the joints. As now modified, the conducting rod is surrounded by a loose-fitting casing of vulcanite or other non-conducting material, pierced at intervals by metallic cross bolts upon which the carbon blocks are mounted. These bolts, while supporting the blocks which constitute the working anode, are preferably coated with insulating material in order that no portion of the current may be carried by them, this office being performed by carbon sleeves surrounding the bolts and by them pressed into close contact with the retort carbon blocks and the central conductor. The function of this somewhat fragile casing is by no means clear from the present patent specification: it is understood, however, that in practice it serves as a reservoir for mixed oil and graphite, which percolating outward through any chance fissures, closes them, or, at least, serves to prevent access of the electrolyte to the metal rod and other vulnerable parts of the electrode.

WIRELESS TELEGRAPH PLANT DEMOLISHED.—During the recent violent storm along the Atlantic coast the Marconi wireless telegraph pole plant at Southwellfleet, Mass., was destroyed by the gale.

SCHOOL FOR TELEPHONE OPERATORS.—The Central District & Printing Telegraph Company, Pittsburg, realizing the difficulty of obtaining first-class telephone operators, will establish a telephone school, where girls who aspire for a position of regular employment as telephone girls, will be taught, and when they graduate will be given permanent positions.

MAGNETIC POLE EXPEDITION.—A cable dispatch from Christiania, Norway, says: Boothia Felix has been chosen as the headquarters for Professor Amundsen's three-year magnetic pole expedition. Boothia Felix is a peninsula, and is the most northern part of the mainland of North America, having east, Boothia Gulf; north, Bellot Strait, and west, Franklin Channel. The magnetic pole is in this peninsula, the northern point of which is in about latitude 72 degs. north.

NEW YORK ELECTRICAL SOCIETY.—The society held a most successful meeting on Nov. 26, when Mr. R. T. Lozier, of the Bullock Electric Manufacturing Company, addressed a crowded audience at the College of the City of New York, on electric motors and methods of control, regulation, etc. His excellent lecture was accompanied by a large number of lantern slides, including motor equipments, circuits, curves, load diagrams, etc. Mr. Lozier was followed by Mr. Campbell Scott, of the C & C Electric Company, who gave a brief and pithy talk on their series parallel system of motor control. Mr. Gano S. Dunn, of the Crocker-Wheeler Company, also spoke. President Williams was in the chair. The evening was one of the most practical and useful that the society has had in a long time.

TELEPHONE CONNECTION WITH TRAINS.—It is announced in Chicago that the officials of the Chicago & Northwestern Railway Company are considering plans to give telephone connection between the telephone exchange and the "Overland Limited" while the train is standing in the station in that city. It is said that frequently passengers leave home for the train in a hurry and forget things they desired to carry with them. In this event they could telephone and have them brought to the train. Furthermore, business men would be able to use the telephone, either long distance or local, to transact any business which they might have neglected. It is also possible that the company may equip the train with a telephone service of its own to used in transit. By means of the device luncheons could be ordered from the dining car and communication had with the various cars composing the train without leaving the car.

ELECTRIC FURNACE.—Under date of Nov. 26 Mr. Marcus Ruthenburg, of Philadelphia, patents a simple electric furnace for agglomerating magnetite, a process somewhat fully considered in these columns last week in connection with an electric furnace operating in a magnetic field. The elements of the new furnace are a hopper, and a cylinder revolving immediately beneath its discharge orifice, both formed of cast-iron and constituting opposed terminals of an electric circuit. The charge in the hopper is evacuated by the slow rotation of the cylinder, and in passing the narrow interval between them is subjected to the full heating effect of the current, and thereby fritted into coherent masses suited for reduction by ordinary metallurgical processes. Or, it is said, the ore may be mixed with carbon and a flux and reduced to metal by a single operation. The lower end of the hopper is, of course, water-cooled, and a positive rotary movement is preferably imparted to the cylinder by means of a motor, mounted upon the hopper and actuating a worm-gear meshing with the cylinder.

PACIFIC CABLE.—In his message to Congress this week, President Roosevelt said: "I call your attention most earnestly to the crying need of a cable to Hawaii and the Philippines, to be continued from the Philippines to points in Asia. We should not defer a day longer than necessary the construction of such a cable. It is demanded not merely for commercial, but for political and military considerations. Either the Congress should immediately provide for the construction of a Government cable, or else an arrangement should be made by which like advantages to those accruing from a Government cable may be secured to the Government by contract with a private cable company." On the list of the new measures introduced in Congress are three Pacific cable bills, by Representatives Sherman, of New York; Corliss, of Michigan, and Jones, of Washington, Mr. Jones' proposing the northern route, via Puget Sound, with an appropriation of $8,000,000; Mr. Corliss' proposing a route built and maintained by the Government, and Mr. Sherman's offering the plan allowing private participation in the enterprise.

MULTI-VOLTAGE MOTOR CONTROL.—A patent granted Nov. 26 to W. S. Andrews relates to a system whereby five different voltages for motor operation may be derived from any given power circuit. Assuming a direct-current generator, on the shaft are three collector rings, which are connected to three equi-distant points of the commutator. From the brush of each ring a connection is made to one of three legs of a Y-box, or three inductive windings having a common point. The commutator brushes are connected to conductors 1 and 2 of the motor distributing circuits, and the common point of the Y-box is connected to conductor 3. Conductor 4 is connected to a balancer or double armature machine, which is in shunt with the Y-box neutral point and one of the direct-current generator brushes. Assuming that the main generator supplies 240 volts, then the difference of potential between conductors 1 and 2 will be 240 volts, and that between conductors 2 and 3 120 volts. If one winding of the balancer produces 80 volts and the other 40 volts, then the potential between conductors 3 and 4 will be 40 volts, and that between conductors 1 and 4 will be 80 volts, and between conductors 2 and 4, 160 volts.

CHRISTMAS TREE FIRES.—The executive committee of the Philadelphia Fire Underwriters' Association has felt compelled to call the attention of the public to the dangers to life and property from Christmas displays, decorations, signs, etc., in dwellings, churches, public buildings, mercantile establishments, and especially department stores. The use of Christmas greens, harvest specimens and other inflammable materials, such as scenery, cotton to represent snow, and the like (especially in connection with electric and other lighting systems), is decidedly an increase of hazard, it being impossible to make displays of that nature perfectly safe. The making of such displays would, the committee claim, under a strict interpretation of the conditions of the policy, render the contract of insurance void unless the policy is indorsed with a special permission for the increased hazard, which will generally be granted only in consideration of an additional premium commensurate with the hazard. If electricity is used in the building the permit for same in the insurance policy is subject to the following conditions, viz.: "No additions, alterations or repairs shall be made in the system of wiring, lamps or any portion of the system of wires or appliances for conducting, creating or controlling the electric current until written notice has been given to the Philadelphia Fire Underwriters' Association and an additional permit granted for such."

TESTS OF STEAM PIPE COVERINGS.—Some interesting tests have been made by Mr. George H. Barrus at the Manhattan Railway power house, New York, on condensation in bare and covered steam piping. The tests were made at two pressures—80 and 150 lbs.—and every precaution was taken to exclude extraneous factors from the results. Many of the coverings were tested day after day for a period of a month, and every one was subjected to at least three days' run of 8 to 9 hours' continuous test each day. The piping in one set of tests was 2 inches in diameter and 100 ft. long, and in other tests 10 inches in diameter and 35 ft. long. With the 2-inch piping and at 80 lbs. pressure, the condensation per hour without covering was 60.30 lbs. maximum and 55.75 lbs. minimum. Of five coverings applied, the condensation varied from 14.07 lbs. maximum and 13.46 lbs. minimum in the case of the lowest, to 15.14 lbs. and 14.60 lbs. for the highest. At 150 lbs. pressure the condensation uncovered was 72.20 lbs. and 71.75 lbs., and covered 10.93 lbs. and 10.47 lbs. for the best of four kinds of coverings, and 14.00 lbs. and 13.18 lbs. for the lowest of the tests. The 10-inch pipe was subjected only to 150 lbs. pressure, at which the condensation bare was 112 lbs. per hour maximum, and 105.9 lbs. minimum. Four kinds of coverings were tested on the large piping, from which the best results were 11.67 lbs. and 11.07 lbs., and poorest, 15.93 lbs. and 15.79 lbs.

GERMAN NERNST LAMP.—A patent issued Nov. 26 to Dr. Carl Ochs, of Berlin, and assigned to the Allgemeine Elektricitats Gesellschaft, the owners of the German Nernst lamp patents, relates to a form of this lamp which appears to be the standard of the German manufacturers. The glower is enclosed in a bulb somewhat similar in shape to that of an ordinary incandescent lamp, but with the tip end open, and having an ordinary lamp base, which screws into a socket. The glower is mounted vertically and surrounded by the spires of a heating coil. A solenoid is mounted centrally in the socket, the plunger of which cuts out the heating coil when the glower becomes incandescent. Another function of the plunger is to keep closed ventilator openings in the socket during the time the heater coil is in operation, thereby assisting the heating of the glower. The lamp socket plug is hollow, and after the ventilator openings in the socket are uncovered by the action of the plunger, the lamp is continuously ventilated.

RAILWAY MOTOR CONTROL.—The Patent Office budget of Nov. 26 adds three patents to the long list which during the past several years have been taken out on railway train motor control and assigned to the General Electric Company. The patents just issued involve so much detail that our space will permit only a summary of their objects. One of the patents is issued to Frank E. Case, and is a development of a system of motor control constituting the subject matter of a patent issued to E. W. Rice, Jr. This system relates to a train system comprising motors on the end cars, and a train control system whereby the motor equipments on the end cars may be connected either in series or multiple by means of a controller located at either end of the train, a single train conductor being employed for completing the motor circuits. In this system it is necessary that the operator may readily reverse the direction or motion of the train without leaving the car from which it is for the time being controlled. A patent by Entz is mentioned which for this purpose provided each controller with auxiliary contacts arranged to reversely connect motors on that particular car, the motors on the other car being at such times disconnected from the supply circuit. The Case patent consists in providing the train system with a separate reversing switch for each motor equipment, and a control system so arranged that both reversing switches may be actuated from the controller at either end of the train, the contacts of the controller being so arranged that either the two motor equipments on the train, or the several motors of one equipment, may be connected in series or in multiple. By this means the motors on the forward car can be operated in series or in multiple in case the other motor car is disabled or disconnected. A second of the patents was granted to A. S. Garfield and Carlos E. D'Ornellas, of Paris, France, and relates also to an improvement on the Rice system mentioned above, which does not provide means for operating the train in the reverse direction from the controller in one end of the train. One of the objects of the present invention is to provide, without any unnecessary complication, that all motors on the train may be operated in either direction from a single controller. The system is intended for operation on roads where it is not necessary that the train shall be controlled from either end, and a controller is, therefore, provided at one end of the train only. In order that the train may be operated in either direction from this single controller, separate reversing switches are provided for the motor equipments at the two ends of the train, one of which switches is to be operated directly, as by manual labor, and the other to be operated indirectely by some means which will be actuated when the directly-operated switch is moved. By the means described all of the motors of a plurality of motor equipments may be permanently connected in multiple when it is desired to cut any one motor out of circuit. The possibilities of accident in series parallel motor control system by one of the motors becoming disabled, is reduced by compelling the motorman to operate the remaining motors in multiple connection when any of the motors have been cut out of circuit. The third patent was granted to W. B. Potter and has for its object the prevention of the exchange of excessive current between motors in parallel when disconnected from the power circuit and connected for reverse rotation, but driven forward by the momentum of the vehicle on which they are installed. This is accomplished by preventing any of the motors from operating as generators under such conditions. An electromagnet is placed in the supply circuit which, when current is shut off from the motor, becomes de-energized, whereupon a mechanism connected therewith makes contacts which shunt the motor fields. On current being again supplied to the motors the electromagnet becomes energized, and the shunt connections are broken.

LETTERS TO THE EDITORS.

Signal Corps Telephone Apparatus.

To the Editors of Electrical World and Engineer:

Sirs.—Why is it that the Military Signal Corps, State and National, persist in using for field service an instrument so unsuitable as the one illustrated in No. 21, page 851, Fig. 2, of ELECTRICAL WORLD AND ENGINEER, in connection with the automobile races? A glance through any telephone manufacturer's catalogue will show a lineman's test set of some sort that would be far better for the purpose, to say nothing of the very handsome, durable and portable box telephone offered by Couch & Seeley, Lambert Schmidt, the Ericsson Telephone Company, and many others.

In 1889 I went over this matter with Lieutenant H. H. M. Borghardt, at that time in command of the Signal Corps, First Brigade, Massachusetts Volunteer Militia, our attention being riveted to the subject by the excuse of a private, who had been captured, "that he could not talk into the telephone and look around him at the same time." Recommendations were made to the military authorities of that State, but the subject was not deemed worthy of notice, no attention having ever been paid to it. Since then I have always noticed that whenever a Signal Corps was illustrated as telephoning in the field, it was invariably equipped with this style instrument, which we all know to be the worst possible shape for such service, as it cannot be conveniently carried by man, mule or horse. It takes up twice the room a telephone should in a transport wagon, and has to be hung up in some way before use, which is not always convenient or possible. These objections do not apply to the numerous test sets on the market.

In conclusion, I would say that I am not interested in pushing the product of any telephone manufacturer, but am moved by sympathy for the Signal Corps private, and by recollection of "how fearsomely they swore" when duty compelled them to "lug" or pack such an instrument as shown in above-mentioned illustration.

MOUNT SAVAGE, MD. W. M. LANNAN.

American Manufacture of Pacific Cable.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest your editorial "Pacific Cable" in the Nov. 23 issue of your paper, and beg leave to call your attention to the fact that two of the prominent cable manufacturers of the United States have stated before Congressional committees and elsewhere, that they are willing to undertake the manufacture of the Pacific cable, by providing quickly the necessary plant and experienced employes, for the manufacture, testing and installation of such cable, if they can be reasonably protected against foreign competition, as the armor plate, tin plate, shipbuilding and iron and steel interests generally have been and are protected.

American cable manufacturers have never had any *actual* protection on deep-sea cables landing on our shores, but only a *theoretical* protection, because the jurisdiction of the United States extends only one marine league from shore, and the "theoretical" duty on such cable has been applied to but three miles of a cable thousands of miles in length, produced in foreign factories with cheap labor and cheap raw materials.

Just as soon as Congress cures the serious and apparent defect of the existing tariff laws, by an amendment imposing on foreign-made submarine cables, such a duty as shall equal the "theoretical" protection of the Dingley bill, applied to the entire length of a cable, the manufacture of deep-sea cables will become an American industry of no mean magnitude.

American manufacturers have had many years of practical and successful experience in the manufacture of underground cables, and of submarine cables of the types more common in this country, as well as in the operation of much of the machinery and processes used in making transoceanic cable, and there is no step in the process of manufacture or installation of the latter class of cable, that is not

known to certain American cable makers who have given the subject careful special study for several years past. Furthermore, the extremely careful, continuous and well understood tests, to which deep sea cables and their constituent parts are subjected at every stage of manufacture, by both the manufacturer's and the buyer's experts, will make the delivery of defective cable from Amercian factories just as impossible as though it were made in the oldest European plant.

There is no serious reason, except the one above mentioned, why American manufacturers have not long since begun, or should not now begin, the manufacture of deep-sea cable, at the point of excellence so slowly reached by foreign manufacturers, and, after a reasonable time, it may not be too much to expect that American enterprise and American genius will improve the methods of manufacture in this industry, to such an extent as to enable us to compete in the markets of the world for submarine cable orders, as we now do in steel and iron and many other products.

PITTSBURG, PA. J. W. MARSH.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Capacity of Railway Motors.—MUELLER.—The capacity of a railway motor is limited by the sparking at the commutator and by the heating of the armature and field coils. The sparking limit determines in any case the maximum current. The heating of the windings does not depend only upon the current but upon the duration of the load also. It would be very difficult to calculate exactly this dependency, taking account of all the various influences. By neglecting the heat due to hysteresis and eddy currents and the variation of the resistance with the temperature, he develops a formula which enables one to calculate for a given motor the end temperature, when the load, the duration of the load, and the temperature at the beginning, are known. This formula, of course, also enables one to determine the temperature as a function of the time. This is an exponential formula, and contains two constants which can be easily determined. Laboratory tests of a Westinghouse tramway motor gave results in good agreement with the formula. This formula may also be used to determine the cooling curve of the motor, i. e., the curve giving the temperature as a function of the time, after the operation of the motor has ceased. He shows that the cooling is very slow. The conditions of actual tramway practice are different from laboratory tests and much more complicated. The conditions may be approximately dealt with as follows: A total round trip of a car is considered and divided into the single parts in each of which the current is constant while the current may vary from part to part. He determines that current which, flowing constantly during the total time of the round trip, would cause the same end temperature of the motor as the varying load of the actual service. This current is called the "equivalent current," and may be found approximately as follows: Calculate for each part of the round trip the product of the duration and square of current, take the sum of the products for all parts of the round trip, and divide this sum by the total time of the round trip. This gives the square of the equivalent current. For good service it is necessary that this equivalent current is smaller than the current which the motor can stand for continuous lasting load without an increase of the temperature above the allowed limit. —*Elek. Zeit.*, Nov. 7.

Synchronous Converters versus Motor-Generators.—BRAUN.—A long communication referring to a recent article in which motor generators and synchronous converters had been compared and the results obtained were found to be very much in favor of the motor-generators (ELECTRICAL WORLD AND ENGINEER, Sept. 21, p. 460; see also Digest, Nov. 30). He claims that the author of that article comes to his conclusions only because he overlooks the great improvements of synchronous converters accomplished in recent years. He discusses in detail the several points of comparison and gives some data and tables. His conclusion is that in modern plants the synchronous converter is to be preferred. He describes the improvements in design, made in recent years by the Westinghouse Company. —*Elek. Zeit.*, Nov. 7.

REFERENCES.

Synchronous Converter.—BLONDEL.—The first part of his paper in full, presented to the last Internat. Electrical Congress, in which he gives a graphical theory of the regulation of synchronous converters. The paper is highly mathematical and cannot be abstracted. —*L'Eclairage Elec.*, Nov. 9.

Natural Period of Oscillation of an Alternator.—SOUBRIER.—A brief and simple proof of Boucherot's and Blondel's formula for the natural period of oscillation of a coupled alternator, running at no load.—*L'Eclairage Elec.*, Nov. 2.

Five-kw Dynamo.—A very long article, illustrated by many diagrams, in which the complete design of a 110-volt, 45-ampere direct-current dynamo is given, which can be made with the ordinary tools found in every engineering workshop.—Lond. *Elec. Eng.*, Nov. 15.

LIGHTS AND LIGHTING.

Lighting Appliances.—A long illustrated article, giving in the form of trade notes descriptions of some fittings, appliances and novelties, for the current lighting season. Among them are Siemens' solid system of main laying; the Traveller light fitting; Union arc lamps, electrical illuminators; America electrical novelties; the Jandus arc lamp; the Edison incandescent lamp of the British Thomson-Houston Company; steel conduits pendant fittings; a new electric gas lighter; the Turret multiple distributor; gas-tight fuse box; heating and lighting appliances of the Gen. Elec. Co.; vulcanized rubber cables and wires; several fittings; heating and cooking appliances; the Stewart "Continental" enclosed arc lamp, etc.—Lond. *Elec. Rev.*, Nov. 8.

REFERENCE.

Photographs of the Arc.—SCOTT.—An illustrated article on photographs of the electric arc.—*Sc. Amer.*, Oct. 19.

POWER.

British Electric Plant and Dust Destructor.—An article on the opening of the Hackney electric plant. The present capacity of the generating plant is 3000 horse-power. The system is a low-pressure, direct-current, three-wire supply, with 240 volts at the consumers' terminals. For power purposes the pressure will be 480 volts. The dust destructor will not be in working order until early spring. Then there will be sufficient steam raised by the destructor to run cheaply one of the small sets (300 kilowatts) so that coal fuel will be used chiefly. The refuse destructor consists of 12 furnace cells, capable of burning 160 tons of refuse in 24 hours. Arrangements have been made for the automatic handling of the refuse, so far as this is possible, from the moment it is tipped at the works to the time when it emerges from the furnaces in the form of clinker.—Lond. *Elec. Rev.*, Nov. 8.

REFERENCES.

Californian Transmission.—HEITMANN and CURRIE.—An illustrated description of the generators and transformers for the Bay Counties Power Company in California.—*Eng. News*, Nov. 21.

Gas Engines.—BURSTALL.—A long illustrated report with many tables, presented to the Brit. Inst. Mech. Eng., on gas engine research.—Lond. *Enging.*, Oct. 25, Nov. 1, 8.

TRACTION.

Italian Electric Railway.—REYVAL.—A very long and well illustrated article on the development of electric traction in Italy. On the Lecco-Chiavennu line three-phase motor cars will be used, the Milan-Gallarate Railroad will be operated by 650-volt direct-current. Storage battery cars are used by both railroads on such branch lines on which the traffic is not extended enough to justify a permanent installation. A very detailed description is given of the Milan-Gal-

larate Railroad, which, with three extensions, has a total length of 78 miles. Water power is used for the generation of 13,000-volt, three-phase currents, which are distributed to sub-stations and converted there to 650-volt, direct-current, at which pressure the current is supplied to the motor cars by means of the third rail. The description of this line is profusely illustrated.—*L'Eclairage Elec.*, Nov. 2.

REFERENCES.

Emergency Brake for Electric Cars.—A powerful brake instantaneously applied to the wheels simply causes them to skid. An emergency brake must act on the track itself, and be entirely independent of the brake on the wheels. Such a brake designed by Hewitt and Rhodes is described and illustrated. The brake acts directly on the rails and is worked by means of air pressure, procured from a compressor driven by one of the axles of the car.—Lond. *Elec. Rev.*, Nov. 15.

Dynamometric Brakes.—GUILLAUME.—An illustrated article on magnetic and electromagnetic brakes. The Siemens & Halske, and the Pasqualini brakes are described.—*L'Eclairage Elec.*, Nov. 9.

Rail Chair.—KOETENSKY.—A report on the use of the Scheinig & Hofmann rail chair on the electric railway between Linz and Urfahr, Austria. The rails are wedged together by means of a "rail shoe" without spikes. The installation has proved very satisfactory.—*Zeit. f. Elek.*, Nov. 10.

Electrolysis by Return Currents.—WHEELER.—A communication on cases of the destruction of gas pipes by electrolysis, due to careless soldering of the rail bonds of the tramways.—*Eng. News*, Nov. 21.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Station.—A description of the electric plant of the Hackney Borough Council, which is not yet completed, although the supply for public and private lighting has been started. There will be a refuse destructor in combination with the plant. The generating plant consists of two 1000-hp engines and two 500-hp engines, each driving two direct-current dynamos. The three-wire system is used with 240 volts between the outers, and one dynamo is connected to each side of the system. The batteries are connected across the outers with the regulating cells in the middle. The battery is a very large one, there being 304 cells with a capacity of 2800 ampere-hours on a four-hour discharge and capable of giving 1500 amperes for one hour.—Lond. *Elec.*, Nov. 1. (See item, page 947.)

REFERENCES.

General Electric Company's Constant-Current Transformer for Alternating Series Arc Lighting.—The full illustrated report of a Franklin Inst. committee, which recommends the award of a prize to Elihu Thomson for this invention.—*Jour. Frank. Inst.*, Nov.

British Lighting Station.—An illustrated description of the Heywood electric plant. The direct-current system is used. The station contains two 60-kw sets and a battery of 230 cells with 350 ampere-hour capacity.—Lond. *Elec. Rev.*, Nov. 8.

WIRES, WIRING AND CONDUITS.

Insulation and Insulating Material.—KESSLER.—An article, illustrated by various diagrams. He first deals with turn and layer insulation. Two pieces of double cotton covered wire lying side by side, with only the thickness of the cotton between them, which will be about .009 inch in the case of a No. 18 wire, will stand approximately 1000 volts. This insulation is that of air, the cotton serving simply to space the wires. He then discusses the insulation to be used between flat surfaces which are of considerable potential differences. Cellulose materials, such as paper, fibres, fullerboards, pressboards, etc., are all quite hygroscopic. They are to be dried out and covered with a layer of insulating varnish, which is moisture proof. The drying out must, however, be somewhat limited to prevent too great a loss of flexibility, resistance to tearing forces, etc. As insulating oils, the animal and vegetable oils are not practical, as they easily saponify and form fatty acid salts with the metals. The influence which small amounts of water exert with respect to the insulation of oil, is very great. Mineral oils are undoubtedly hygroscopic. There is probably little difference in the insulation of perfectly dry mineral oils ranging from benzine to cylinder oil stock, or from the very light to the very heavy oils. Both of these advantages are questions of viscosity, as the lighter oil circulates much more rapidly, exposes fresh portions continually to the dielectric stress and carries off the heat. Light oils cannot be used, however, on account of increased fire risk, and a mineral oil must be chosen which will be neither too viscous nor too light.—*Rose Tech.*, Nov.

REFERENCE.

Voltage Drop in a Three-Phase System.—STOCK.—An article illustrated by diagrams, in which he describes how to calculate the voltage drop in a three-phase system, taking into account induction and phase difference.—*Elek. Anz.*, Oct. 31.

ELECTRO-PHYSICS AND MAGNETISM.

Optical Electric Phenomenon.—A note on an observation made by Bose. When an electric current is passed through a slightly acid solution for a long time with gold electrodes, the anode alters considerably in appearance, becoming coated with a covering of gold hydroxide. If now the charging current be stopped and the electrodes connected to a high resistance galvanometer, it is found that the e. m. f. of the combination depends on the illumination of the oxidized gold electrode. The differences in e. m. f. obtained amounted in some cases to as much as 0.1 volt, very strong lights such as the arc, magnesium light, Welsbach light, etc., causing the potential of the electrode to drop. The different actions of the various parts of the spectrum are interesting. Pure violet light has the same effect as white light, i. e., lowers the potential. Sodium light, and the yellow and green parts of the spectrum have hardly any effect. Red light raises the potential even to an amount greater than the high value reached in the dark. Röntgen rays have a very strong action similar to white light. "It is possible that practical good may result from these observations. If the effect is proportional to the cause, i. e., to the illumination, which seems probable, the phenomenon may form the basis for the construction of a direct reading photometer, that apparatus so earnestly desired by all who have to do with photometric measurements."—Lond. *Elec. Rev.*, Nov. 8.

Chemical Action or Radium Rays.—BERTHELOT.—He has discovered some interesting chemical changes produced by radium rays. The first reaction described is the decomposition of powdered iodic acid into oxygen and iodine after being placed next to the radium tube in the dark for nine days. In this reaction the rays not only determine the action, but furnish the necessary energy. Another endothermic reaction, which is common to sunlight and to radium rays, is the decomposition of nitric acid. The rays, on the other hand, are not capable of precipitating sulphur from its solution in carbon bisulphide, as is done by sunlight.—*Comptes Rendus*, Oct. 28; abstracted in Lond. *Elec.*, Nov. 15.

Law of Magnetic Induction.—MUELLENDORF.—An article in which he develops formulas for the relation between the magnetic induction B and the field intensity H. From theoretical reasoning he develops two different sets of formulas which are equally probable; but only the one set is in accordance with the facts. He shows that the experimental results for three different kinds of iron and for hard steel may well be represented by the formula

$$B = a \left\{ 1 - \frac{1}{\left(1 + \frac{k^m}{m\,n} H^m\right)^n} \right\} + H$$

in which a is the maximum limit of the difference between B and H, and k, m, n are constants. For wrought iron and cast iron is $m = 2$ and $n = 0.5$. If instead of the field intensity H, the magnetizing force M is given as ampere windings per centimeter, H in the above formula is to be replaced by $c\,M$, when c generally depends upon the form of the coil and is a numerical coefficient to be determined empirically.—*Elek. Zeit.*, Nov. 7.

REFERENCES.

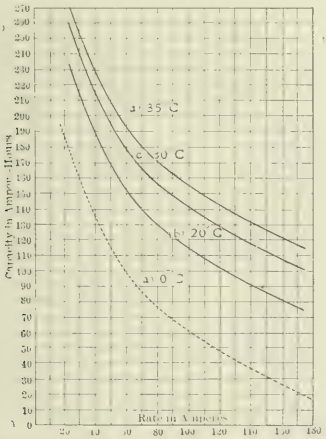
Vector Analysis.—PUNGA.—The conclusion of his illustrated article, the first part of which was noticed in the Digest, Nov. 16. He explains the topographical method of treating alternating-current phenomena by means of Grassmann's "Ausdehnungslehre."—*Zeit. f. Elek.*, Oct. 27.

Resonance.—TURPAIN.—A French Ass'n Adv. Sc. paper on the phenomena of electric resonance in rarefied air.—*L'Eclairage Elec.*, Nov. 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemistry.—NERNST.—Abstracts of a lecture, held before the German Association of Natural Philosophers and Physicians on "The importance of electrical methods and theories in chemistry." The following hypothesis, brought forward by him, seems remarkable. Since the time of Faraday, we know that equivalent quantities of all elements are always combined with the same quantity of electricity. For the description of this fact we may use the following scheme: Electricity may be regarded as a matter having atomic structure, and consisting of positive and negative electrons; the ions may be regarded as the chemical combinations of the elements with such electrons. An ion is then a saturated chemical combination of an atom and an electron. A sodium ion, for instance, is, therefore, entirely different from a sodium atom, as it is a combination of a sodium atom with a positive electron. All elements or radicles have affinity to positive as well as negative electrons, with which they form ions; they have besides a non-polar attraction to each other, which, for instance, causes the combination of two hydrogen atoms to a hydrogen molecule. When positive and negative elements combine there is, besides the combination of the two atoms, also a combination of a negative and a positive electron; and in the case of electrolytic dissociation, there is not a pure chemical dissociation, but an electric molecule is also split up. This hypothesis is not at all complete, but it is thought to be justified because it stirs up future scientific work.—*Zeit. f. Elektrochemie,* Nov. 14; *Phys. Zeit.,* Nov. 15.

Influence of the Temperature Upon the Capacity of Lead Storage Batteries.—LIAGRE.—An article referring to the great increase of capacity with the temperature, about 3 per cent per degree Celsius (see Digest, Nov. 16, article of Heim). Manufacturers and engineers, when giving the capacity of a battery should always state the exact temperature at which the test was made. He made experiments with a battery, both plates of which were of the Plante type, the active surface being 348 square decimeters for each electrode. Tests were made for temperatures betwen 16 dgs. and 70 dgs., and for various rates. The capacity for a given rate can be fairly represented as a linear function of the temperature; the capacity of his cell, within the limits of his measurements, is given by the sum of the extrapolated capacity at 0 deg. C. plus the product of the tempera-



INFLUENCE OF TEMPERATURE ON STORAGE BATTERIES.

ture in Celsius, and a constant, which varied between 2.55 and 2.80 for different discharge rates. For a cell with 1 square meter of active surface of each electrode, the temperature coefficient of the capacity per deg. C. is, therefore, $2.70 \div 3.48 = 0.77$. The increase of the capacity with the temperature is much greater for rapid discharge than for slow discharges. The adjoining diagram shows in the three curves (b) (c) (d) the capacity in ampere-hours at 20 degs., 30 degs., 35 degs. C. as a function of the rate in amperes. The curve (a) is found by extrapolation for 0 deg. C.—*L'Eclairage Elec.,* Nov. 2.

Electro-Chemistry in France.—J. B. C. KERSHAW.—The third part of his serial in electro-chemical and electro-metallurgical industry, dealing with the progress made in France, where there is plenty of water power available. Eleven electro-chemical and electro-metallurgical works have 54,000 hp derived from waterfalls. The number of electrolytic copper refineries is eight, and it seems improbable that this industry can develop in France, on account of the scarcity of raw copper suitable for refining. There are two plants for the production of aluminum, one with 5000 horse-power at Le Praz, using the Heroult process, the other with 4000 horse-power at St. Michel, using the Hall process, but not all of the 4000 horse-power are used for the production of aluminum. Chlorate is made at St. Michel, under the patents of Gall and Mortlaur, cells without diaphragm being used with platinum electrodes. Chlorate is also made by a similar process at Chedde, where 12,000 tons are available. The calcium carbide industry has developed to a greater extent in France than in any other European country. A moderate estimate of the power available in the 26 carbide factories places it at 50,000 horse-power. The growth of the alkali and chlorine industry has been slow. It is possible that early in 1902 there will be four electrolytic alkali works. Ferro-chrome, ferro-silicon and other similar alloys are produced in electric furnaces at several places. The production of ozone by the silent electric discharge through air, and the use of this ozonized air for sterilizing water, for oxidation purposes in the manufacture of perfumes, and for ageing wines and spirits, have received much attention in France. In only one case has a practical success been achieved, namely in connection with the manufacture of heliotropine and vanilia. The Verley ozonizer is used in this plant, near Paris, and 10,000 kegs of the two products named are produced per year. The experiments, made with the Hermite sewage disinfecting process at Havre and Marseilles, about 1890, have not led to any practical success. This process, in which electrolyzed sea-water was used, resembled the Wolff process tried at Havana in 1899, and failure in each case was due to excessive cost.—*Elec. Rev.,* Nov. 23.

Straying of the Lines of Current in Electrolytes.—PFAUHAUSSER.—In elctro-plating one wants to obtain a uniform deposit on the surface to the plate. This is often not the case when this surface has a very irregular form with elevations and deepenings. It is especially difficult to get a good uniform deposit of an alloy, for instance, of copper and zinc in the form of brass. To accomplish this, one has to use electrolytic baths which stray the lines of current well. He compares the straying of the lines of current in electrolytes with the magnetic stray fields in dynamos. The electrodes correspond to the magnet pole and armature, the electrolyte corresponds to the air-gap. To get uniform electrolytic deposits on special surfaces, mechanical means are sometimes used to advantage. Non-conducting diaphragms are placed between anode and cathode, to deviate the lines of current in the way desired, or for covering a plane surface with a uniform coating, and to prevent the coating from being thicker at the rims than at the central part, a non-conducting frame is placed before the cathode, the open part in the middle of the frame being smaller than the cathode. He discusses the influence of the composition of the electrolytic bath upon the phenomenon of the straying of lines of current. He calls attention to the fact that acid solutions stray less than neutral or alkaline solutions. He gives an explanation which is highly theoretical and cannot well be briefly abstracted. He mentions that practical experiments have shown that the addition of Na H SO_3 to the electrolytic bath is a means for obtaining good uniform deposits of copper and zinc together as brass. —*Zeit. f. Elektrochemie,* Sept. 26.

Diaphragm Cells for the Production of Alkalies and Chlorine.—J. B. C. KERSHAW.—After a brief notice of the four types of diaphragm cells, now in actual use, namely, the Electron, the Le Suever, the Hargreaves-Bird and the Outchenin-Chalandre cells, he gives a detailed illustrated description of a new cell of American origin. It is patented by Moore, Allen, Ridlon and Quincy, and in many respects resembles the Harbreaves-Bird cell. The advantage claimed for the new cell over the Hargreaves-Bird cell is that no steam is required, and that the design and structure of the cells are simpler. The author considers the cell to be defective in one very essential point, namely, that there are no means provided for quickly removing the sodium hydrate which is formed; if it is not quickly removed, it is decomposed by the current in preference to the sodium chloride.—Lond. *Elec.,* Nov. 15.

Carbon Anodes for Electrolysis of Chlorides of Alkalies.—SPROESSER.—The first part of an account of experiments in which he tested different commercial kinds of carbon for use as anodes in the electrolysis of chloride of alkalies. He tested three kinds of retort car-

bon, seven kinds of artificial carbons, and one kind of graphite. He gives some data as to the chemical composition, the heat of combustion and the porosity. The porosity is given in percentages and defined as 100 times the difference of true specific gravity and apparent specific gravity, divided by the true specific gravity. The porosity varies between 12.6 and 18.3 per cent for the retort carbons, between 18.4 and 27.8 per cent for the artificial carbons, and is 23.2 per cent for graphite. He describes the arrangements of his experiments without a diaphragm. The article is to be continued.—*Zeit. f. Elektrochemie,* Nov. 7.

REFERENCE.

Peigne Storage Cell.—An illustrated description of this lead storage battery, made by a French company. The watt-hour capacity per kilogram of plate is 6.6, 8.6 and 10.1 for discharges in 3, 5, 10 hours, respectively. The capacity per kilogram of total cell is not given.—*L'Eclairage Elec.,* Nov. 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localizing Faults and Testing the Insulation of Electric Networks.—CHARPENTIER.—A very long article, illustrated by diagrams. He first gives the principle of the method which is shown in Fig. 1 (and which is not new). An earth-fault has developed somewhere on the circuit *A B C D,* or on the branch circuit *F G E H.* To localize the fault, *G* and *H* are disconnected from each other, and *B* and *D*

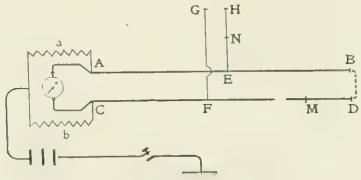


FIG. 1.—TESTING FOR FAULTS AND INSULATION.

are connected together; a galvanometer is inserted between *A* and *C.* At *A* and *C* the two resistances *a* and *b* are connected, as shown in the figure, and the point where these two resistances join is connected through a battery to earth; *a* and *b* are known variable resistances. They are varied until the galvanometer shows no deflection. If *R* is the total resistance of the loop *A B C D,* two resistances *x* and *y* may be easily found, the sum of which is *R,* and the ratio equal to that of *a* to *b; x* and *y* represent then the point on the line where the ground exists. This follows from the principle of Wheatstone's bridge. If the point found is at *E* or *F,* the ground is on the branch circuit *E H F G,* and to determine it exactly it is necessary to break the connection *B D,* connect *G* and *H,* and repeat the same test (but this is correct only when the resistance per foot is the same on the branch wire as on the mains). He claims that the method is not very exact, as there are errors due to the resistances of the joints of the line. To overcome these errors he has devised the following scheme: He does not test the network itself, but another network, formed of pilot wires, which is parallel to the real network throughout its length, and which has the property that when a fault develops in the real network it also develops

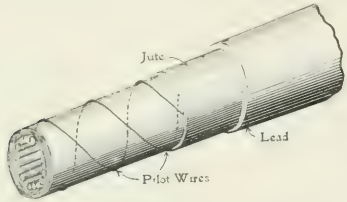


FIG. 2.—ARRANGEMENT OF PILOT WIRES.

probably but not necessarily at the same time and at the same place in the pilot wires. The pilot wires can always be easily tested, so that there is a possibility of continually testing the insulation of the network and immediately ascertaining a developing fault. To accomplish this, the pilot wires are arranged, as shown in the second figure, which shows a cable of the network. Between the last and the preceding layers of jute the two pilot wires are wound in spirals; they are bare copper or brass wires of some tenth's millimeter diameter. (To avoid complicated calculation, however, the pitch of the spiral must be a function of the diameter of the cable, as the resistance per foot of cable should be the same for all cables. He says this arrangement could easily be made in the construction of the cable and would be inexpensive.—(If in the first method—Fig. 1—the battery is placed where the galvanometer is, and vice versa, better results will be obtained for faults with an appreciable resistance or counter e. m. f. due to electrolysis, as there is then no current passing through the fault, it being a mere contact point for the galvanometer circuit.—Comp.)—*L'Eclairage Elec.,* Nov. 9.

Voltameter for Small Currents.—LEHFELDT.—An abstract of a Brit. Phys. Soc. paper on a voltameter for small currents. The instrument consists of a capillary tube about 25 cm. long, completely filled with mercury, with the exception of a bubble of mercurous nitrate solution about 1 cm. long, placed near the middle of the tube. Connection with the two mercury columns is made by means of platinum wires passing through the side of the tube. To use the instrument it is placed in a vertical position, the anode being at the top, and the quantity of electricity which passes through is measured by the change in volume of either electrode. In a test experiment the change in volume was measured by means of a micrometer, and agreed within 0.6 per cent with the amount deduced from the known value of the current. It is necessary that the currents should be small, so as to avoid complications due to polarization.—Lond. *Elec.,* Nov. 15.

Electromagnetic Units and Unit of Time.—REY-PEILHADE.—A French Ass'n Adv. Sc. paper on a reform of the electromagnetic units by means of the adoption of a new unit of time, the "millice" which is the 100,000th part of the average day (about 0.864 second). His system is called millice-centimeter-gram system. The units have names with the prefix "no"; for instance, nowatt is the unit of power in his new system. A comparative table of the units in the centimeter-gram second system and in his new system, is given.—*L'Eclairage Elec.,* Nov. 2.

MISCELLANEOUS.

Aluminothermic Process of Soldering.—GOLDSCHMIDT.—A long illustrated description of a modification of his well-known process. The total quantity of thermit required is put into a crucible in the form of a funnel, the opening at the lower end being closed by a thin plate of iron. When the thermit is lighted at the surface by means of match or hot iron, the total quantity of thermit in the funnel burns in a few seconds, the molten metal is at the bottom and melts the thin iron plate and flows out, so that the metal flows out first and afterwards the lighted corundum. This is the reverse of the usual method, in which when the contents of the crucible are poured out, the lighter corundum first flows off and then the metal. The new method cannot be used for all the cases to which the old method is adapted, but is especially useful in certain cases, like soldering rails. The new method and several of its applications are described in detail and illustrated.—*Zeit. f. Elektrochemie,* Oct. 17.

Locating Metals by Electricity.—An illustrated description of a new method for locating metals in the earth. The principle upon which the method rests is that a metallic streak in the earth is a better conductor than the earth on either side of it. Movable electrodes are used which are connected with a Wheatstone bridge and other apparatus for measuring resistances. These electrodes are moved about a regular system over a given area in such a way as to obtain the measurement of a large number of resistances in various directions, and by a comparison of the various measurements one can ascertain where the current is taking a metallic streak or deposit as a conductor.—*West. Elec.,* Nov. 16.

REFERENCES.

Electric Furnace for Laboratory Use.—HOWE.—An illustrated paper read before the A. I. Min. Eng., in which he describes an electric resistance furnace for laboratory use. The heating wire is of platinum. The furnace walls and the crucible are of magnesia.—*Eng. and Min. Jour.,* Nov. 16.

National Electrical Contractor.—The first number of a new monthly journal which is the official organ of the National Electrical Contractors' Association. Besides the news of this association, it contains a few brief notes on 200-volt incandescent lamps, the Nernst lamp, etc.—*Nat. Elec. Contr.,* Nov.

New Books.

Transactions of the American Institute of Electrical Engineer. Vol. XVII. New York: American Institute of Electrical Engineers. 822 pages, illustrated.

The 1900 volume of the *Transactions* of the American Institute of Electrical Engineers is in several respects one of the strongest in the entire series of Institute *Transactions,* and contains perhaps the most notable paper lately read before the Institute, that in which Dr. Pupin first announced his system of compensating long-distance telephonic air lines and submarine cables for the deleterious effects of capacity. Another notable paper in this volume is that of Messrs. Crehore and Squire on a new system of cable telegraphy. Still other papers that form contributions of permanent value to the literature of electrical engineering are those of E. A. Behrend on the magnetic pull on decentralized armatures; hysteresis in sheet iron and steel, by A. H. Ford; eddy-current losses in transformers, by Fitzhugh Townsend; use of aluminum line wire and some constants for transmission lines, by Messrs. Perrine and Baum, and Mr. Steinmetz's paper on single-phase motors.

Of the several discussions there should be mentioned those on electric traction under steam railway conditions and on electrolytic corrosion from railway currents, and the Paris discussion on the relative advantages of alternating and direct current for the general supply of electricity. This latter topic, which was discussed at Paris, was selected by our English brethren, and it will be long before American engineers will have recovered from their surprise at the serious manner in which the foreign participants in the discussion considered a question, almost all interest in which had ceased in this country at least ten years ago, for the very good reason that American development had so long ago as then shown the absurdity of considering these two branches of the electrical art as antagonistic.

Mention should not be omitted of the excellent paper by Professor Carhart on the Reichanstaldt at Berlin, the reading of which before the Institute was particularly opportune in that the paper undoubtedly had a considerable influence in securing the passage by Congress of the bill establishing the National Standardization Bureau.

The present volume has been considerably improved with respect to the opening pages and the indexes. The title page no longer bears extraneous matter, and the list of officers and members of the Council has been transferred from the copyright to the following page, ordinary book style thus being followed. The index is in three sections under the heads of "Business of the Institute," "Subjects Discussed Before the Institute," and "Authors of Papers and Participants in Discussions."

Cours D'Electricite. By H. Pellat. Tome I. Paris: Gauthier-Villars. 329 pages, 145 illusttrations. Price, 10 francs.

This book is the first of three volumes giving the course of electricity as taught at the Sorbonne by Professor Pellat. The work is divided into three parts, the present volume taking up electrostatics. Ohm's law and thermo-electricity, and the following volumes will comprise the subjects of electro-dynamics, magnetism, induction, electrolytics, electro-capilarity, etc. The development follows the usual academic method, general descriptions of phenomena being accompanied by their mathematical expression, with some references to their practical role. The author has confined the mathematics as far as possible to a kind that will be easily within the reach of the average student, and to this end only the simpler calculus is employed. The author departs from the usual treatment of electrostatics founded on the laws of Coulomb, the experimental base of which he considers inexact, owing to their not taking into consideration the medium between the acting bodies, since the specific inductive capacity and, therefore, the force acting depends upon the several dielectrics that may intervene.

Etude Sur Les Paratonnerres. Par A. Della Riccia. Liege: Leon de Thier. 81 pages, 41 illustrations.

This is an extract from a *Bulletin* of the Alumni Association of the Institut Electrotechnique Montefiore. While no attempt has been made by the writer of this monograph to advance any new theories, he has nevertheless succeeded in condensing within a very small compass the fundamental principles underlying the modern applications of the lightning rod. To this he has added a number of useful practical examples, and as a handy compendium, therefore, the little pamphlet has a distinct value. Those, of course, who desire to go more deeply into the subject will find fuller elaboration in Dr. Lodge's classical work on the subject. Even should they do so, the present work will be of value from its practical nature and as giving the latest thought on the subject. The pamphlet before us does credit both to the author and to the excellent Institute from which he graduated.

Practical X-Ray Work. By Frank T. Addyman, B. Sc. (Lond.). New York: D. Van Nostrand Company. 207 pages, 52 illustrations, 11 plates. Price, $4.

This is perhaps the first working handbook on Röntgen rays from the standpoint of their medical applications, that has yet been published. The author appears to be well qualified for the work, since he occupies the position of radiographer to St. George's Hospital, London, and is a teacher of radiography in a medical school.

The book is divided into three parts, of which the first is historical, the second describes apparatus most generally used, giving special attention to induction coils and focus tubes, and the third part deals with the general practical conditions under which Röntgen rays are used in medical work. The author in his preface refers to the natural difficulty with which he met in preparing the book, owing to the fact that being intended for medical men, many prospective readers will not have a proficient knowledge of electrical science. As a way out of the difficulty the author has taken as a starting point as to electrical knowledge the requirements of the examination for qualification to the Royal Colleges of Physicians and Surgeons.

About half of the book is devoted to apparatus and its manipulation. An excellent chapter in this section is on tubes, in which the author gives much practical information on this part of the apparatus, which in the hands of a beginner is subject to such apparently unaccountable vagaries. The second part of the book treats entirely of practical Röntgen ray work, and will be found of the utmost value to the medical man, since the information contained is presented in practical form for their specific needs. Even from the standpoint of a general descriptive treatise the book is much above the plane of the usual compilations treating of Röntgen rays.

Pocket Book of Electrical Engineering Formulæ. By W. Geipel and M. Hamilton Kilgour. New and enlarged edition. New York: D. Van Nostrand Company. 829 pages, illustrated. Price, $3.

This is a revised edition of the Electrical Engineering pocket book that the authors first issued in 1894, and which has ever since held a foremost place among the reference volumes of its class printed in the English language. Thinner paper has enabled a reduction in bulk in spite of the addtion of about 50 pages of fresh matter, and brings it down to a point where it can be conveniently carried in the pocket.

In contradistinction to a usual practice with pocket books, the revision has not been effected by merely adding an appendix or inserting a few extra paragraphs at the end of each chapter, but bears evidence of having been carefully considered and carried on with less reverence for the retention intact of the original electrotyped page plates than is ordinarily the case.

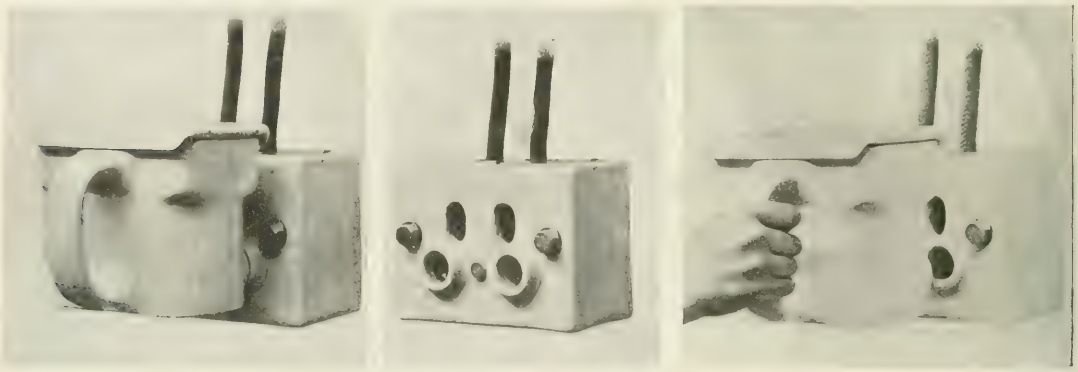
As is to be expected, the first parts of the book containing tables, mathematical formulæ and general miscellaneous engineering data have not required extensive correction, a few tables that should be found convenient having been inserted together with comments on modern practice in the way of steam engineering, condensers, etc.

In the purely electrical section occupying the last 300 pages the progress of the art has necessitated greater revision. The entire chapter on "electric traction" that took up but 19 pages in the first edition has been rewritten and brought up to 56 pages in the present issue, this having been done with the collaboration of Mr. Justus Eck. Of course, even now it is by no means suitable for a text book on the subject, but for the class of information usually sought for in engineering pocket books it would seem to answer well.

Other sections that have been revised are those treating of enclosed arc lamps, storage batteries, high-voltage incandescent lamps and electric welding. Strange to say, the chapter on electro-chemistry in which branch the most notable advances have been made remains absolutely untouched, three brief pages still comprising the only contribution to this most important subject.

New Form of Oil-Break Fuse.

The need of a really satisfactory fuse and the difficulty in obtaining it has, in many instances, necessitated working without them in places where they would otherwise have been used to advantage. Messrs. S. Z. de Ferranti, Limited, of London, have furnished a remedy for this by manufacturing an oil break plug fuse which, combined with a special type of contact block, can be added to any circuit, fixed on to any type of switchboard, or even on to a wall in a central or sub-station.



FIGS. 1, 2 AND 3.—OIL-BREAK FUSE.

The illustrations represent this useful device, Fig. 1 showing the plug fuse in position. The cable will be seen entering from the top, although the block can be easily mounted in the reverse direction for the cables to enter from below. Fig. 3 represents the withdrawal of a fuse from its contact, no special tool or, in fact, any apparatus being required for this operation. Fig. 3 shows the block attached to the wall or switchboard after the removal of the fuse. It will be seen from this illustration how securely the metal sockets are shielded by the surrounding porcelain. It is quite impossible to make accidental contact with either the metal terminals or the plug sockets, both these fittings being out of sight under the surface of the porcelain. The metal fittings are held into the porcelain block by sulphur compound, and this compound is recessed where the cables enter so that the rubber paper covering can pass the socket so formed. By these precautions a method for sealing the end of the compound or cable is obtained, at the same time preventing the exposure of the live cable end.

This useful combination is produced in several sizes for capacities varying between 30 and 350 kilowatts. They are equally applicable for 500 volts, direct current, or 2000 to 5000 alternating current circuits. Even on 250-volt circuits, it is found that the oil break fuse is advantageous where an inductive circuit is likely to be broken. Experiments have shown that the usual strip type of fuse, in blowing, causes considerable damage to the fuse contacts and to the surrounding parts of the switchboard, whereas an oil break fuse will act on the same circuit without a disturbance.

It is unnecessary to describe the details of the actual fuse, which is of the well-known Ferranti type, in which the arc produced on the break of a circuit is drawn into a bath of oil and so immediately damped. It is interesting to note the care which has been taken in producing a safe apparatus. This feature is one of the characteristics of the manufacturers, and needless to say it is an essential one, especially when dealing with high-tension systems.

Selective Lockout Party-Line System.

The accompanying illustrations refer to a selective lockout party line system known as the "Ideal," and manufactured by the United States Electric Manufacturing Company, of Butler, Pa. This system is capable of application to existing exchange boards, and is especially adapted to farmers' lines. Any number of telephones up to

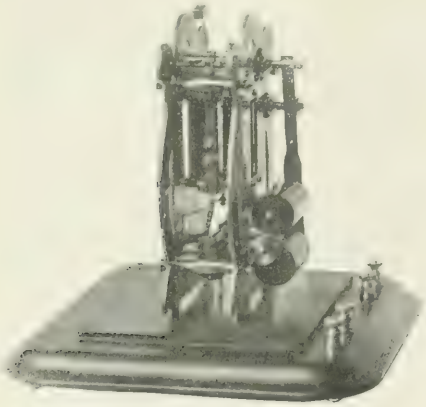


FIG. 1.—AUTOMATIC DEVICE.

FIG. 2.—TELEPHONE SET.

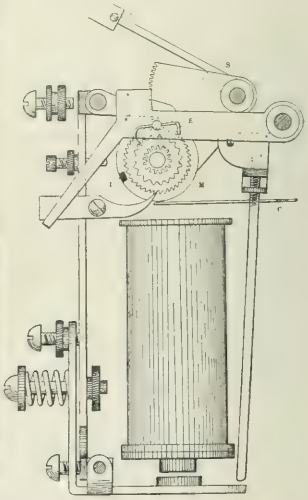
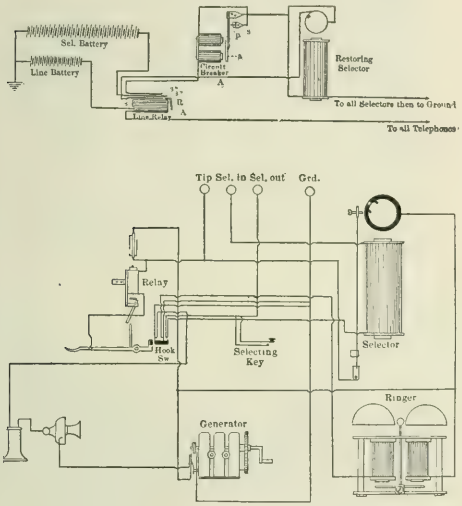


FIG. 3.—AUTOMATIC BATTERY CIRCUIT.

35 can be operated on a single line. This system involves the lock-out principle, thus ensuring secrecy. Through the selective feature only the subscriber called is rung up, and the exchange system is entirely automatic, each subscriber connecting himself with any other subscriber.

Fig. 2 shows a telephone set installed, and Fig. 1 illustrates the automatic device, which is also shown in section in Fig. 3. Fig. 4 is a diagram of the line circuit, and Fig. 5 that of the telephone circuit. The line circuit includes the line battery, selector battery, line relay, circuit breaker and the restorer selector or battery cutout. All of the batteries work on open circuit. When the receiver is taken off its hook a contact is made grounding the tip of the line, which pulls up the line relay (Fig. 4), which in turn closes the selector battery through the circuit-breaker, and also closes the telephone circuit at the relay (Fig. 5), this in turn holding the line relay after the contact is broken. The selector battery is now open at the selecting key (Fig. 5) which, when it closes, immediately operates the circuit-breaker, which stops all the selectors on the line when the desired station is reached, as indicated by the dial and indicator (Fig. 1). When the selective key is released the party line is called by the usual method. Upon hanging up the receivers the line battery is opened (Fig. 4), and the line relay drops back, thus throwing the selector



FIGS. 4 AND 5.—LINE AND TELEPHONE CIRCUITS.

battery direct on the line and restoring the same to its normal condition.

The selector battery is opened automatically by restoring the selector (Fig. 3), which is stopped or revolved in unison with all the selectors. When not in use the insulated point *I* rests on the spring *C*, which opens the selector battery at that point; when a station is being selected the point *I* moves around and an electrical contact is made between the disk *M* and the spring *C*. When the restoring battery is thrown on the line the disk *M* is restored to its normal position, its motion being retarded by the escapement *E*, for the purpose of giving the telephone selectors sufficient time to restore themselves before the battery is cut out.

Referring to Fig. 4, the operations on the selector circuit are as follows: The battery connects to a middle spring on the relay line, and when the relay is opened the battery connects through the top spring to the circuit breakers and through it to the line, where it is opened until the selecting key (Fig. 5) is closed, to select a station. When the line relay is dropped by hanging up the receivers, the selector battery then goes through the lower spring of the line relay to the restoring selector, thence out on the line through the disk *M* and spring *C* (Fig. 3), and also through the coils of the restoring selector. When this is done the circuit breaker is not in the circuit, which allows additional current to restore the selectors to their normal position, as may be seen by tracing the circuit through Figs. 3, 4 and 5.

De Veau Telephone Apparatus.

The attention of the telephonic community has of late been very closely riveted upon automatic systems, which are beginning to enjoy great vogue and popularity. The firm of Stanley & Patterson, 93

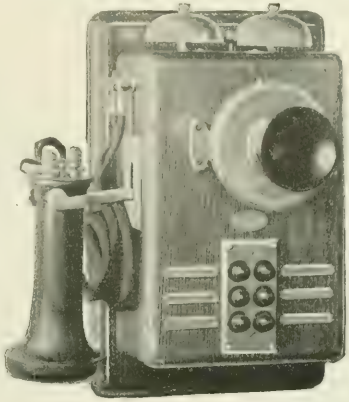


FIG. 1.—FRONT VIEW AUTOMATIC SWITCHLESS TELEPHONE.

Liberty Street, New York City, already well known as the manufacturers of the De Veau telephone apparatus, has just introduced an ingenious automatic intercommunicating system which is expected to take the place of switch and plug forms in that class of work. The system has been patented recently, and is here illustrated in Figs, 1, 2, 3 and 4. In this system any station may be called by pressing the button, with the receiver on or off the hook. When the receiver is put back on the hook, all connections are automatically restored. By holding down the button on the first call and pressing any of the other buttons, one or more additional parties may be cut in and can take part in the conversation, so that no annoying repetition by a "human repeater" is necessary, and in reality a brisk general conversation can be indulged in. This is a feature of great utility and merit, giving not only greater flexibility to telephone service but saving much time and avoiding many serious mistakes and misunderstandings. It is by such arrangements as this that the telephone best fulfills its function.

Another feature of the De Veau switchless system is that pushing

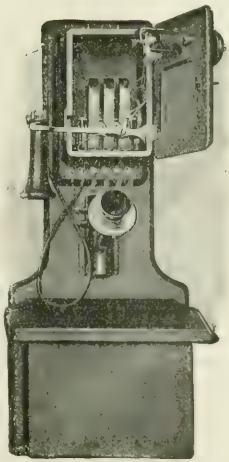


FIG. 2.—STANDARD BRIDGED TYPE LONG-DISTANCE TELEPHONE.

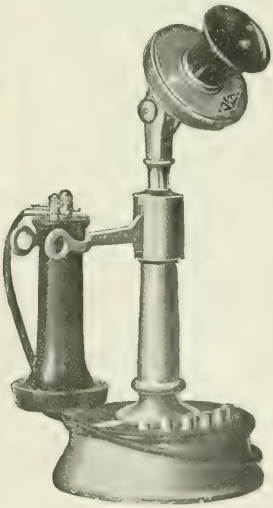


FIG. 3.—AUTOMATIC SWITCHLESS DESK TELEPHONE.

in the button all the way calls the station. When the pressure on the button is removed, it comes back half way and cuts in the talking circuit. All parts of the apparatus are, as usual, made of the best

material with the most careful workmanship, great pains being taken with the constructional details and to avoid intricate working parts, with the result of minimizing liability to interruption of service even with the most bungling and impatient user. The push and switch connection have rubbing contacts. The telephone is wired complete to a hinged back board, so that the line circuits can be connected permanently to the back board, while the interior of the set can be examined or the circuits tested without disconnecting any of the wires.

The De Veau automatic switchless desk set is also shown in Fig. 3. It is a handsome piece of mechanism and will grace any desk, directors' table or other article of that kind. The base is made of cast metal in highly finished and polished nickel, and in it the intercommunicating switchless mechanism is enclosed. Each instrument is fitted with the De Veau solid back Bell type of transmitter and a solid bipolar receiver.

Another recent product is new standard type of Mr. De Veau's long distance and exchange telephone set, fitted with a 25,000-ohm series generator, a solid back Bell type transmitter and a solid bipolar receiver. There are several improvements embodied in this apparatus due to extensive experiments and long experience. In the transmitter the diaphragm is made of aluminum, specially coated to prevent its becoming corroded. The dampening springs are made of tempered steel. The bridge holding the electrodes is made from heavy half-hard brass, ⅛ inch thick and 1 inch wide. This bridge is provided with a bushing or collar, through which the back electrode plunger passes. This collar is provided with a screw, by means of which any adjustment of resistance in the carbon electrode

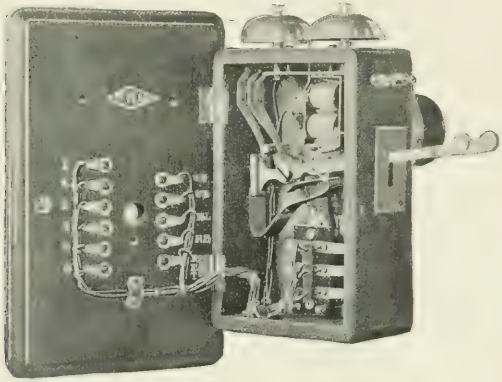


FIG. 4.—INTERIOR OF SWITCHLESS TELEPHONE.

desired may be made, and when properly adjusted, firmly fixed by setting the screw. The front electrode is attached to the diaphragm by a screw and lock-nut. This arrangement allows the electrode to have a lateral as well as a vertical movement, which absolutely prevents the transmitter from packing. The carbon electrodes are fastened to the brass holders by screws, not by solder, as solder is often unreliable because of the acid used, which causes local action and is frequently the source of much annoyance. The carbon electrodes are of carefully tested resistance throughout. The method by which the electrodes are manufactured is entirely original, it is stated. The carbon granules used are prepared in the Stanley & Patterson factory, where they employ a special process, ensuring an exact resistance. The front plate of the transmitter, which supports the parts described above, is made of heavy cast bronze metal, which entirely eliminates the metallic ring so common to transmitter cases when made of spun metal or of a light-weight casting. The mouthpiece is of new type, with perforated guard and vent holes. The vent holes allow a person's breath to escape, thereby preventing the condensation which is so commonly seen on telephone diaphragms.

Apartment House Telephony.

We show herewith the apartment entrance telephone and the telephones for the individual apartment put on the market by the Haines & Noyes Company, of Chicago. The apartment entrance telephone is furnished in connection with letter boxes or without them. These may be either in wood or metal. There is a permanent hook, and the battery circuit is not closed until the receiver is taken off the hook of the individual apartment called. This apartment telephone is furnished with a long-distance microphone transmitter and a bi-polar pony watchcase receiver, with water-shrunk hard rubber shell. The telephone for the apartment is furnished in any kind of wood de-

FIG. 1.—APARTMENT HOUSE TELEPHONE.

sired, with buzzer or double gong vibrating bells. It is very small and compact, and the cost of the installation of this system, including telephones and wiring is but a little more than the ordinary speaking

FIG. 2.—APARTMENT HOUSE TELEPHONE.

tube system. If desired, a special apartment annunciator can be used in connection with the above which permits the janitor to connect apartments together.

Two Connecticut Telephones.

The accompanying illustrations, Figs. 1 and 2, show two styles of telephone outfits manufactured by the Connecticut Telephone & Electric Co., Meriden, Conn. The instrument shown in Fig. 1 was designed with the object of producing a compact set, embracing all of the essential parts of a complete magneto call telephone. It is made in three sections, the upper containing the switch hook, induction coil and ringer (the latter being mounted on the cover); the middle section contains the generator and the lower section the necessary battery for operating the transmitter. The lower or battery compartment will hold two dry cells. The entire front of the instrument consists of a lid or cover which can be opened, exposing to view all of the working parts, thus rendering it very convenient to make any changes or repairs. The outfit is supplied with the company's improved form of receiver, long-distance transmitter on adjustable arm and new type of magneto generator, and it can be furnished for both series and bridging lines of any capacity. This instrument is also supplied with a carbon lightning arrester when desired. This is mounted between the binding posts on top.

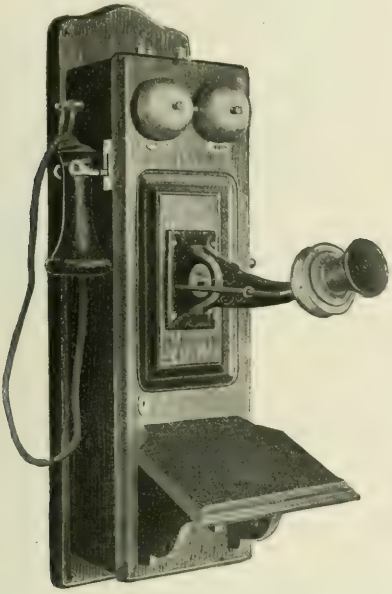


FIG. 1.—CONNECTICUT TELEPHONE.

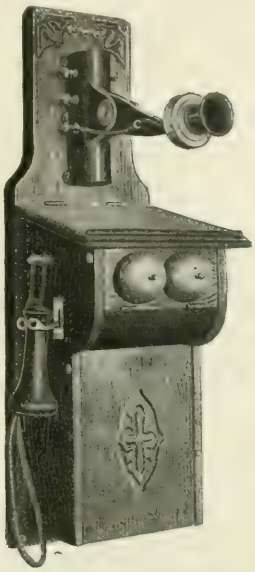


FIG. 2.—CONNECTICUT TELEPHONE.

MOLDED RECEIVER.

The other instrument (Fig. 2) is constructed on the general lines of a central energy instrument, but unlike the latter is made for use on a magneto system. The cabinet is so constructed that the upper lid can be raised; the front, on which are mounted the ringer and gongs, can be lowered or opened, and the battery box is also supplied with a door so that the batteries are accessible. This instrument is supplied with magneto generator, switch hook and ringer and the battery case will hold three cells of dry battery. It is likewise supplied with carbon lightning arrester when so desired. It is especially adapted for residence work on account of its attractive appearance.

Molded Telephone Receiver.

A little over a year ago, a patent was issued to Mr. William J. Murdock on a telephone receiver, in which the parts are molded into the case. The manner of molding is as follows: The magnet, pole pieces, binding posts, connection wires and other necessary parts are placed in a mold and when surrounded by the material, the whole is put under great pressure, making virtually a unity to exist between the metal parts and the case. The fact that these parts are all imbedded in the case makes it obvious that it is impossible for them to work loose or to change their position in any way. When a receiver is made in this manner and once set up, with the pole pieces at a proper distance from the diaphragm, there is no possibility of the receiver losing its adjustment, no chance of the binding posts pulling out, nor of the case breaking, even though it be given the roughest kind of usage.

This receiver, which is called the "Solid," and is made up in different styles, has been on the market now nearly a year, and its manufacturers, William J. Murdock & Co., of Chelsea, Mass., state that it has met with unqualified success. The style shown herewith has the binding posts covered with a cap.

A New Telephone Exchange at Wheeling W.Va.

The National Telephone Company, of West Virginia, which owns an exchange not only in Wheeling but in surrounding towns, and has long-distance connections in western Pennsylvania, Maryland and Ohio, is now putting in a new central energy bridged multiple switchboard of an ultimate capacity of 5040 subscribers' lines. This is one of the new lamp signal boards made by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The board is equipped for the present for the operation of 2160 lines. There are 120 subscribers on each operator's position, and 15 pairs of cords and appliances connected therewith at each position. The switchboard is of interest because of several new features embodied in it, one of the most important of which is the busy test. The instant a subscriber takes the receiver from the hook his line will show a busy test at any of the multiple jacks on the board. On many boards, as is well known, there is no means of telling whether a line is busy until connection between the subscribers is established. Differential relays are used in the subscribers' circuits for signaling purposes. An insertion of a plug to answer a call by an operator unbalances a relay to put out the lamp signal. On this board there is a double lamp supervision for each cord inserted. In addition to the regular operator's board in this exchange is a chief operator's desk with complete intercommunicating lines, and one monitor's desk with monitor lamps and supervision apparatus. In the terminal room the main arc is built for 5600 lines on the cable side and 2400 pairs of lightning arresters of the Stromberg-Carlson slate-base, heat-wire type. The intermediate distributing frame is also for 5600 lines. All cables in the switchboard have No. 22 copper wire conductors with silk-cotton insulation. These cables are manufactured by the Stromberg-Carlson Telephone Manufacturing Company.

A 40-volt storage battery is used on the Stromberg-Carlson central energy system. There are two sets of 20 cells each, Chloride accumulators of 640 ampere-hours capacity installed in lead lined

tanks. For charging these, two 5-hp Roth motor-generators are being installed. These receive current at 110 volts and give 60 amperes at 60 volts at the generator terminals. These sets consist of motor and generator on the same base connected by a flexible insulated flange coupling. The ringing is done by a Roth motor-generator receiving 110 volts direct current and generating 100 volts, 20 cycle alternating current. Provision is also made for the supply from an alternating-current lighting circuit of 104 volts, 60 cycles. The motor-generator for this consists of an Emerson single-phase motor direct connected to a ringing generator giving 100 volts at 20 cycles. To supply a ringing current from the storage batteries in case all others fail, a Roth motor-generator will receive current at 40 volts and deliver at 100 volts alternating current. The power board, which is white marble, is equipped with Weston ammeters and voltmeters, I. T. E. underload and overload circuit breakers, together with the necessary single and double-pole switches, fuse links and rheostats.

To handle the extensive long-distance business, a three-position toll board is being put in. This company also has branch exchanges at Pleasant Valley, Benwood, Barnesville and Bridgeport. On the main board at Wheeling are five operators' positions for taking care of incoming trunk circuits. These trunk circuits terminate directly in plugs, so that when one of the trunk circuit operators receives an order, she has simply to connect a plug on the proper trunk line to the subscriber's jack on the board in front of her. The branch exchange at Pleasant Valley is a 400-line trunking lamp signal board; that at Benwood is a 280-line board of the same kind; at Barnesville a 280-line board, and at Bridgeport one of 250 lines.

New Motors for Sewing Machine Work.

The accompanying illustration shows some of the new features of the iron-clad motors of the Diehl Manufacturing Company, Elizabethport, N. J., and their application to different types of machines. This type of motor for operating sewing machines and other special use has attained great popularity on account of its high efficiency and durability. Iron-clad armature, silk insulation on armature wire, hard-drawn copper commutator bars, self-aligning and self-oiling

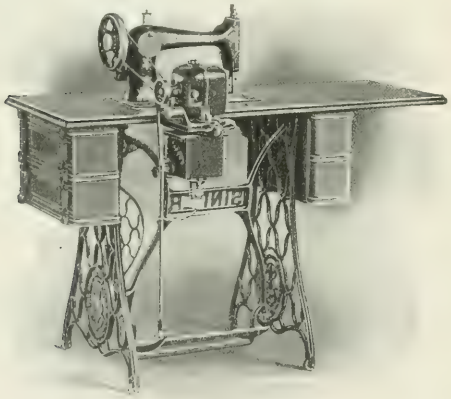


FIG. 1.—SEWING-MACHINE MOTOR.

bronze bearings are prominent features. Fig. 1 shows the motor with brake attachment and speed regulator supported by an iron bracket, with belt tightener. Different speeds are obtained by pressing the treadle downward, and the current is automatically cut off and the machine instantly stopped by removing the pressure from the treadle. There are different styles of brackets for any make of family or manufacturing machine.

Fig. 2 shows an ingenious arrangement by which the motor with brake attachment and speed regulator can be applied to a drop-head machine without any changes being made on the machine except to remove the band wheel from the stand. An idler with a gravity catch and belt tightener is included in this outfit. The idler guides the belt

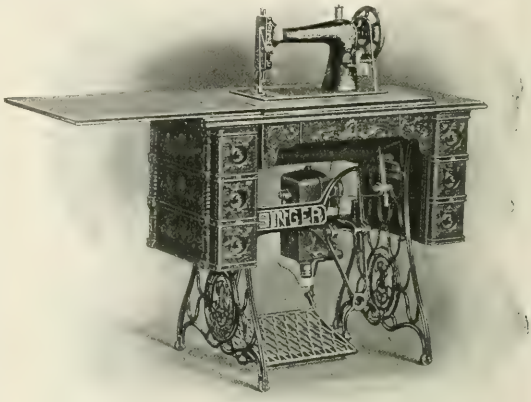


FIG. 2.—SEWING-MACHINE MOTOR.

through the holes in the lifting plate, and the gravity catch releases the belt when the machine head is lowered into the cabinet.

New Vertical Spindle Milling Head.

We show herewith a half-tone and sectional view of a new vertical spindle milling head for use on heavy-knee types of milling machines, the former showing the head attached to a machine, and the latter, which is a section on a vertical plane through the horizontal and vertical spindles, indicating the construction and size. Although the views are self-explanatory, a word relative to method of adjusting the spindle may not be out of place.

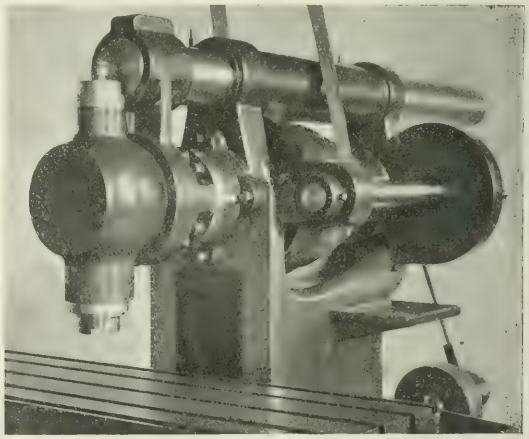


FIG. 1.—VERTICAL MILLING HEAD.

The spindle is taper at its lower end, where it runs in a babbitted bearing, and is adjusted to this bearing by means of a lock nut on its upper end. The upper box is bronze, split, and taper on its outside. It is adjusted to the end of the spindle by means of the lock nut on the box. This method of adjustment is the same as that used on the horizontal spindle of the machine. The head can be swiveled in a vertical plane through 360 degs. The circle bearing the graduation is divided into degrees and is 8⅝ inches in diameter, which size is important in that it brings the graduations far apart. A notable feature is the method of securing the cutter shanks in the spindle. The

cutter shanks form the male part of a clutch, of which the spindle is the female, this taking the place of the usual tang on the end of the shanks. In this case the ends of the shanks are tapped ⅝ to 11, to fit the bolt shown, and by which they are firmly secured. The bolt is provided with a shoulder near its head, so it can be used for backing a shank out as well as for drawing it in.

The end of the spindle is threaded on the outside, as in the case of the end of the horizontal spindle of the machine, and both spindles have the same size taper hole so that all tools are interchangeable between the two spindles. With this attachment the horizontal spin-

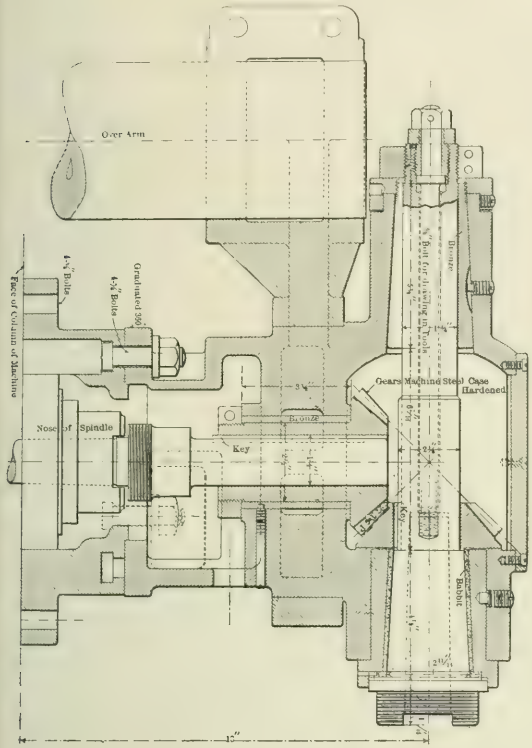


FIG. 2.—SECTION OF VERTICAL MILLING HEAD.

dle miller is readily converted into a vertical spindle miller, capable of doing heavy work, thus embodying in one machine the advantages of both. It will work a 6-inch diameter face mill in cast iron.

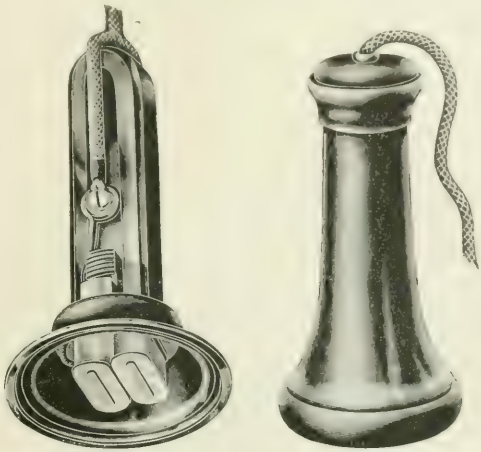
When there is occasion to change cutters while the work is chucked on the machine, the head can be swung at an angle, and the operator has all the room he wants for making the change. This obviates the awkward position which so often arises from a lack of room for changing cutters on the usual vertical spindle miller. This attachment is made by the Cincinnati Milling Machine Company, and is especially designed for use on their No. 3 and No. 4 machines.

An Improved Telephone Receiver.

An improvement in telephone receiver construction is shown in the accompanying illustrations, Fig. 1 being a view of a receiver with its case removed, and Fig. 2 the receiver complete.

The absence of binding posts at the end of the instrument is the first thing to attract attention. As will be seen in Fig. 1 the connections are made inside of the instrument, and are independent of the case. It is evident, therefore, that if the shell is damaged or broken by accident it does not necessarily impair the operation of the instrument. The insulation of the connecting cord, it will be noticed, is continuous up to the point of connection with the magnet terminal wires. The case, therefore, is simply a protection for the operative parts of the instrument, just as a watch case is a protection for the works of a watch.

The Russell-Tomlinson Electric Company, of Danbury, Conn., the manufacturer, calls attention to several points in favor of this telephone, among which may be mentioned its immunity from any disorders due to atmospheric changes on account of its being made entirely of metal; absence of binding posts, which are prone to work loose and harbor loose connections; the working parts are screwed



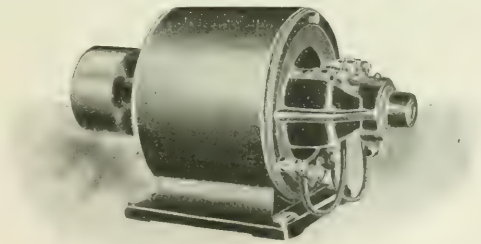
FIGS. 1 AND 2.—TELEPHONE RECEIVER.

into the shell, and when the cap is in position it becomes a check nut, thereby rigidly holding the parts in the case, and, finally, the fact that the entire removal of the shell does not impair the usefulness of the instrument.

Shielded Type Motors.

The accompanying illustration shows a shielded type of direct-current motor manufactured by the Sterling Electric Motor Company, Dayton, O. This motor is wound for 110, 220 and 500 volts, and develops ½ hp at medium speed, ¼ hp at slow speed, and ⅛ hp at very slow speed. It embodies new magnetic, electrical and mechanical features, each of which, it is stated, contribute to the efficiency of the machine. The armature is built up of stampings from specially prepared steel sheets, the conducting wires being held in place in the slots by strips of bamboo. The company calls attention to the yoke of this machine, which is made of a special iron very dense and of even composition, and has a very high permeability.

The commutator is of the standard design and construction, and the brushes used are of high-grade carbon or graphite, rectangular



SHIELDED TYPE MOTOR.

in form, and have a universal adjustment by means of the brush holder.

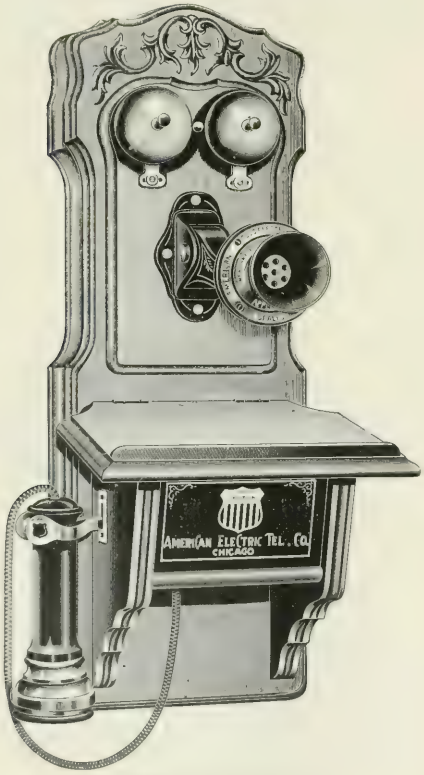
These motors may be fastened to a column, side wall or suspended from a ceiling, the turning of the journals in their seats being the only necessary adjustment in case of a change. It is stated that these machines run with almost entire absence of noise and are so well constructed mechanically that there is practically no vibration when the machines are in operation.

New "American" Telephone Apparatus.

One of the latest types of telephone apparatus made by the American Electric Telephone Company is shown herewith. In designing this set it was the purpose to produce an instrument that would, by means of a superior form of construction, overcome a number of objectionable features. The switch-hook is accessible by lifting up the cover which at the same time forms a writing tablet support. For a ready examination of the signal bell and condenser, the removing of a screw permits the swinging outward of that part of the telephone which contains the signal bell, switch-hook, the writnig tablet and the transmitter with its supporting arm. The swingable portion is hinged to a back board containing the condenser, the lightning arrester and line connecting terminals. Thus with the telephone cabinet opened up we have the condenser, line terminal and lightning arrester accessible as well as the signal bells.

All the wires and connections required for interconnecting all of the elements contained in the telephone are exposed for the purpose of inspection or repairs. All the parts have been symmetrically designed, and the lightning arrester, the switch-hook, the telephone receiver, the signal bell are of high grade and efficient construction.

In the design and construction of the new long lever automatic switch-hook, several novel features have been incorporated. The hook is self-contained, the working parts being mounted on a solid



A RECENT TYPE OF TELEPHONE.

casting. There is no electrical connection through the lever joint, the main spring acting as a switching device. All contact points are platinum tipped, ensuring freedom from bad connections or poor contact.

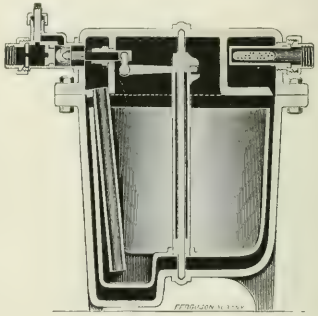
The gold electrode transmitter applied to this telephone is an interesting device, the object being to produce a transmitter that is extremely sensitive, and at the same time one that would give clear and perfect articulation, with sufficient power to insure successful conversation over lines of either extremely high resistance or those having a combination of high resistance and a large number of bells bridged across the lines. The diaphragm proper is of metal, having its inner bearing on springs and held in such a way that the entire surface is vibrated instead of the vibration radiating from the center, as in the case where the diaphragm is firmly clamped at its edges. The shell or casting is made of material with sufficient weight to prevent vibration taking place anywhere, excepting at the diaphragm.

High Pressure Non-Return Steam Trap.

The trap shown herewith has been designed by the Albany Steam Trap Co., Albany, N. Y., for use in connection with high-steam pressures and differs materially from the usual type of non-return steam trap, both in construction and operation. The great difficulty with non-return steam traps used with high-steam pressure, has been the rapid wearing away of the discharge valve and its seats, due to the great velocity of the condensed water escaping from the trap cylinder to the atmosphere, which is about 120 ft. per second for 100 lbs. pressure, increasing to about 140 ft. per second for 150 lbs. pressure.

This high velocity requires the use of a very small orifice for the discharge of the condensed water from the trap cylinder. A trap having a capacity for handling, say, 10 gallons of water a minute working under from 100 to 150 or 160 lbs. pressure, needs not have a discharge opening greater than from one-eighth to three-sixteenths of an inch in diameter. In designing the trap illustrated the advantage of the velocity in discharging a large quantity of water through a small opening, is availed of and forms an important feature of the trap. At the same time the discharge valve proper of a trap of this size, instead of being small, is fully three-quarters of an inch in diameter.

Inside of the trap case or shell, is contained a movable open top bucket which operates the discharge valve. This is so operated that it remains on its seat until the bucket has filled with water, when it drops through several inches of space to the bottom of the trap case, and in dropping opens or removes the discharge valve from its seat



STEAM TRAP.

fully three-eighths of an inch. Were it attempted to leave this three-quarters of an inch opening free for the escape of the water to the atmosphere with the great pressure of steam in the trap, the latter could be emptied of the remaining water in about 3 seconds, when it would blow steam until such time as the bucket could be floated high enough to close the valve. This, however, is prevented by placing in the discharge pipe or valve case proper, a thin disk of metal having in it a hole of one-eighth or three-sixteenths diameter, through which the water much escape before reaching the atmosphere, thus insuring time for the bucket to rise and close the discharge valve.

It will readily be seen that the advantage of this construction and operation is two fold. First, the wear caused by the great velocity of the water escaping to the atmosphere is not on the valve proper, but in the small metal disk, and this disk can be removed and renewed in a few minutes' time at a slight cost. Second, the velocity through the valve opening is reduced to about one-fortieth less than it would be with the small opening, or where the discharge valves are gradually opened enough to allow the gradual escape of the condensed water. It follows that the discharge valve in this trap working under the conditions described should remain in good condition 40 times longer than the ordinary valve working under ordinary circumstances.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 4 per cent nominal, and time money at 4 per cent for 60 to 90 days; 4¼ per cent for four months and 4¼ or 4½ for five and six months. In the main, there was a strong tone in the stock market in spite of a certain amount of irregularity in its movements. The unsteadiness of Amalgamated Copper shares was the only decided bearish manifestation, but the general market was not affected by it. The traction stocks were a leading feature, Manhattan making a new record by advancing to 138½. Metropolitan also held strong, but Brooklyn Rapid Transit was neglected and irregular, with a downward tendency. Eighty-eight thousand four hundred and fifty shares of Brooklyn Rapid Transit changed hands during the week at prices ranging between 63½ and 68½, the closing price being 64, a net loss of 3½ points. Manhattan Street Railway closed at 166⅛, representing a net loss of 2⅞ points on the week's transactions, which aggregated 21,700 shares. General Electric was the feature of the electric securities, and this stock was active, the sales amounting to 15,000 shares. The closing price was 277½, which was 14½ points higher than our last previous quotation, the range for the week being between 264 and 281½. Western Union, on a fair business, kept within a narrow margin of prices, closing at 91½, a net gain of ⅛ point. One hundred shares of Commercial Cable was sold during the week, the closing price being 183, which is a net gain of 1¾ points over the last quotation. Following are the closing quotations of Tuesday, Dec. 3:

NEW YORK.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
American Tel. & Cable..	-	—	General Electric.....	274	276¼
American Dist. Tel.....	-	—	General Carriage.....	⅛	1
Brooklyn Rapid Transit..	67½	63	Hudson River Tel.....	112	112
Ches. & Pot. Telephone..		67	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....		—	Metropolitan Street Ry...	167¾	164⅛
Electric Boat.....	20½	19	N. E. Elec. Veh. Tran....	-	—
Electric Boat pfd.....	47	45	N. Y. Elec. Veh. Tran...	9¼	11
Electric Lead Reduc'n...	2	1⅞	N. Y. & N. J. Tel.....	166	167
Electric Vehicle.....	2	2¾	Tel. & Tel. Co. of Am...		—
Electric Vehicle pfd.....	4¼	5	Western Union Tel.....	91⅛	91⅛

BOSTON.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
Am. Tel. & Tel.....	160	160	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	133*
Boston Electric Light...	—	—	Westinghouse Elec.....		—
Erie Telephone.....	24	16	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
American Railways.....	45½	44⅝	Phila. Traction.....	97½	97½
Electric Storage Battery..	58	64	Philadelphia Electric.....	5	4¾
Elec. Storage Batt'y pfd..	58	64	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America.....	6½	6⅜	Pa. Elec. Veh. pfd.....	1	1

CHICAGO.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
Central Union Telephone	—	—	National Carbon pfd.....	83	83
Chicago Edison.....	155	160	Northwest Elev. com....	36	—
Chicago City Ry.....	188	185	Union Traction.....	11⅜	—
Chicago Telep. Co.....	225*	—	Union Traction pfd.....	47¼	—
National Carbon.....	19½	19			

*Asked.

SEATTLE ELECTRIC REORGANIZATION.—The Seattle Electric Company is capitalized for $4,518,000 5 per cent bonds, $1,750,000 6 per cent non-cumulative preferred stock and $5,000,000 common stock and representing this capitalization the company has about 70 miles of electric road—a consolidation of several companies—and an electric light and power plant. About one-third of the earnings are derived from the electric lighting plant and two-thirds from the railroad properties. The city of Seattle is showing an increase in population between 20 and 30 per cent for the past few years. This has naturally been reflected in the earnings of the Seattle Electric Company. The company began the payment of dividends on its preferred stock this spring, 1½ per cent having been paid in April and 3 per cent in October, and the management sees no reason why this 6 per cent rate cannot be indefinitely maintained. The company is just beginning to receive the benefits through reduced operating expenses. While the properties were passing through the transition period expenses were abnormally high. The company owns a valuable coal mine within 15 miles of Seattle, which assures a cheap fuel supply. The stock of the Seattle Electric Company is mostly owned in Boston, principally in large blocks. Messrs. Stone & Webster are the general managers of the company.

GENERAL ELECTRIC PROSPERITY.—The General Electric Comapny has made a remarkable record of earnings the past few years, as the following figures will show, but never before in its history has it been able to show earnings of $1,000,000 net per month, as it did in October, and promises to do in November and December. Its earnings since 1898 have been as follows:

Year.	Gross.	Net.	Surplus after charges.
1898.....	$13,045,098	$2,148,520	$1,815,185
1899.....	17,260,858	4,166,324	3,876,324
1900.....	24,406,068	5,479,131	5,197,464
1901.....	29,829,652	6,243,792	6,167,092

For the year to end Jan. 31, 1902, the company will show net earnings in excess of $8,000,000. When the company is able to restore its capital next April to $42,000,000 it is believed that the management will immediately place the stock on a 10 per cent dividend basis. Net earnings of $8,000,000 per annum would amount to about 20 per cent on $42,000,000 of capital.

INDEPENDENT TELEPHONY AT TRENTON, N. J.—The plant and franchise of the Home Telephone Company (independent), of Trenton, N. J., which furnished local service at considerably lower rates than those charged by the Bell Company, have been sold at auction under foreclosure for $20,000. After the foreclosure and receivership expenses have been paid, bondholders can hardly expect to receive more than from 5 to 10 per cent upon the par value of their holdings. The company was organized something less than five years ago, when $300,000 in equal amounts of first mortgage bonds and capital stock were issued and sold to local investors. For the first year it was claimed that the company was making money and in a prosperous condition. At the end of that time, however, it found its earnings were not sufficient to pay its expenses, and was forced to borrow money from time to time to make up the deficiency. For the past two years no interest has been paid on the bonds, and the bondholders finally foreclosed and had a receiver appointed and the property sold with the above result.

NEW YORK STATE TROLLEYS.—A certificate of consolidation of the Utica Belt Line Street Railroad Company and the Utica & Mohawk Railroad Company, forming the Utica & Mohawk Valley Railway Company, has been filed with the Secretary of State. Capital, $461,237.50. Directors: L. B. Grant, Charles V. Nellsay, Charles C. Clark, John T. Wells and Henry L. Merry, of Brooklyn, and Richard T. McKinvy, Ashley T. Cole, Charles H. Warner and William J. Bagnell, of New York City. The Kingston Consolidated Railroad Company has received the consent of the State Board of Railroad Commissioners to the issuance of a mortgage for $700,000 and for an increase in its capital stock from $250,000 to $400,000. The company merged the former Colonial Traction Company, of Kingston, and will employ the increased capital in the purchase of the Kingston City Road, and for new construction.

CINCINNATI GAS & ELECTRIC.—The stockholders of the Cincinnati Gas & Electric Company will vote Jan. 8, 1902, upon a proposal to increase the capital stock of the company from $28,000,000 to $29,000,000. The stock is to be retained in the treasury and only to be sold at the market price when necessities for increase may arise. The extensions of the company during the past six months have been enormous. This increase is more or less a surprise, though the large buildings, the additions to the plant, the replacing of the overhead wires by the underground system and the large extensions to the electrical plants, made the matter of more stock but a question of time. The company was organized in the spring and was the result of the consolidation of the Cincinnati Gas Light & Coke Company, and the Cincinnati Edison Electric Company, absorbing every electric lighting station in the city.

GENERAL CARRIAGE COMPANY.—General Carriage stock has been active on the New York curb, advancing from ⅜ to ½ on sales of around 2000 shares. As previously announced, a new company is to be formed with total authorized capital of $2,000,000, consisting of 40,000 shares of $50 par value each, and it will issue $500,000 5 per cent debenture bonds, of which $400,000 will be sold at par to provide the means of putting the company into active business in New York City.

DIVIDENDS.—The directors of the American District Telegraph Company, of Brooklyn, have declared the usual semi-annual dividend of 3½ per cent, payable Dec. 10. Directors of the Massachusetts Electric Companies have declared the regular semi-annual dividend of $2, payable Jan. 1 to stockholders of record Dec. 10.

CANTON-MASSILLON TROLLEY.—The Elkins-Widener syndicate has purchased the Canton-Massillon Electric Railway property, paying $1,250,000. It is 13 miles long. The Canton electric plant was purchased some time ago.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable reports were made through the mercantile agencies during the past week from most all sections. The needed stimulus to retail and holiday demand in the North, East and portions of the South seems to have come with the advent of more seasonable weather. The great basic conditions of wholesale trade and industry, however, show no particular change, though in iron and steel the situation is apparently further strengthening the position of producers. There has been no perceptible change in the car shortage situation; indeed, it has been aggravated somewhat by the switchmen's strikes at several points. A number of furnaces in the Pittsburg district are banked and several mills are idle from lack of supplies. In finished products, bars, sheets and structural material are all active. It is stated that the big steel interests have plenty of cars, but not enough power to move them. The buying of railway supplies is the most urgent feature of the market, rails, cars, engines, structural material for bridges and shop equipments all being wanted much earlier than they can be delivered. In general lines the movement is scarcely less active, and despite the vigorous prosecution of work since the end of the big strike, there is no evidence that mills have gained on their orders. In the copper market there were rumors of a prospective cut in the prices, but these proved to be unfounded up to the close of the week. Owing to the depreciation of the principal copper stock, interest in the copper situation has become more acute, but as to active trade conditions the situation is unchanged. The prices remain practically unchanged at 16¾c. for Lake, 16.30c. to 16⅝c. for electrolytic, and 15⅝c. to 16⅝c. for casting stock. The number of business failures last week, according to *Bradstreet's*, aggregated 189, as against 225 the previous week and 184 the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Nov. 27: Antwerp—15 pkgs. material, $616; 31 pkgs. machinery, $3,132. Argentine Republic—111 pkgs. material, $2,954. Bristol—26 pkgs. machinery, $7,710. Brazil—65 pkgs. machinery, $7,840; 85 pkgs. material, $517. British Guiana—18 pkgs. material, $583; 50 pkgs. wire, $95. Bordeaux—1 pkg. material, $50. Bilboa—1 pkg. electrical material, $50. Birkenhead—22 pkgs. wire, $1,242. British East Indies—6 pkgs. material, $230. Bolivia—2 pkgs. material, $96. British West Indies—17 pkgs. material, $424; 6 pkgs. wire, $26; 5 pkgs. motors and parts, $927. British Possessions in Africa—80 pkgs. material, $4,465; 1 pkg. wiring machinery, $396. Cardiff—25 pkgs. wire, $1,391. Central America—4 pkgs. material, $185. Cuba—1 pkg. machinery, $100; 177 pkgs. material, $6,976. Chili—66 pkgs. material, $150; 16 pkgs. machinery, $150. Glasgow—15 pkgs. machinery, $895; 37 pkgs. wire, $2,671; 10 pkgs. material, $427. Genoa—5 pkgs. material, $500. Havre—5 pkgs. material, $131; 1 pkg. machinery, $45. Hamburg—3 pkgs. machinery, $229; 57 pkgs. material, $2,077; 291,610 lbs. copper, $47,859. Hull—15 pkgs. machinery, $21,048. Ipswich—12 pkgs. wire, $491. Japan—3 pkgs. machinery, $1,320; 34 pkgs. material, $5,384. Leeds—1 pkg. material, $250. Liverpool—188 pkgs. machinery, $10,409; 40 pkgs. material, $2,669; 561,230 lbs. copper, $93,728; 76 pkgs. wire, $1,305. London—348 pkgs. material, $12,585; 91 pkgs. machinery, $3,854. Leicester—7 pkgs. machinery, $210. Manchester—10 pkgs. material, $190; 104 pkgs. machinery, $14,015; 448,208 lbs. copper, $74,000. Mexico—32 pkgs. material, $984; 44 pkgs. machinery, $4,000; 50 pkgs. wire, $1,000. New Castle—14 pkgs. machinery, $1,993. Nice—2 pkgs. material, $200. Odessa—106 pkgs. agricultural implements, $1,600. Philippines—25 pkgs. material, $1,403. Peru—34 pkgs. material, $461; 20 pkgs. copper wire, $750. Rome—6 pkgs. material, $500. Rotterdam—2 pkgs. machinery, $135. San Domingo—71 pkgs. material, $420. St. Petersburg—1 pkg. material, $24. Southampton—3 pkgs., material, $93. U. S. Colombia—5 pkgs. material, $126. Venezuela—17 pkgs. material, $269. Vienna—21 pkgs. machinery, $860.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., is being pushed to the utmost to keep up with the large number of orders it is daily receiving and has on hand. It is constantly adding to the number of factory hands, and has for some months been working a regular night shift. Among shipments made during the last month are two 520-kw generators for the American Smelting & Refining Company, Perth Amboy, N. J.; three 400 kw and one 100 kw for the Alsen Cement Plant, West Camp, N. Y.; one 400-kw generator for the Christensen Engineering Company, Milwaukee, Wis.; one 300-kw generator for the Balbach Smelting & Refining Company, Newark, N. J.; three 200-kw generators for the Stetson & Co.'s new power plant, Philadelphia; one 375-kw generator for the Anglo-American Provision Company, Chicago; one 400 kw and one 75 kw for the Lake Shore & Michigan Southern Railroad; one 200-kw generator for the Vandergrift Construction Company for railroad work; one 200-kw generator for the Crucible Steel Company, of Blair, Pa.; one 150-kw generator for Latrobe Steel Company; one 200 kw for the Otis Elevator Company and one 100-kw generator for the United States Tube Company. The company has also completed the entire shipment of the 45-kw direct-connected generator, and 50 or 60 motors for the Government Printing Office in Manila, Philippine Islands. Among the orders recently received are noted the following: Two 300-kw generators for the Singer Manufacturing Company, South Bend, Ind.; two 200-kw belted generators for Sayre & Fisher, Sayreville, N. J.; one 60 and one 30-kw generator for the Orange Brewing Company, with various motors ranging from 35 to 2 hp in capacity; four 140-kw generators for the Fort Hill Chemical Company, Rumford Falls, Me.; two 75-kw generators for Henry Lang & Co., Newark, N. J.; one 90-kw generator for the United States Electric Lighting Company, Washington, D. C. Shipments of 13 motor-dynamos for the Western Union Telegraph Company's new office at Milwaukee, and the electrical equipment of Skinner & Sethman Publishing Company's plant, Denver, Colo., consisting of a 40-kw generator and 28 motors will also be made immediately.

EXPORTATION OF MANUFACTURES from the United States continues to show a healthy growth in nearly all important articles, except copper and iron and steel. The export figures just made public by the Treasury Bureau of Statistics show that in the ten months ending with October, exports of copper have fallen about $23,000,000, and of iron and steel about $23,000,000, making a total reduction in these two classes of $46,445,685. The total reduction in exports of manufactures of all kinds during the same time is only $44,162,856, thus showing an increase in the exportation of manufactures as a whole, exclusive of these two articles, copper and iron and steel. The value of copper exports in the ten months ending with October is 45½ per cent below that for the corresponding months of the preceding year, and the value of iron and steel exports is 21½ per cent below that for the corresponding months of last year. In the other manufactures, taking the entire group, except copper and iron and steel, there is, as already indicated, an actual increase. In the case of iron and steel the reduction is partly due to reduced prices per unit of quantity, in part to a reduced demand abroad, and in part to forced sales at low rates in certain foreign countries. In copper the reduction is not due to reduced prices, the average value per pound of the copper exports of the ten months of this year being the same as that of the corresponding months of last year, viz., 16.3 per cent per pound. The reduction in copper, therefore, is in quantity, the exportation of ingots, bars and plates falling from 300,160,141 lbs. in the ten months of 1900 to 162,728,397 lbs. in the corresponding months of 1901. This falling off in the case of copper is due in part to a reduced demand in the European countries which were the chief foreign market for American copper, and in part to an increased production in other countries and reduction of prices by foreign producers. The only other important article showing a material reduction is mineral oil, which is about $3,000,000 less than in the corresponding months of last year, but this decrease is solely due to reduced prices,

THE HAINES & NOYES COMPANY, manufacturer of telephone apparatus for every possible use, 118-132 West Jackson Boulevard, Chicago, has during the past month closed the following large contracts through its private telephone plant department: The Manistee Iron Works, Manistee, Mich.; Story & Clark Piano Company, Grand Haven, Mich.; David C. Cook Publishing Company, Elgin, Ill.; College of Physicians and Surgeons, Chicago; Rush Medical College, Chicago; Wesley Hospital, Chicago; Evanston Hospital, Evanston, Ill.; St. Anne's Hospital, Chicago; Elmes Engineering Works, Chicago; Tampa Electric Company, Tampa, Fla., Electric Railway Telephone Equipment; Houghton County Street Railway Company, Hancock, Mich.; Blue Hill Street Railway Company, Milton, Mass. It has also supplied Armour & Co., of Chicago, with a large outfit of telephones, besides replacing a number of telephones that were formerly used there. Through agents the Haines & Noyes Company has also equipped a large number of business houses in Lynn, Mass.; Philadelphia, Pittsburg, Louisville, Boston, Kansas City, St. Paul, San Francisco, Los Angeles, etc. Besides these plants, this company has equipped a number of private residences with telephone systems, as well as numerous apartment buildings throughout the United States.

THE ARROWSMITH ELECTRIC CO., LTD., Reading, Pa., a large electrical construction company, has opened a branch house at Harrisburg for the purpose of facilitating its growing business in central Pennsylvania. Its working force is strong. C. H. Hill, formerly of the Prismatic Electric Sign Company, of Syracuse, N. Y., has assumed the local management, with Maxwell H. Hite as assistant and foreman of construction and repairs. The office, wholesale and retail departments are looked after by Eugene Gallagher, formerly of the Prismatic Electric Sign Company. The company reports good business and bright prospects, and is working its facilities day and night to keep pace with orders. Mr. A. V. Arrowsmith visited New York recently, where he purchased a large line of electrical supplies and novelties for the Harrisburg and other branches of the concern.

RECIPROCITY—President Roosevelt, in his message to Congress, approves the general acquiescence in the present tariff as "the first requisite to our prosperity," and adds: "Yet it is not only possible but eminently desirable to combine with the stability of our economic system a supplementary system of reciprocal benefit and obligation with other nations. Such reciprocity is an incident and result of the firm establishment and preservation of our present economic policy. It was specially provided for in the present tariff law. Reciprocity must be treated as the handmaiden of protection. Our first duty is to see that the protection granted by the tariff in every case where it is needed is maintained, and that reciprocity be sought for so far as it can safely be done without injury to our home industries. Just how far this is must be determined according to the individual case, remembering always that every application of our tariff policy to meet our shifting national needs must be conditioned upon the cardinal fact that the duties must never be reduced below the point that will cover the difference between the labor cost here and abroad. The well-being of the wage-worker is a prime consideration of our entire policy of economic legislation. Subject to this proviso of the proper protection necessary to our industrial well-being at home, the principle of reciprocity must command our hearty support. The phenomenal growth of our export trade emphasizes the urgency of the need for wider markets and for a liberal policy in dealing with foreign nations. Whatever is merely petty and vexatious in the way of trade restrictions should be avoided. The customers to whom we dispose of our surplus products in the long run, directly or indirectly, purchase those surplus products by giving us something in return. Their ability to purchase our products should, as far as possible, be secured by so arranging our tariff as to enable us to take from them those products which we can use without harm to our own industries and labor, or the use of which will be of marked benefit to us.

TRADE WITH JAPAN.—The annual return of the foreign trade of the Empire of Japan for the year 1900, which has just reached the Treasury Bureau of Statistics, shows that the growth in American imports into Japan during the decade has been far greater than that of any other nation. The total value of imports from the United States into Japan in 1900 was, according to this official publication of the Japanese Government, 62,761,196 yen, against 6,874,531 in 1890, being thus nearly ten times as much in 1900 as in 1890. That this growth of imports from the United States has been far in excess of that of other countries, or of that of the average, is shown by the fact that the total imports of Japan are but 3½ times as much in 1900 as in 1890, while those from the United States are, as already indicated, nearly ten times as much in 1900 as in 1890. The total imports of Japan in 1900 are 287,261,845 yen, against 80,554,874 in 1890. Comparing the growth in the imports from the United States with those from other countries, the gains from the United States are equally apparent. The imports from Germany increased from 6,856,955 yen in 1890 to 29,199,695 in 1900, the figures for 1890 being almost identical with those of the United States, while in 1900 they are less than half of those of the United States. From Great Britain the imports in 1890 were 26,619,102 yen, and in 1900 71,638,219, having thus been four times as much as those from the United States in 1890, while in 1900 they exceeded those from the United States by about 15 per cent only.

WATER POWER DEVELOPMENT IN MICHIGAN.—A project is on foot to furnish to the manufacturing plants of Grand Rapids, Mich., electric power generated at the rapids in Muskegon River, half way between Muskegon and Big Rapids. The Higginbothams, of Chicago, control or own practically all of the rights on Muskegon River between the two cities named. It is understood that the Edison Light Company, of Grand Rapids, has been approached with an offer to enter into an arrangement in this connection. The Edison company now controls the field in Grand Rapids, having recently absorbed the Grand Rapids Electric Light & Power Company by purchase. It is not the idea of the Higginbothams to compete with the Edison company, but rather to secure the co-operation of the company. There is a large amount of available water power in the river at the point referred to, which is about 40 miles from the city, and a small part of it is now used to supply power to manufacturing industries in Newaygo. There appears to be no question at all about the feasibility of the plan, and it will undoubtedly be put through in one form or another provided the city is able to care for the enterprise to a sufficient extent to make the investment pay.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY.—Harry Shafer, formerly manager of the Stromberg-Carlson Telephone Manufacturing Company, has severed his connection with that company to organize a new telephone manufacturing and construction company to be known as the International Telephone Manufacturing Company. The factory, which is at Harrison and Clinton streets in Chicago, is being fitted out with up-to-date machine tools, and the new company will make all kinds of telephones and switchboards for both public and private exchanges. Mr. Shafer is president of the company. W. E. McCormick, the vice-president, who will have charge of manufacturing, is the inventor of the numerous new features upon which patents have been allowed, and which will be incorporated in the apparatus produced. Mr. McCormick is an old Bell man. John C. Burmeister is secretary, and D. A. Clithere counsel. The factory is starting at present writing, and will soon be in full swing.

EQUIPMENT AND SUPPLIES FOR FAR EAST.—The American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, Manila and Singapore, continue to place fair-sized contracts for various electrical equipment in the United States. The Skinner Engine Company, of Erie, Pa., recently secured a contract from the Yokohama office, calling for two fair-sized engines for installation in a Tokio electrical plant. The General Electric Company is building a 300-kw generator for the Kobe Dockyards; the Adams-Bagnall Electric Company, of Cleveland, Ohio, has obtained an order for several hundred globes, etc., which are intended to be shipped to Singapore; and the New York Insulated Wire Company, 15 Cortlandt Street, has a contract for tape, to be forwarded to the same part of the world. The Gibson Gas Fixture Works Company, of Philadelphia, have also got an order on hand for electric fixtures to be shipped to the Straits Settlements.

CONTRACTS PENDING FROM HONG KONG.—Mr. W. G. Winterburn, general manager of G. B. Fenwick & Co., which concern operates a large foundry and general machine shop in Hong Kong, China, has been in the United States for the past two months. He has been inspecting our various shop methods and gathering data with a view to the re-equipment and extension of the Fenwick works, which would include the extensive use of electric transmission machinery, etc. He left New York last week en route for China via San Francisco. Very shortly after his arrival in Hong Kong it is anticipated that some substantial contract will be dispatched to manufacturers on this side.

LARGE BUCKEYE ENGINES FOR TAMPA (FLA.) PLANT.—The Buckeye Engine Company, of Salem, Ohio, and 39-41 Cortlandt Street, New York, has just secured a contract valued at over $100,000 for two 1800-hp cross compound condensing engines, together with three similar type of engines of 300 kw each. This equipment will be installed at Tampa, Fla., where the engines are to drive the general power station in that Southern city. The Buckeye plant is stated to have been working day and night since 1893. This is claimed as the record for continuous operation of any manufacturing plant in the country.

WESTINGHOUSE GAS ENGINES AND ELECTRIC GENERATORS.—Westinghouse, Church, Kerr & Co. have secured a contract calling for the supply of two 175 brake-hp and the same number of 125 brake-hp, three cylinder Westinghouse gas engines, which will be direct connected to two 110-kw and two 75-kw generators to be built by the Westinghouse Electric & Manufacturing Company for installation in the new Keystone Bank Building, Pittsburg, Pa. The equipment, which will be one of the largest plants of its description in the country, will be utilized for electric lighting and power purposes.

PACIFIC COAST ELECTRICAL EXPORTS.—For some time past this Department has recorded the electrical exports from New York port. There has now sprung up, however, a considerable export trade via San Francisco. During the month of October the exports of electrical material from the port of San Francisco reached a valuation of no less than $14,328. We propose recording these exports month by month in addition to our weekly reports for the port of New York.

BIG BUCKEYE-GENERAL ELECTRIC EQUIPMENT.—The New York, New Haven & Hartford Railroad Company's new power station at Berlin, Conn., is to be equipped with two 1400-hp cross-compound condensing Buckeyes the same number of condensers each having a capacity of 25,000 lbs. and independent beam air pumps of 25 by 18 dimensions. The generators of 1000 kw capacity each are to be furnished by the General Electric Company.

THE BALL ENGINE COMPANY, Erie, Pa., has recently furnished a 175-hp engine for electric power to the Modoc Coal & Mining Company, Jacksonville, Ohio. The American Ordnance Company, Bridgeport, Conn., recently purchased a 300-hp tandem compound direct-connected engine from the Ball Company. The Evansville Water, Light & Power Company, Evansville, Wis., is installing a Ball engine.

LIGHTING PLANT FOR HOBOKEN CONCERN.—The Hoboken Land & Improvement Company has just placed orders for one 75-hp and one 60-hp simple horizontal Buckeye engines, for electric lighting, direct connected to 50-kw Westinghouse and 60-kw Lundell generators, respectively.

SUBWAY POWER STATION.—The Rapid Transit Subway Construction Company has purchased a site on East Nineteenth Street, New York, for a sub-power station to cost from $60,000 to $70,000.

THE EUREKA TEMPERED COPPER WORKS.—North East, Pa., has just shipped a large order of gauze brushes to Amsterdam, Holland.

Telephone News and Notes.

SCOTTSBORO, ALA.—W. L. Moody and several others are putting in an independent telephone system.

CORNING, ARK.—The Corning Telephone Company will extend its lines and have long distance connection in the near future. It uses a Western Electric 100-drop board and has 85 subscribers. Growth is normal and prospects bright.

BLACK ROCK, ARK.—Messrs. Anderson and King operate five switchboards of 500-drop capacity and have 100 subscribers. Fifty new instruments are projected and the outlook is very bright. They use apparatus of the American Electric Company.

CONEJOS, COLO.—The Extension Telephone Company uses apparatus of the Colorado Telephone Company, has a 20-drop board and 75 subscribers. Recent growth has been good and prospects are bright.

EAST HAVEN, CONN.—The East Haven Telephone & Electric Company uses apparatus of the Connecticut Telephone & Electric Company. The company has a 3-drop board and 36 subscribers.

TAMPA, FLA.—The Peninsular Telephone Company has increased its capital stock from $200,000 to $500,000.

STARKE, FLA.—The Starke Telephone Exchange is making excellent progress, having added 16 telephones lately, with probable increase to 100. Switchboard capacity is 100 drops with 76 subscribers. Rates, $1.50 per month. All this within three months, and in a small place shows great enterprise. Mr. M. G. Rowe is the manager.

DAYTONA, FLA.—We are indebted to the secretary of the Daytona Telephone Company for the following: It operates a 200-drop board with apparatus of the Kokomo Telephone & Electric Manufacturing Company, and has 100 subscribers. An exchange has recently been established at Sea Breeze, and another line is being built to De Land.

GAINESVILLE, GA.—The Dahlonega Telephone Company uses Bell apparatus; a 24-drop board and 8 subscribers. Extensions and local work are in progress and prospects are bright.

FORT GAINES, GA.—Mr. J. H. Haskins operates his line here with apparatus of various makes. He has a 100-drop board and 85 subscribers. A toll line to Eufaula, Ala., is contemplated.

MONTICELLO, GA.—Mr. Hecht, proprietor of the Monticello Telephone exchange, uses Sumter apparatus, a 100-drop board and 50 subscribers. Advance has been rapid and the future looks bright.

MURRAY, GA.—The Murray County Telephone Company has several miles of line and several stations. Victor and American electric apparatsu is installed. Mr. W. R. Davis expects that future railway improvements will give a stimulus to business.

WINDER, GA.—The North Georgia Telephone & Telegraph Company informs us, through Mr. Irwin, that a toll line to Atlanta is projected. A Southern Bell switchboard of 100 drops is operated, and it has 60 subscribers. Recent growth and future indications are good.

PASCHAL, GA.—The Union Telephone & Electric Light Company has a 110-drop board at Talbotton and one of 100 drops at Buena Vista. It uses American Electric & Western Telephone apparatus and has 275 subscribers, with an expected increase. We are indebted to Mr. Moore, secretary and treasurer, for the above information.

STREATOR, ILL.—The Streator Independent Telephone Company has increased its capital stock from $40,000 to $100,000.

BARRY, ILL.—The Adams-Pike counties and Hannibal Telephone Company will be incorporated, and will then try to build its line into Hannibal.

CORDOVA, ILL.—The Cordova Creamery Telephone Company is of recent formation. It operates a 10-drop board of American make and has 52 subscribers.

BRIMFIELD, ILL.—The Brimfield Telephone Company finds business pretty fair and the outlook good. It operates a 100-drop board and has a subscription list of 51.

DELAVAN, ILL.—The Boynton Mutual Telephone Company has installed apparatus of the Chicago Telephone & Supply Company. There are 20 subscribers and rates are $1 per month.

STANFORD, ILL.—The Stanford Telephone Company operates 275 telephones from a 100-drop American board. Its business is mostly rural, and there are probably 100 prospects in its territory.

MASCOUTAH, ILL.—The Kinloch Telephone Company is at work extending its line to O'Fallon from Belleville. After the completion of the O'Fallon line work will be commenced on the line to Mascoutah.

MARTINSVILLE, ILL.—The Martinsville Telephone Company operates a 200-drop board of the Western Telephone Construction Company make, and has 150 subscribers. The outlook is extremely promising.

FRANKFORT STATION, ILL.—The Northwestern Telephone Company has built a line from Mokena to Tinley Park and will build a toll line to Peotone. Also, a line will be built immediately east of Frankfort.

RIDGWAY, ILL.—The Gallatin County Telephone Company operates a 100-drop board of American make and has 168 subscribers. Toll service is $1 and $1.50 for residences and business places respectively.

HOPEDALE, ILL.—The Mutual Telephone Company has a 100-drop board with 175 subscribers. A large increase is projected; service and lines are first class. American and Stromberg-Carlson apparatus is used.

KIMMUNDY, ILL.—The Salem Telephone Company operates Chicago apparatus with a 200-drop board and 165 subscribers. Mr. Sims informs us that growth is steadily improving and that rural lines are projected.

HAMILTON, ILL.—The Farmers' Mutual Telephone Company operates a Central Union 100-drop board, and has about 50 subscribers. It puts up its own lines and rents telephones from the Central Union for $8 per year.

CARLOCK, ILL.—The Farmers' Telephone Company is in the hands of neighboring farmers, who build their own lines, one connecting with the other, and forming lines around Carlock, Hudson, Genoa and many other towns.

CARLINVILLE, ILL.—The Carlinville Telephone Company has extended its lines from Shipman to Plainview. The work of extending the lines to Carlinville is in progress, and will soon be completed, making a complete circuit of the country.

CERRO GORDO, ILL.—The Cerro Gordo Telephone Company, although in business only since last May, has prospered exceedingly, and expects a large increase the coming year. It uses Sterling apparatus, and has a 200-drop board with 160 subscribers.

BELLEVILLE, ILL.—The telegraph, telephone and electric light wires on the public square are to be put underground as soon as the City Council passes an ordinance directing it to be done, as the companies interested have given their assent to the proposed improvement.

MONMOUTH, ILL.—The Monmouth Telephone Company commenced operations July with 300 telephones; growth in four months, 205, with every prospect of an equal increase in the next four. A Sterling 500-drop board supplies 505 subscribers. Prospects could not be brighter.

SALEM, ILL.—The Salem Telephone Company has several exchanges and the increase in one of them, Sandoval, has been rapid. A toll line is also operated. With an 800 drop board, it has 758 subscribers, which number promises an early increase. Mr. Hull is the proprietor.

CHISTEN, ILL.—Mr. A. W. Gordon, of the Gordon Telephone Company, informs us of continued healthy growth in telephone business. He operates Stromberg-Carlson apparatus, with a 200-drop board, and has 220 subscribers. The principal work at present is connecting up farmers.

GREENVILLE, ILL.—The City Council has granted a franchise for a new telephone company to erect poles and wires and maintain an office in Greenville. The new line is to be operated in connection with the Kinloch system and the city is to receive 1 per cent of the gross earnings.

WARRENSBURG, ILL.—We are in receipt of the following from Mr. C. C. H. Cowen, manager of the Warrensburg Telephone Company. It is using Western Electric apparatus, it has a 50-drop board and 150 subscribers, including farmers on party lines. A large increase is projected.

MANHATTAN, ILL.—We are informed by Mr. Tennysen, of the Manhattan Telephone Company, that apparatus of various makers is used by his company. The switchboard capacity is 100 drops, having 10 bridging lines. The number of subscribers is 106. Good prospects of an increase.

STAUNTON, ILL.—The manager of the Staunton Telephone Company, Mr. Williamson, informs us that its Western Construction Company's apparatus has switchboard capacity of 200 drops. It has 140 subscribers and a large number in prospect. The company only commenced operations Jan. 1, 1891.

ROCHELLE, ILL.—The Ogle County Telephone Company informs us through Mr. A. A. Phelps that prospects were never better. With American Electrics and Stromberg-Carlson apparatus, it operates a 1000-drop board and has 800 subscribers. It also has stations at Oregon, Polo, Mt. Morris and other places.

CHICAGO, ILL.—The Chicago Telephone Company has recently been troubled by the cutting of wires in outlying parts of the city. The cutting is taking place striking linemen or their sympathizers. The work has interfered seriously with on the North, West and South Sides, and is generally believed to be the work of some of the suburban exchanges.

GALVA, ILL.—We are indebted to Mr. Wyberg, manager of the Galva Telephone Company, for details of his very successful enterprise. He operates Stromberg-Carlson apparatus. The switchboard has two sections of 100 drops each, and they accommodate 250 subscribers, while 60 more are to come in. Prospects and service satisfy all parties.

HARDIN, ILL.—The Calhoun County Telephone Company has decided to extend its lines into St. Louis. At a meeting of the directors of the company. The decision was reached to run the line by way of Grafton, and thence along the Illinois shore of the Mississippi River into St. Louis. This will give St. Louis three independent telephone lines to nearby points in Illinois.

MINIER, ILL.—The Mutual Telephone Company, of Minier, operates a 300-drop board, of which 225 are installed. The apparatus is of American and Stromberg-Carlson make. It has 430 subscribers, 245 of them on farms, and its territory covers six townships. The company consists of 12 business men who believe in low rates and small profits in view of other benefits arising from such arrangements.

CHICAGO, ILL.—President Sabin, of the Central Union Telephone Company, has sent to stockholders a report of the business done by months so far this year. The rental earnings in January were $126,411, and in October $153,770. It is estimated in the circular that the rental earnings for November will be $156,000 and in December $160,000. At the time of Mr. Sabin's connection with the company in April there were 75,341 stations. At the end of October there were 91,485, a gain of 16,144.

TELEPHONE NEWS.—(Continued.)

ANGOLA, IND.—The Farmers' Telephone Company, of Steuben County, has been incorporated with $1,500 capital stock.

UNION CITY, IND.—The Union City Telephone Company has increased its capital stock from $30,000 to $50,000. The lines will be extended into the rural districts.

BOWERS, IND.—The Co-operative Telephone Company, using Eureka instruments, has a 50-drop board and 76 subscribers. Service is good and very satisfactory.

MILAN, IND.—We learn from Dr. D. C. Roney that he operates a 6-drop switchboard. Six miles of new line are to be built and prospects of improvement are good.

HALL, IND.—Mr. R. W. Brown is the proprietor of this telephone line, which operates American Electric and Chicago apparatus, and with switchboard capacity of 25 drops and 40 subscribers.

HAZELRIGG, IND.—The Hazelrigg Co-operative Telephone Company is operated on the co-operative system, and has a 100-drop board of Eureka Electric Company make, with 80 subscribers.

MOORESVILLE, IND.—This city enjoys the distinction of having three telephone systems, the last being a local affair recently installed, and connects the town with the farmers for miles around.

WARREN, IND.—The Warren Telephone Company, owned by J. M. Hollingsworth, operates a 200-drop board of American make and has 165 subscribers. Some extensions are projected and the outlook is fair.

INDIANAPOLIS, IND.—The Chrisney & Grandview Home Telephone Company, Spencer County, has been chartered; capital stock, $5,000. Directors: L. F. Gage, G. J. Clement, D. S. Goble, J. P. Chrisney and T. E. Chrisney.

CROTHERSVILLE, IND.—The Jackson Telephone Company operates a 100-drop board of American make and has 65 subscribers. Nearly as many more are expected. Mr. Warner informs us that the outlook is good.

SHELBYVILLE, IND.—The Cove Telephone Company informs us through Mr. Williams, that a 100-drop Eureka board is operated, with 88 subscribers. He expects that in the near future telephones will be found in every house.

ALBANY, IND.—The Albany Telephone Company, using Globe automatic apparatus, has a 100-drop board and 59 subscribers. Mr. Perkins informs us that business is good and that an exchange and country lines will soon be built.

CORUNNA, IND.—Mr. M. J. Thomas, of the Thomas Telephone Exchange, kindly furnishes us with the following: With a 25-drop board it has 90 subscribers, and business is steadily increasing. Subscriptions or toll service is $12 per year.

CENTER POINT, IND.—The Center Point Telephone Company has a 10-drop switchboard and 60 subscribers. An increase of nearly as many more is expected. We are indebted to Mr. W. S. Gard, secretary of the company, for this information.

TAYLORSVILLE, IND.—The Taylorsville Telephone Company reports business in good shape. The apparatus used is American Electric; a 100-drop board and 30 subscribers. Seven county lines have recently been built and more are in contemplation.

ANGOLA, IND.—A new switchboard with a capacity for 300 subscribers has been ordered and will be installed in the exchange of the Steuben County Electric Telephone Company. The demand for service has grown to most encouraging proportions.

HUNTINGBURY, IND.—The Dubois County Telephone Company has a successful and constantly improving undertaking. Eureka apparatus supplies a 200-drop board, with 190 subscribers. In addition there are 169 in Jasper, Dubois and other towns.

PERRYSVILLE, IND.—Mr. C. Carpenter, of the Perrysville Telephone Company, informs us that extensions and more telephones are planned for the near future. Apparatus of the Eureka Electric Company is installed; a 50-drop board and 65 subscribers.

ELWOOD, IND.—After repeated attempts during the past two years, the Long Distance Telephone Company, of Indianapolis, has at last succeeded in getting a franchise to establish a new system at Elwood. The plant is to be in operation within four months.

VINCENNES, IND.—The City Council has granted a franchise to the Independent Telephone Company for twenty-five years. The Central Union Company is just finishing a $25,000 improvement, and a telephone cut rate war is expected when the second plant is established.

DANA, IND.—The Citizens' Mutual Telephone Company, which has just started business, commences under favorable auspices, with a switchboard at Dana and Newport, of 100 drops, 50 subscribers at Newport and 75 at Dana. American apparatus is used, and an extension is contemplated.

BREMEN, IND.—The Bremen Telephone Company is the property of Koontz Bros., and we are indebted to the manager, Mr. C. E. Koontz, for the following: He operates apparatus of the Eureka Electric Company, with a 100-drop board and 80 subscribers. Prospects for an increase are favorable.

ANGOLA, IND.—Norman C. Shank, president; George Rude, vice-president; Chas. W. DeLancey, secretary and treasurer, incorporated as the Farmers' Telephone Company of Steuben County, will ask the village Council for a permit to establish an exchange here. The company has a line from Orland to Nevada Mills.

SOUTH McALESTER, IND.—The South McAlester-Eufaula Telephone Company operates Central, Eureka and Standard apparatus; has five exchanges, 400 drop boards and 400 subscribers. Mr. L. H. Roberts, general manager, informs us that 600 miles of toll lines have been put in recently and prospects are excellent.

CANTON, IND.—The Hoosier Telephone Company has Eureka and American installations; an 800-drop board and 1200 subscribers. There are 8 exchanges all connected by a first class metallic circuit, and 200 miles of toll line, with projected extensions. We are indebted to Mr. J. M. Morris for the above information.

QUINCY, IND.—The Mugg Telephone Company informs us through Mr. Carlton, its secretary, that it has first-class toll service to every town in the county. It uses Eureka apparatus, a 200-drop board and has 125 subscribers. It has connections over copper lines of the New Long Distance Company. It has an exchange at Spencer.

EUREKA, IND.—The Ohio Township Telephone Company has increased its capital stock from $1,150 to $10,000, and now proposes to place a 300-drop switchboard in Rockport and connect all the independent plants. Elliott Telephone Company and North Electric Company apparatus is used. There are now 44 subscribers. Mr. F. H. Crowder is secretary.

GOSHEN, IND.—The manager of the House Telephone Company sends us the following items: It is operating apparatus of various companies; has an 800-drop board in Elkhart, and 500 in Goshen, with 720 subscribers in the former place, 480 in the latter. There has been a great gain recently, and it has many orders ahead. Additional cable room for 500 is projected.

INDIANAPOLIS, IND.—The instruments used by the New Telephone Company are from the Kellogg Switchboard & Supply Company. The switchboard capacity is 6000 drops; number of subscribers, 4527. The company has just contracted for two sub-stations of 1800 and 2500 respectively, and is connected with the New Long Distance Telephone Company, one of the finest properties in the West.

GREENSBURG, IND.—The Bell Telephone Company has a force of 50 men at work building its long-distance lines in this and adjacent counties. The company has just completed its lines from Madison and North Vernon to this city and is extending them to Hope and other points in Bartholomew County. Every point in Decatur County is now reached by either the Bell Company or the Decatur County Independent Telephone Company.

NORTH VERNON, IND.—The North Vernon & Vernon Telephone Company informs us that it operates a Stromberg-Carlson switchboard of 325 capacity, and has 310 subscribers. The outlook is the very best. Mr. Kendrick, the manager, also informs us it owns and operates the Gunnings County Telephone Company, which has 125 miles of toll line, reaching 18 small towns, and it expects to build large extensions in Spring. This latter company has 75 subscribers.

ROCKVILLE, IND.—The Parker County Telephone Company has sub-exchanges at Bellmore, Bridgeton, Rosedale, Montezuma, Mecca and West Union. The main office has 400 lines, the sub-stations 100 each. They employ principally Eureka, Sterling and Victor apparatus. Subscribers number between 500 and 600. Mr. Haynes, manager, informs us that the plant has doubled in the last year. The company has 125 miles of toll line and includes 30 towns in its system.

MUNCIE, IND.—The telephone war at this place has assumed a new phase. The independent company, which has been seeking admission, was promised a franchise as soon as it secured 800 subscribers. The company renewed its petition and filed a list of 850 subscribers secured. A member of the Council charged fraud, alleging that many of the names had been secured by misrepresentation. This charge was resented and the feeling is intense. The franchise is being withheld pending an investigation. At the time the promise was made it was thought the restriction would bar the company from the city.

DUNKIRK, IND.—The city attorney has been instructed to prepare an ordinance to tax the Central Union's poles to the utmost limit, also one revoking the franchise of the company, on the ground of grave abuses of rights and privileges. The telephone fight has been of interest here for some time. The city appropriated $2,500 to put in a municipal plant, but did not have the $2,500, and the project failed. The Central Union began its improvements and disturbed the sewer and the workmen were arrested. A citizens' company was organized and an old franchise purchased and the fight is on now for supremacy. There are but few complaints against the Central Union's service, but the people want competition, and a hostile feeling has developed. The attempt to revoke the franchise will be vigorously contested.

MIAMI, IND. TERR.—The Miami exchange has a 100-drop board and 56 subscribers, with a large expected increase. Mr. Crandall is the manager. The exchange uses Western apparatus.

PURCELL, IND. TERR.—The Purcell & Lexington Telephone Company uses American apparatus; at the former place a 22-drop board, the latter 100. There are 214 subscribers. Purcell exchange has been rebuilt and new transmitters put in. A new toll line to Chickasha is projected.

MURRAY, IDAHO.—Mr. A. Aulbach is proprietor of the telephone line between Murray and Wallace, with branch lines 3 to 7 miles to mines in the mountains several miles distant from the main wire. There are great opportunities in this direction. Mr. Aulbach thinks his the only independent line in Idaho.

CLARINDA, IA.—A company has been organized to build a telephone line between Page Center and College Springs.

CROYDON, IA.—The Wayne County Telephone Exchange uses a 200-drop American switchboard and has 150 subscribers.

MUSCATINE, IA.—The Wilton Telephone Company, capital stock $3,000, has been incorporated. J. M. Rider is president.

NEWELL, IA.—The Northern Telephone Company uses Eureka apparatus and has a 100-drop board, 40 installed, and 40 subscribers.

MARCUS, IA.—A 15-year franchise has been granted to the Marcus Telephone Company. Mr. F. S. Barnes is interested in the company.

TELEPHONE NEWS.—(Continued.)

SANBORN, IA.—The Sanborn Telephone Company operates a Chicago 130-drop board and has 100 subscribers. Growth and outlook both excellent.

AUDUBON, IA.—The Audubon County Telephone Company operates an American 250-drop board and has 250 subscribers, which indicates a flourishing business.

BUSSEY, IA.—The Bussey Mutual Telephone Company uses Chicago apparatus. It has 50 telephones, and the outlook for the next six months promises as many more.

SHELL ROCK, IA.—E. H. Eckles, of Tama County, has purchased the telephone line of the Cedar Valley Company running to this place and will enlarge the system.

NEW LONDON, IA.—We learn from Mr. Stephenson, of the Henry County Telephone Company, that a drop board of 150 capacity is operated, with 200 subscribers. The outlook is good.

HARTLEY, IA.—Mr. F. E. Fee, owner of the telephone line, operates a Standard 80-drop board and has 78 subscribers. Increase is steady and the outlook promises well for the future.

SEHALLEN, IA.—Mr. Whiteside, of the Sehallen Telephone Company is installing new lines and reports a steady increase. A 100-drop board is operated and there are 60 subscribers.

IOWA CITY, IA.—The Farmers' Mutual Telephone Company, of Johnson County, has filed articles of incorporation, with a capital stock of $4,500. Noah Yoder and others are the incorporators.

WAPELLO, IA.—The Mississippi Valley Telephone Company operates a 200-drop American switchboard and has the same number of subscribers. Progress has been very rapid, with every prospect of continuance.

MARATHON, IA.—Mr. A. P. Welch, of the Marathon Telephone Exchange, informs us of a contemplated increase on farmers' lines. It uses Stromberg-Carlson apparatus and has a 100-drop board, with 50 subscribers.

BOONE, IA.—Mr. Deering, of the Boone County Telephone Company, informs us of good prospects and fair business. Western apparatus is used, and a 600-drop board with 595 subscribers constitute a thriving business.

BATTLE CREEK, IA.—The Battle Creek Telephone Company has made good progress since its start early this year. It has a Eureka board of 100 drops and 125 subscribers. Rates are $1.75 for subscription or toll service.

LEON, IA.—The Leon Telephone Company operates Keystone apparatus; a 100-drop board with 162 subscribers. There are about 20 miles of farm lines and more projected. Mr. Ellinwood, the manager, reports a fair outlook.

BLOOMFIELD, IA.—The Davis County Telephone Company uses an American drop board of 200 capacity, 160 lines being installed. There are about 200 subscribers. Recent growth has been good and new toll lines are projected.

DAYTON, IA.—The Dayton Telephone Company has just completed its organization here, J. A. Lindberg being chosen president and Dr. M. F. Anderson vice-president; Dr. H. E. Nelson, secretary, and E. M. Lundien, treasurer.

CORNING, IA.—The Corning Telephone Company uses Victor apparatus, and is about to install some of Stromberg-Carlson make. The present 180-drop board supplies 190 subscribers. One or two exchanges and new toll lines are contemplated.

JESUP, IA.—The Buchanan County Telephone Company operates an American 50-drop board and has 43 subscribers. Mr. Cates informs us that the exchange started business in June of this year and that new farmers and town lines are already projected.

MAPLETON, IA.—The Iowa Telephone Company uses Bell apparatus, has a 15-drop board and 15 subscribers. The New State Company has Swedish-American apparatus and its toll lines cover a large territory. The Bell uses metallic circuits and the State grounded.

GUTHRIE CENTRE, IA.—The Guthrie Center Telephone Company uses Swedish-American apparatus, and operates a board at North Branch, with one of 50 drops at Bayard. There are about 60 subscribers and the company has some 30 miles of party lines. Mr. A. D. Carothers is president.

OAKLAND, IA.—The Harlan-Avoca Telephone & Telegraph Company informs us through Mr. M. Babcock, secretary, that a switchboard of 600 drops supplies the needs of 475 subscribers at present. An increase of 200 is projected. Subscription rates are $24 and $12 per annum.

LAKE CITY, IA.—The North Coon Telephone Company operates a 200-drop board at Lake City and lever switchboard at Glidden, of Stromberg-Carlson make. It has 36 subscribers at present, and another wire will be built next spring. Almost every rural home will probably have telephone connection soon.

FONDA, IA.—The Northern Telephone Company sends us the following through Mr. Coleman, its secretary. The apparatus used is Eureka. There are 3 new exchanges at Aurelia, Newell and Gilmore City, and farm lines are projected. A 200-drop board is operated and there are 125 subscribers in Fonda.

OSBORNE, KAN.—The Osborne Telephone Company employs apparatus of the National Automatic Company. It has 100 telephones and 98 subscribers.

GARDEN CITY, KAN.—The Garden City Telephone Company employs National Automatic apparatus and has 55 subscribers. Rates are $1 and $2 respectively for residences and business houses.

LYONS, KAN.—Mr. A. Long, of the Lyons telephone exchange, informs us that it has a steady increase of business and project farmers' lines. Its drop-board capacity is 200, with 182 subscribers, and its rates are $1 for residences, $2 for business houses.

STOCKTON, KAN.—We are informed by Mr. L. D. Burchfield that he operates Stromberg-Carlson apparatus of 120-drop switchboard capacity, and has 105 subscribers. Rates for residence and business houses are $1 and $2 respectively and prospects are good.

ST. MARYS, KAN.—The St. Marys Telephone Company operates an automatic and toll line of 80 switches, with apparatus of the National Automatic Telephone Company. There are 80 subscribers. Mr. Anderson, secretary, reports a favorable outlook and a projected 10-mile toll line.

CALHOUN, KY.—At present there is no independent company operating an exchange here, but Mr. A. L. Mosely informs us that there is a good opening for one.

NEW HAVEN, KY.—We are indebted to the secretary of the New Haven Telephone Company for the following particulars: The company has made its own apparatus, and operates a 20-drop board, with 20 subscribers.

DONALDSONVILLE, LA.—Mr. L. H. Lancaster, a representative of the American Telephone Company, was in town looking over the field preparatory to the establishment of an exchange here.

ALEXANDRIA, LA.—The Cumberland Telephone & Telegraph Company, which bought out the Alexandria Telephone Company, January, 1901, is installing an entirely new system. The apparatus is made by the Cumberland Telephone & Telegraph Company; switchboard capacity, 400 drops, number of subscribers 300. Recent increase has been large and prospects are bright.

SEBAGO, ME.—The Baldwin & Sebago Telephone Company is a small concern using Bell apparatus.

HARTLAND, ME.—There is no telephone company in this place, only a local line and one to St. Albans, owned by Dr. C. A. Moulton.

CORINNA, ME.—The Corinna Telephone & Telegraph Company has exchanges at Stetson and Exeter also. It has a 6-drop board and 20 subscribers.

UNION, ME.—The Union Telephone Company operates a 25-drop board of the American Electric Company make, and has 50 subscribers. Extensions of five and ten miles are contemplated. The outlook is very favorable.

PORTLAND, ME.—The Dirigo Telephone Company, of Maine, whose lines cover the western section of the State, has nine exchanges and 25 pay stations. It has nearly 1000 subscribers, the number increasing rapidly, and it contemplates extensions throughout the entire State. Apparatus, Stromberg-Carlson, Ericcson, Couch-Seeley and Kellogg.

HOYES, MD.—The Garrett County Telephone Company has a Keystone Electric 50-drop board, with 40 subscribers. A 10 to 15 mile extension is projected.

WOLFSVILLE, MD.—We are indebted to Dr. A. J. Smith, president of the Catoctin Telephone & Telegraph Company, for details of his enterprise. His line was only built to obtain connection with the county town, but will probably be extended in the near future.

FITCHBURG, MASS.—The North Fitchburg and Bunker Hill lines cover all territory adjacent to the places named, and have 20 subscribers, each telephone representing a share in the company. Mr. C. A. Chuton is secretary.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company operates Strowger apparatus of from 1000 to 2700 as required, and has 600 subscribers, 70 being added during the past month. Prospects are very good for a large increase. Mr. V. A. Sears has kindly furnished the above.

ADRIAN, MICH.—The Midland Telephone Company and local telephone exchange have 100 subscribers, and a bright outlook. They employ Stromberg-Carlson apparatus.

FREMONT, MICH.—The manager of the Citizens' Telephone Company informs us that it has a 100-drop board and 88 subscribers. The outlook promises well for the future.

BEAVERTON, MICH.—Dr. F. S. Pierce operates apparatus of the Michigan Telephone Company and has had a considerable increase with projected improvement in the future.

BELLEVUE, MICH.—The Citizens' Telephone Company, with headquarters in Grand Rapids, has installed apparatus of Geo. G. Smith. It has a 100-drop board and 66 subscribers.

DETROIT, MICH.—The American Telephone Directory Company has been incorporated with a capital stock of $5,000, by John D. Browning, Charles E. Smith and Clark S. Potter.

SPARTA, MICH.—The Sparta Telephone Company informs us that it goes on steadily improving. The switchboard of American make has a capacity of 100 drops and there are 30 subscribers.

CHARLOTTE, MICH.—The Eaton County Telephone Company uses American and Williams apparatus. A 350-drop board supplies 344 subscribers and 100 rural connections are about to be made. Growth has been rapid.

BERRIEN SPRINGS, MICH.—The Twin City Telephone Company employs Stromberg-Carlson (central energy) apparatus, and has a 50-drop board with 35 subscribers. It has stations at Benton Harbor and St. Joseph, Mich.

LESLIE, MICH.—The Leslie Telephone Company operates a 150-drop board, and including farmers' lines, business and private telephones, has a subscription list of 250. Building extensions are in progress and prospects are good.

WILLIAMSBURG, MICH.—The Williamsburg Telephone Company is a small local enterprise connecting with other larger lines. It has a 5-drop board and 25 subscribers. M. B. Wheeler Electric Company's apparatus is installed.

FITCHBURG, MICH.—The Fitchburg Telephone Company uses apparatus of local make and has 12 party lines, using call bells in the towns which they connect. Mr. E. W. Lawrence, president, gives a good account of the business outlook.

GAYLORD, MICH.—The Otsego County Telephone Company has proved such a success that its projectors contemplate a second exchange at Vanderbilt, Mich. They operate a Stromberg-Carlson, 100-drop board and have 95 subscribers. Mr. F. Calkins tells us that growth has been rapid.

SCHOOLCRAFT, MICH.—We are indebted to Mr. Burney, proprietor of the Schoolcraft Telephone Company, for the following: He uses Stromberg Telephone Manufacturing Company's apparatus, has a 100-drop board and 45 subscribers. Several country lines, with from 50 to 100 more, are projected. The sale of the Central Telephone Company has bettered conditions and the outlook is very bright.

TELEPHONE NEWS.—(Continued.)

VERNDALE, MINN.—The Verndale Telephone Company operates apparatus of the National Automatic Telephone Company, and has 100 switches, 52 installed, with 52 subscribers.

GLENCOE, MINN.—The Glencoe Telephone Exchange Company uses Standard apparatus and operates a 200-drop board, with 150 subscribers. About 50 miles of farmers' lines are to be built.

RED WING, MINN.—The Northwestern Telephone Exchange operates a 300-drop board of Western Electric make, and has 250 subscribers. Mr. Hastings informs us that prospects are very good.

CANTON, MINN.—Mr. Dunford informs us that he uses a switchboard of his own make, and that he operates 15 toll lines, with the Standard and Winona Telephone companies' lines also, giving 130 subscribers.

BIRD ISLAND, MINN.—The Kandiyohi County Telephone Company is building a line from this place to Lake Lillian, where it will connect with a line to Willmar, Atwater and other places in Kandiyohi County.

LONG PRAIRIE, MINN.—The Minnesota Electric Telephone Company informs us through Mr. Dick that Eureka apparatus is used. A 100-drop board and 89 subscribers. The system is being rebuilt, and the outlook is favorable.

MONTEVIDEO, MINN.—The Citizens' telephone exchange has had a good year and contemplates farmers' lines for the next. Western apparatus is employed, and with a 200-drop board it has 165 subscribers. Mr. Zienbeck is secretary.

HECTOR, MINN.—The Hector Telephone Exchange Company, using Standard and Stromberg-Carlson apparatus, has a 100-drop board and 65 subscribers. The company contemplates building two or three farmers' lines of about 15 miles each.

HOUSTON, MINN.—We are informed by Mr. Schoulan, of the Houston Telephone Company that it projects a big increase in farm lines. It uses Standard Madison apparatus and has service and growth of the best. There are 30 subscribers.

GRAND MEADOW, MINN.—The Home Telephone Exchange Company informs us that its apparatus is of L. M. Ericsson make. It operates a 100-drop board and has 169 subscribers. An increase of 50 telephones is projected, and the outlook is excellent.

BENSON, MINN.—We are indebted to Mr. L. W. Stone for information respecting his telephone lines. He employs Victor apparatus, has a 100-drop board and 123 subscribers, and has had a steady increase since opening business. Independent apparatus is used throughout.

WADENA, MINN.—We learn from Mr. Toole that the Iron Range Electric Telephone Company has absorbed the Norman County Telephone Company and is putting in metallic circuits throughout, and building a new exchange in Ada. A Kellogg 100-drop switchboard is installed, and the company starts with 65 subscribers.

GLASGOW, MO.—The Glasgow Telephone Company operates a 164-drop board and has 215 subscribers, with a continually steady increase.

RAVENNA, MO.—The Ravenna Telephone Company operates a 20-drop board, with 95 subscribers. Its apparatus is Keystone-American and Victor. Prospects are good.

CHILLICOTHE, MO.—Messrs. Leach & McArthur informs us that they use Western apparatus, have a 500-drop board and 450 subscribers. Growth has been very large recently.

KANSAS CITY, MO.—The Kansas City Home Telephone Company, with a capital stock of $50,000, has been incorporated by O. C. Snider, John Enoch, Ed. L. Barker and others.

RICHLAND, MO.—The D. I. Kusel Telephone & Electric Manufacturing Company, of St. Louis, has secured a telephone franchise in this place, and has secured 70 subscribers to its service.

CAMERON, MO.—Mr. Thompson, of the Cameron Telephone Company, reports steady and increasing business. The company has Western apparatus, a 400-drop board and 308 subscribers.

HARRIS, MO.—The Harris-Princeton Telephone Company has a 20-drop board at Princeton and 10 at Harris. There are 20 subscribers, and the prospects for success are very promising.

EVERTON, MO.—The apparatus operated by the Everton Telephone Company is made by Wm. Jones, of this place. The switchboard capacity is 10 drops, and there are 50 subscribers.

BOSWORTH, MO.—The Bosworth Telephone Company has been incorporated, with a capital stock of $4,000. The incorporators are W. J. Williams, W. S. Windsor, G. L. Reavis and others.

WARRENTON, MO.—The Warrenton Telephone Company operates 19 instruments on a line 20 miles in length. It uses the bridging system and has 4 lines running into one office with plug switchboard.

CHULA, MO.—The Laredo Telephone Company operates an American 50-drop board and has 30 subscribers. Several new lines are projected and more patrons looked for, as the outlook is very promising.

BOSWORTH, MO.—The Carroll County Telephone Company, of Bosworth, has been incorporated, with a capital stock of $1,000. The incorporators are H. A. Forsythe, R. E. Cabbell, W. P. Stout and others.

MOVINGER, MO.—We have received the following from Mr. Hemrick, of the Movinger Telephone Company. It operates a 25-drop American board, with 16 subscribers, and has good prospects for the future.

BROOKLYN, MO.—The Harrison County Mutual Telephone Company, of Brooklyn, has been incorporated with a capital stock of $9,000. The incorporators are E. Reynolds, F. Davis, J. L. Stanton and others.

GREENFIELD, MO.—The Interurban Telephone Company is operated by Chicago Telephone Supply Company and has a 100-drop board, with 68 subscribers. Mr. A. D. States informs us that the growth is steady and satisfactory.

AUXVASSE, MO.—The Auxvasse Telephone Company, which has been in operation less than a year, has 100-drop switchboard capacity and 40 subscribers. An increase of 25 is projected. National Automatic apparatus is used. Mr. McCue is manager.

HUNTSVILLE, MO.—We learn from Mr. Johnson, manager of the Huntsville Telephone Company, that the outlook never has been better. He operates a 200-drop board of American make, and there are 160 subscribers. In addition there are numerous farmers' telephones, which would bring up the number to about 400.

JAMESPORT, MO.—We are indebted to Mr. A. W. Cropper, manager of the Jamesport telephone exchange, for the following: His apparatus is of American Electric and Stromberg-Carlson make. With a 100-drop board, there are an equal number of subscribers, 16 or 17 party lines, with 4 to 18 telephones on each line, and 3 through lines to the county seat.

ST. LOUIS, MO.—A bill has been introduced in the Board of Public Improvements, providing that all telegraph and telephone wires be placed underground in the underground district. Telephone companies accepting conduit privileges under the proposed ordinance will be prohibited until 1940 from raising their rates for services above those existing Jan. 1, 1900.

MACON, MO.—The Missouri & Kansas Telephone Company has established a long distance exchange at Macon and put in a fine switchboard there. With the completion of the new line to Kirksville, Macon will be the central office for twenty distinct long distance telephone lines, all of which have been built during the past three years. The wires for the Kirksville line have been strung and the instruments are now being placed in position.

CAMPBELLSVILLE, MISS.—The Sunflower & Silver Creek Telephone Company has 11 stations on the line to Yazoo City. American Electric apparatus is used and gives good service.

CRAIG, NEB.—The Craig Telephone Company, capital stock $5,040.75, has been incorporated by George F. Smith, A. Whitney and T. I. Minier.

ARLINGTON, NEB.—Mr. Vail, of the Arlington Telephone Company, informs us that its apparatus is of Farr make. At present a 30-drop board is operated, but it will be increased. There are 41 subscribers, and farmers' lines are projected.

NEBRASKA CITY, NEB.—The Nebraska City Telephone Company operates American, Swedish-American and Eureka apparatus. There is a 400-drop board at this place, one of 100 at Talmage, Julia and Douglas, and one of 25 at Unadilla. There are 700 subscribers, and 240 instruments have been put in since January, 1901. Mr. Munn informs us that business is increasing more rapidly than it can be taken care of.

CHARLOTTE, N. C.—Long distance telephone lines are being constructed from New Decatur, Ala., to Moulton and other points West.

HAMLET, N. C.—The Hamlet Telephone Company has Sumter apparatus and a 100-drop board, with 60 subscribers. It contemplates adding 10 or 15 more telephones, and reports a bright outlook.

ELIZABETH CITY, N. C.—The Camden Telephone Company uses apparatus of American Electric make. It has recently established long-distance connection with Norfolk, Va., and prospects are good for extended business.

STANLEY, N. C.—The Gaston Telephone Company operates long-distance lines connecting towns for about 300 miles, and is extending them. It uses Phœnix switchboards and telephones; also Simplex telephones. It has 50 subscribers.

ELKIN, N. C.—The Wilkin Electric Company, Elkin and Jonesville exchange, uses Sumter apparatus; a 100-drop board, with 65 subscribers, and 4 toll lines. The outlook is very encouraging and a large increase is expected. Mr. H. W. Horton is manager of North Wilkesboro and Wilkesboro exchanges. Both systems are prosperous.

MAXTON, N. C.—We are indebted to Mr. Burns, of the Carolina Telephone & Telegraph Company, for notes of his progressive business. Commencing in 1899 with 25 farms, he now has 70 in operation, and contemplates putting in larger boards to meet the increasing demand. Increase has been rapid and prospects are excellent.

ELKIN, N. C.—Mr. H. W. Horton, of the Wiekin Electric Company, informs us that it has 100-drop boards in North Wilkesboro and Elkin, the apparatus being of the Sumter Telephone Company. Recent growth has been very satisfactory; the town is growing and farmers are becoming subscribers. These latter now number 150.

ST. THOMAS, N. D.—The St. Thomas local telephone exchange uses National Automatic apparatus. It was established in 1900 and has 22 subscribers, with good prospects.

COOPERSTOWN, N. D.—Mr. Goff, owner and manager of the Cooperstown Telephone Exchange, sends word of rapid improvement. His apparatus is American, and a 100-drop Kellogg switchboard takes care of 105 subscribers. Toll lines will be built next summer.

SOMERSWORTH, N. H.—The New England Telephone & Telegraph Company is making arrangements to extend the service in this city the coming winter.

PLYMOUTH, N. H.—The Plymouth & Campton Telephone Exchange Company supplies the towns of Plymouth, Campton, Thornton, Woodstock, Lincoln, Franconia, and several others, operating 5 Western Electric switchboards of 136 drops. There are about 300 subscribers, and Mr. Lee, the manager, informs us that business is increasing fast, both toll and instruments.

BORDENTOWN, N. J.—The general manager of the Bordentown Telephone & Telegraph Company, Mr. Wiese, kindly favors us with the following: He operates a 200-drop board with American Electric apparatus, and has 150 subscribers. Business is increasing steadily and the outlook is excellent.

ROSWELL, N. MEX.—The Roswell Telephone & Manufacturing Company operates an American 200-drop board, and has 180 subscribers. Toll lines

TELEPHONE NEWS.—(Continued.)

and a larger switchboard are projected, for the possibilities seem unlimited in this territory. We are indebted for particulars to Mr. S. D. Saunders, the superintendent.

HOBART, N. Y.—The Hobart Telephone Company operates a 15-drop switchboard and has 50 or more subscribers.

BINGHAMTON, N. Y.—The local telephone company will soon be connected with the Citizens' Telephone Company, of Elmira.

WOODSTOCK, N. Y.—The Woodstock Telephone Company operates a line built by farmers and others, and has no exchange. Mr. Byde Snyder is the manager.

FRANKFORT, N. Y.—The Schuyler Telephone Company reports slow but steady increase. It has a 75-drop board and 72 subscribers, and uses American and Utica apparatus.

CALEDONIA, N. Y.—The Citizens' Telephone Company intends installing new apparatus. It has about 50 subscribers and is now spreading out in the direction of farmers' lines. Thirty-five new contracts are now on hand.

CAMERON, N. Y.—The Swale Telephone Company informs us through Mr. Downs that it has Stanley & Patterson and Mianus Electric apparatus. It has 20 subscribers. A change from the series to the bridging system is projected.

ROCHESTER, N. Y.—Mr. Stinson, general manager of the Rochester Telephone Company, informs us that a Stromberg-Carlson 4000-drop board is operated and another of 6400 capacity is projected. There are 4100 subscribers, and contracts come in at the rate of 10 each day.

STAFFORD, N. Y.—The manager of the Stafford Local Telephone Company, Mr. Pixley, notifies us of a projected extension of four or five miles, and expects a satisfactory increase of business. He operates Eureka apparatus, with a 6-drop board and 28 subscribers. The rate per message is only 5 cents.

CHESTERTOWN, N. Y.—Mr. C. H. Burge informs us that the apparatus used by the Chestertown Telephone Company is from the Western Telephone Construction Company. It operates a 100-drop board and has 75 subscribers. Recent growth has doubled the capacity, and future indications are equally good.

POTSDAM, N. Y.—The Racket River Telephone Company uses an American 200-drop board and has 215 subscribers. A full metallic circuit and 4000 feet of cable will be put in next Spring. It has connection with the St. Lawrence Telephone Company, which gives subscribers communication with several New York towns.

WELLSVILLE, N. Y.—We are informed by Mr. Savidge, of the Wellsville Telephone Company, that its apparatus was installed by the Century Telephone Construction Company—a 100-drop board and 75 subscribers. The company is now building, and uses cable system throughout. The 100-drop board is on the lamp signal system.

WEST EXETER, N. Y.—The Wharton Valley Mutual Telephone Company has apparatus of the Williams Electric Company. This line was built by $5 subscriptions by the people along the route. Those who helped have free use of telephones, of which there are now 23 in service. Those who have not helped pay 10 cents per message.

GRANVILLE, N. Y.—The Granville Telephone Company operates Eureka Electric apparatus, with a 400-drop board. It has 425 subscribers. Many increases are projected. This company has connections at Whitehall, N. Y., and Poultney, Vt., which covers a rich territory of the slate region of New York and Vermont, consequently the outlook is excellent.

NUNDA, N. Y.—We are indebted to Mr. G. W. Koppie, manager of the Business Mens' Telephone Company, for the undermentioned. The company covers about 70 miles of territory, and is a farmers' line, without any switchboard at present, and with about 100 instruments on the entire line. An 18-mile extension is contemplated.

MAYVILLE, N. Y.—Mr. Loomis, manager of the Mayville Telephone Company, sends us the following: With a Victor switchboard of any capacity under 200 drops it has 105 subscribers. Extensions have been made lately, and another to Jamestown is projected. Common return system is used in Mayville, and beyond full metallic party lines American Electric telephones.

ELYRIA, OHIO.—The North Ridgeville Telephone Company has increased its capital from $2,000 to $5,000.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company is building branch exchanges at Toronto and Cumberland.

ARLINGTON, OHIO.—The People's Telephone Company uses apparatus of the Harrison Electric Company, has a 100-drop board and 80 subscribers, with more in prospect.

FREMONT, OHIO.—The Fremont Home Telephone Company has established a new exchange at Lindsey. The business in that section of Sandusky County is growing rapidly.

COLUMBUS, OHIO.—The Central Union Telephone Company has added another section to its switchboard. The addition was made necessary through the great increase in business at this point.

WEST JEFFERSON, OHIO.—The West Jefferson Telephone Company, operating Stromberg-Carlson apparatus, has a 100-drop board and 56 subscribers. Party lines are to be built in the near future.

WEST MANSFIELD, OHIO.—The West Mansfield Telephone Company has American apparatus; a 100-drop board and 75 subscribers. A farmers' line is to be put in at once, and prospects are very good.

MARSHFIELD, OHIO.—The Marshfield Telephone Company uses apparatus of North Electric make, has a 50-drop board and 30 subscribers. Recent growth and prospects are very good, and a new line is projected.

LANCASTER, OHIO.—The Lancaster Telephone Company is installing an exchange at New Salem with lines connecting it with other villages in the county. The system in Fairfield is now in excellent working order.

RISING SUN, OHIO.—The manager of the Old Belt Telephone Company sends us the following: The company has a 100-drop board and 50 subscribers. New lines are projected to Hatton, Millgrove and Girton, all in Ohio.

TEMPERANCEVILLE, OHIO.—The Somerton Telephone Company operates a 12-drop board at Somerton, and a 6-drop at Temperanceville. Its apparatus is Western Construction Company's make, and it has 12 telephones on a toll line.

LEXINGTON, OHIO.—The Mansfield Telephone Company uses apparatus of the North Electric Company, a 50-drop switchboard, and has 66 subscribers. An exchange was put in last year, and the installation of some more telephones is projected.

NEW BREMEN, OHIO.—The New Bremen Telephone Company operates apparatus of the Sterling Electric Company, and has a 100-drop board supplying 84 subscribers, with three toll lines covering 30 miles. Prospects are good and an increase is in contemplation.

ROCKFORD, OHIO.—The Rockford Telephone Exchange Company has been in business about a year, and is progressing satisfactorily. Mr. Jackson informs us that it uses Sterling Electric apparatus. With a 200-drop board, it has 108 subscribers and an increase is projected.

BLUFFORDS, OHIO.—We learn from Mr. Frederick, of the Bluffords Telephone Company, that it operates a Eureka drop board of 300 capacity and has 315 subscribers, having added 100 telephones in the last year. Country lines have also been built and excellent service is given.

CALDWELL, OHIO.—The Caldwell Independent Telephone Company contemplates the addition of several small exchanges. It operates a 100-drop board, with 100 subscribers. Prospects are very good. Williams-Abbott, Williams Electric and American Electric apparatus are installed.

RICHWOOD, OHIO.—The secretary of the Richwood Telephone Company kindly sends us the following: They use Eureka and Stromberg-Carlson apparatus; a 200-drop board, and have 150 subscribers. Eighteen miles of farmers' lines are now being built, and prospects are very good.

GRANVILLE, OHIO.—Judge B. M. Critchfield, who has a franchise for an exchange in Utica, Ohio, expects to have it in working order by April. A complete system of farmers' lines will be run in every direction. All these will be connected with the Newark Independent Company's lines.

UTICA, OHIO.—The Utica Telephone Company has been granted a franchise in Utica. Farmers' lines will be run in all directions from the town, and it is expected that the exchange will start with 150 subscribers. Direct connection will be given with exchanges at Mt. Vernon, Newark and Columbus.

AMHERST, OHIO.—The Amherst Home Telephone Company, which has been in existence two years, has declared a 6 per cent dividend, besides laying aside a surplus. New officers have been elected as follows: H. G. Redington, president; Chas. Nichols, vice-president; Frank Steel, secretary-treasurer.

BATAVIA, OHIO.—The Batavia Citizens' Telephone Company has been granted a 25-year franchise to build an exchange at Williamsburg. The company has exchanges in all the towns surrounding Batavia and its field is rapidly enlarging. J. W. Gillfill is president and W. H. Baum, general manager.

ELYRIA, OHIO.—The Rawson Electric Company, manufacturers of telephones, is completing a brick building to connect with the one which it already occupies. The plant will be devoted entirely to the manufacture of telephone equipments and switchboards, the increase having been made necessary by the growth of the company's business.

COLUMBUS, OHIO.—The Ohio Telephone & Telegraph Company is stringing an aluminum circuit of seven strands of No. 14 wires between Columbus and Massillon. It is claimed this is the first aluminum circuit of this kind in this section of the country. From the Massillon exchange, direct connection will be made with Cleveland and Toledo. A new line has been built between Columbus and Delaware.

TOLEDO, OHIO.—The Toledo Home Telephone Company is offering unusual telephone service to the farmers of Lucas County. The service will be given at city rates and full metallic circuits are guaranteed; no party lines. The company is building lines throughout the district immediately surroundings the city, and the system is to be extended as soon as the exchange is placed in operation, which will be early next year.

XENIA, OHIO.—The Miami Telephone Company, which heretofore has operated the Bell system in Greene, Warren and Butler counties, has been succeeded by the Central Union Telephone Company. A number of improvements will be made. A new exchange will be built at Morrow; new boards will be installed at Middletown and Lebanon and new long-distance lines will be built to Wilmington, Washington, C. H., and Columbus.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Telephone Company informs us through its manager, Mr. Walter, that it operates American boards of 2200 drops, as follows: New Philadelphia, 600; Canal Dover, 400; Uhrichville, 400; Dennison, 300; Newcomerstown, 300, and Mineral City, 200. It has about 1725 subscribers. It is now extending lines to smaller towns. Independent companies all about are growing very rapidly.

AKRON, OHIO.—The strike of the linemen and electrical workers of the Central Union and People's Telephone companies, which has been on for more than two months, has been declared off, the men losing on every point. Few of the strikers will be taken back, since nearly all their places have been filled by non-union men. The strike has cost the Electrical Workers' Union $9,000, outside of the wages lost by the men, which runs high into the thousands.

SPRINGFIELD, OHIO.—Mayor Milligan has ordered the police to prevent the Springfield Home Telephone Company from working on Sunday. The company is pushing its underground work with all possible haste in order to complete it if possible before cold weather sets in. Citizens sympathize with the company and they want to see the streets in good order as soon as possible. The Springfield company is owned by Cleveland people and is independent of the Federal Telephone Company.

CHAGRIN FALLS, OHIO.—The village of Chagrin Falls has granted a franchise to the Cleveland Telephone Company which will enable it to place its wires underground or else in the alleys back of the main streets. The company

TELEPHONE NEWS.—(Continued.)

has been endeavoring for a number of years to secure a franchise in the village, and recently appealed to the Probate Court to force the grant. The independent company has also been granted permission to use the alleys if it desires, and it will probably change its lines in order to secure the preferred positions, with the hope of keeping the other company out.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company, which is the best paying property in the system of the Federal Telephone Company, is securing new subscribers at the rate of 15 per day without having solicitors in the field. At present the Columbus Citizens' Company has 5600 telephones in use, after being in operation something over a year. The Central Union Company has had its exchange in operation for more than twenty years, and it is said it has less than 2000 lines in operation. The independent company will shortly make an additional installation of switchboards and cables in order to take care of new business.

CANTON, OHIO.—Messrs. J. B. Hoge, Maxime Reber, H. D. Critchfield and William Carey, officers of the Federal Telephone Company, held a meeting in Canton Nov. 24, and concluded a deal for the consolidation of the properties of the Massillon Telephone Company, with those of the Stark County Telephone Company, one of the subsidiary companies of the Federal. Heretofore the Massillon Company has controlled the lines in the western part of Stark County and the Stark County Company has controlled the balance of the county. The new Stark County Telephone Company has a capital stock of $500,000, and $350,000 in bonds are to be issued. The newly acquired property was formerly known as the Farmers Telephone Company, and it not only covers the field thoroughly in Massillon, but reaches Navarre, Canal Fulton, Dalton and other villages. The Stark County Telephone Company has already opened its exchange in Alliance, with 400 subscribers, and the main exchange at Canton will soon be opened for business. When the system is in full operation the toll lines will touch every hamlet and school district in the county and the subscribers will have long distance connection through the lines of the United States Telephone Company.

GUTHRIE, OKLA.—The Pioneer Telephone Company, capital stock $500,000, has been incorporated by J. M. Noble, E. E. Westevelt, David McKinstrey, of Perry; B. S. McGuire, of Guthrie, and others.

ELIZABETH, PA.—The Federal Telephone Company has been granted a franchise at Donora.

PITTSTON, PA.—A private telephone line is to be erected along the line of the Hazleton & Wilkesbarre trolley road.

ELIZABETHVILLE, PA.—The Lykens Telegraph & Telephone Company has lately rebuilt and extended its lines, replacing iron with copper wire. Mr. Buffington informs us that he operates a 50-drop board, and has 70 subscribers. Rates are $33 per annum.

PATTON, PA.—Mr. Denlinger informs us that the Huntingdon & Clearfield Telephone Company is now building its line from Ebensburg to Phillipsburg. It will then be extended to Tyrone, connecting east and west with other independent telephone companies.

ALBION, PA.—We learn from Mr. E. A. Collins, of the Albion Telephone Company, that it uses Stromberg-Carlson apparatus, with a 100-drop board and 75 subscribers, which will soon be increased to 100. The company stands ready to meet any demand for increased service.

LINESVILLE, PA.—The Linesville Telegraph & Telephone Company uses an American switchboard of 100 drops, and has besides Keystone and Stromberg-Carlson apparatus. There are 199 subscribers. Mr. Rushmore, the secretary, informs us that recent growth has been good.

ALLENTOWN, PA.—The Consolidated Telephone Companies of Pennsylvania formally organized in this city to-day. This company controls the independent telephone companies in the counties of Lackawanna, Luzerne, Carbon, part of Schuylkill, Lehigh, Monroe, Berks, Bucks, Montgomery and a long distance line connecting the same with New York and Philadelphia. The capital of the company is $4,000,000. Its present bonded debt is about $300,000. The following officers and directors were elected: R. E. Wright, of Allentown, president; Samuel E. Wayland, of Scranton, secretary and general manager; C. M. W. Keck, of Allentown, treasurer. The company is negotiating for the purchase of several additional plants.

CHARLESTON, S. C.—The Gordon Telephone Company will issue $75,000 of bonds and make improvements in its system.

ORANGEBURG, S. C.—Wm. C. Wolfe, W. H. Lukes and A. C. Andrews have incorporated the Orangeburg & St. Matthews Telephone Company.

CLARK'S HILL, S. D.—Mr. J. E. Luke operates the telephone in this place, and has only recently commenced operations.

SCOTLAND, S. D.—The People's Telephone Company, Mr. C. C. King, president, operates a switchboard of the Standard Telephone & Electric Company, of 120 drops, and has 65 subscribers. Recent growth has been good and prospects are better.

NASHVILLE, TENN.—The Dixie Telephone Company, of Grundy County, filed an amendment to its charter increasing its capital stock from $10,000 to $25,000.

SAN ANTONIO, TEX.—The Commercial Telephone Company is extending its field of operations to thirty-three counties of the State.

CARTHAGE, TEX.—The Oden Telephone Company uses Western Electric apparatus. It has a 100-drop board and 87 subscribers, with expectations of soon doubling the number.

ANDERSON, TEX.—The Anderson Telephone Company, which started with 15 miles of line, has grown to 80 within a year, and projects several more to give connection with all points in the county. Sterling apparatus is used; a 100-drop board, and the outlook could not be better.

RICHFIELD, UTAH.—A contract has been let to construct a telephone line from Parowan to Stateline.

SALT LAKE CITY, UTAH.—President G. Y. Wallace, of the Bell Telephone Company, states that the line to Beaver is completed, and that materials for the Milford and Frisco lines are being sent down as speedily as possible that there may be no delay in building those lines which it is intended shall be completed this winter. The line from Douglas, Wyo., north from Cheyenne is about completed, and Billings, Mont., will be connected up with the entire system as soon as the exchange now building can be made ready.

CORNWALL, VT.—The Cornwall Telephone Company has stations at several towns supplied from Western Electric switchboards at Cornwall, Whitney and Hubbartown. It has 132 subscribers, all within two years. A large increase is projected next Spring.

ADDISON, VT.—The Addison & Panton Telephone Company operates a 25-drop Western Telephone switchboard, and has 86 subscribers. Service commenced August 1, 1901, to cover the two towns and connect with others, and to put in 30 or 40 more telephones. Mr. F. E. Sears is president.

ENOSBURG FALLS, VT.—The Northern Telephone Company operates exchanges here, at Richford and at Swanton, with a 40-drop board in each place. It has 50 miles of toll line and 235 subscribers. The outlook is very bright; constant additions are being made. Mr. C. L. Ovitt is the manager.

PALMYRA, VA.—The Fluoanna Telephone & Telegraph Company operates Sumpter Telephone apparatus—a 5-drop board with 83 subscribers. It is now extending its lines to Richmond.

LOUISA, VA.—The Louisa Telephone Company has a 100-drop board in Louisa and Gortonville of Southern Bell Telephone & Telegraph Company's make. It has 140 subscribers and very favorable prospects.

EMPORIA, VA.—The Emporia Telephone Company operates a switchboard of 100-drop capacity and has 40 subscribers. Sumter Telephone & Electric Manufacturing Company's apparatus is installed. The outlook is promising.

TAZEWELL, VA.—We are indebted to Mr. C. C. Long, owner and manager of the Tazewell Telephone Exchange, for details of a thriving concern. His apparatus is Rawson Electric, and he has 165 subscribers, rapidly increasing. Thirty-six miles are now under construction, and the outlook could not be better.

WELLSBURG, W. VA.—The Wellsburg Telephone Company is prospering, and has connection with the United States Long Distance Company. Eureka apparatus is used; a 200-drop board, with 150 subscribers.

RIPLEY, W. VA.—The Ripley & Millwood Telephone Company, Ripley & Kenna Telephone Company, and Arbuckle & Ripley Telephone Company, each uses apparatus of American, Phœnix and Williams respectively. Various lines have been built and others are projected.

PIEDMONT, W. VA.—The Piedmont Telephone Company has installed apparatus of the Viaduct Manufacturing Company and uses a 15-drop board, another of 50 drops being projected. It has 40 lines, 10 to 40 miles long. New lines are to be constructed at once, probably of 100 miles. We are indebted to Mr. Brawner, general manager, for the above.

ABERDEEN, WASH.—A petition is in circulation asking the Sunset Telephone Company to build and operate a line between this city and Westport by way of Ocosta and Markham.

POYNETTE, WIS.—The Poynette Telephone Company has an American drop board of 100 capacity and 50 subscribers. Rates are $1 per month.

WONEWOC, WIS.—The Wonewoc & Hillsboro Telephone Company operates a 100-drop board and has Standard Madison apparatus. Business is brisk and prospects bright.

MILWAUKEE, WIS.—The Western General Telephone Company will probably be organized for the purpose of putting in a competing telephone exchange in Milwaukee.

ARCADIA, WIS.—The Arcadia Telephone Company has a 100-drop board and 75 subscribers. Twenty miles of toll line have been recently built. Stromberg-Carlson apparatus is installed.

OSSEO, WIS.—The Osseo Telephone Company operates three exchanges at Osseo, Eleva and Wondovi. Stromberg-Carlson apparatus is used, and there are 175 subscribers. The prospects are very good.

OAKFIELD, WIS.—The Oakfield Telephone Company, through Mr. N. E. Bristol, informs us that it uses Victor, Standard and American apparatus. Switchboard, 25 drops. There are 100 subscribers and a large increase is expected. Prospects are bright.

PLYMOUTH, WIS.—The Larson Telephone Company uses apparatus of the Chicago Telephone Supply Company, has 15 subscribers and 12 local stations. Recently a line has been added from Graham to St. Cloud touching intermediate towns, and further extensions are projected.

SHARON, WIS.—The secretary of the Sharon Telephone Company furnishes us with the following: It uses Sterling apparatus, has a 120-drop board and 89 subscribers. Increase has been rapid and the capital may be enlarged. Connection with the Badger State Long Distance and other lines renders the situation very favorable.

WEST SUPERIOR, WIS.—We are indebted to the manager of the People's Telephone Company for the following: Operating Stromberg-Carlson apparatus of 800-drop capacity, 900 equipped; it has 818 subscribers, a gain of 500 in less than two years. A toll line to St. Paul and La Crosse is contemplated. The outlook could not be better.

FONTENELLE, WYO.—The Opal & Big Piney Telephone Company informs us, through Mr. Holden, manager, that the line was constructed more for personal convenience than for public use. The apparatus used is Central Electric, and there are 22 subscribers.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE ELECTRICAL WORLD AND ENGINEER, Nov. 22, 1901.

STEAM AND TROLLEY.—The directors of the London, Brighton & South Coast Railway Company have appointed Major Cardew and Mr. Philip Dawson as consulting electrical engineers, to advise generally on the subject of electric traction and in connection with electric works on their own line. The significance of this appointment lies in the fact that the Brighton & South Coast line has an exceedingly heavy suburban traffic out of London, and in the summer to seashore resorts. The directors apparently see possibilities of electricity being used on their suburban divisions, and, at all events, have taken a forward step in having the question systematically investigated.

SUBMARINE CABLE JUBILEE.—Due note is being made here of the laying of the first submarine cable. Naturally it was English. It crossed the Straits of Dover. A year before, on Aug. 28, 1850, a line twenty-seven miles long was sunk between Shakespeare's Cliff and Cape Grisnez, but the strand crossed a rocky ridge and snapped in two. Mr. John Watkins Brett, on behalf of his brother, Mr. Jacob Brett, the inventor and patentee, made this first experiment. The cable did really work. Congratulations were exchanged; stock messages were transmitted; but it was shortlived, hardly more than one clear day. The news was actually hidden away in small type in an obscure part of the newspapers. On the last day the *Times* woke up to the significance of the fact and said, on Aug. 31: "Instantaneous communication between England and France by electric agency may even while we write be actually taking place. It requires a shorter time for the transit of a message from London to the French coast than is necessary for tracing upon paper the shortest word in the English language." Next year a new cable was laid by the late T. R. Crampton, and it won immediate success. On Nov. 13, 1851, prices on the Paris Bourse were known in London within business hours, and England was once more united to the Continent. The second cable avoided Cape Grisnez, and was landed at Sangatte. At the end of the century there were beneath the seas and oceans of the world 1769 telegraph cables, having a total length of close on 189,000 nautical miles—enough to girdle the globe seven times, mostly English.

LARGE CONDUIT RAILWAY CONTRACT.—A few days ago the London County Council awarded to J. G. White & Company, of London, a contract for the sum of about £171,000, which covers the plate laying and road work for approximately 14 miles of track, all on the conduit system. This contract, however, does not cover the rails. A few days later the County Council awarded the contract for the complete generating plants for the above tramways to Messrs. Dick, Kerr & Company, of London, who will install apparatus manufactured by the English Electrical Manufacturing Company, of Preston, coupled to engines manufactured by Ferranti, Limited, of Hollinwood, Lancashire. The awarding of this contract to British companies has given universal satisfaction, as the whole of the generating plant will, therefore, be made by British companies, and as it embraces machines as large as 1500-kw capacity, it is certainly worthy of the sincerest congratulations to British manufacturers that they are now in a position to take care of such heavy work. These will be the largest machines which have ever been built in Great Britain, and being of three-phase character, it certainly speaks volumes for the progressive policy of the English Electrical Manufacturing Company that they are enabled to do such work so shortly after their organization. The bidders numbered two or three score, from England, America and the Continent. The contract covers electric plant for two generating stations, one for a direct-current temporary station, to be erected near Loughborough Junction, and a three-phase plant required for the permanent generating station, to be erected at Greenwich, together with the necessary sub-stations in connection with the electrification of the tramways above referred to. Dr. A. B. W. Kennedy, the Council's consulting electrical engineer, who has charge of this first section of the work of the County Council in reconstructing their tramways reported fully to the County Council on the tenders. For the supply of the continuous-current plant twenty-nine firms tendered, though with the alternatives which most of the companies proposed it made a total of 212 proposals. That of Messrs. Dick, Kerr & Company, for £25,964, was accepted. For the supply of three-phase plant, which, of course, is the more interesting of the propositions, twenty-two firms tendered, with alternate proposals, bringing the total number up to 160. Messrs. Dick, Kerr & Company also secured the contract for this plant, the price being £46,425, which was not by any means the lowest price. Messrs. Dick, Kerr & Company have undertaken to deliver the continuous-current plant in ten months, and the three-phase plant within eighteen months from the date of order, and this time in both cases is less than what was asked for when the tenders were advertised for. In addition to the main engines, Messrs. Dick, Kerr & Company will sublet to Belliss & Morcom, Ltd., of Birmingham, the manufacture of the auxiliary engines necessary.

General News.

ELECTRIC LIGHT AND POWER.

TOPEKA, ARIZ.—Topeka Federal Light, Heat & Power Company has been incorporated, with a capitalization of $1,500,000. The incorporators are Frank D. Lane, William English and C. V. Sayre, of Phœnix, Ariz.

SAVANNAH, GA.—Application has been made for a charter for the Savannah Electric Company. This is the organization that is expected to consolidate all the electrical interests of Savannah. The most prominent of the petitioners are George J. Baldwin, president of the Edison Electric Company; Capt. W. W. Mackall, president of the Savannah Union Station Company; Abram Minis, a local capitalist, and George Nagle, of Chicago. Considerable Boston capital is behind the organization. The capital stock of the new concern is $3,500,000, $1,000,000 to be preferred stock drawing 6 per cent. The common stock is to draw no interest until this dividend is paid. The franchise to be secured controls 23 miles of street and suburban railway and is a very valuable one. The capital stock of the Edison Electric Illuminating Company at present is $375,000, and it is bonded for $250,000. The Savannah Thunderbolt & Isle of Hope Railway is capitalized at $1,000,000, and it has $1,250,000 4 per cent bonds. The City & Suburban Railway is bonded for $250,000. The parties behind this consolidation movement have merged the electrical interests of Columbus, Ga.; Tampa, Fla., and Houston, Tex. Mr. Baldwin is president of the electrical companies in those three cities.

PANA, ILL.—A receiver has been appointed for the Pana Modern Electric Light Power & Street Railway Company.

WELLINGTON, KAN.—The town has voted to issue $15,000 electric light bonds.

DULUTH, MINN.—The Common Council has passed an ordinance to issue 4 per cent 30-year water and light plant extension gold bonds to the amount of $60,000, dated Jan. 1, 1902.

HELENA, MONT.—Mr. H. L. Walker has been appointed receiver for the Helena Power & Light Company.

MACON, MO.—The new electric light plant is completed and incandescent lights are now in use.

BEVIER, MO.—The city government is discussing a $10,000 bond issue for an electric light plant.

CHILLICOTHE, MO.—The proposition to issue bonds to the amount of $25,000 to build a municipal lighting plant was defeated at an election Nov. 26.

ST. LOUIS, MO.—The Citizens' Electric Lighting & Power Company has completed plans for a large electric light and power plant on its property at the foot of O'Fallon Street. All the contracts have been made and the work will be pushed forward rapidly. The completed plant will involve an outlay of $2,000,000.

NEW YORK, N. Y.—Commissioner Kearny, of the Department of Public Buildings, Lighting and Supplies, has arranged to open bids on Dec. 11 for furnishing, operating, and maintaining electric lamps for the term of one year from Jan. 1 next for lighting the streets, public buildings, and parks of the greater city; and for furnishing gas lamps on streets and in parks, etc., in all the five boroughs. The contract amounts in the aggregate to $2,879,041.23.

MARTIN'S FERRY, OHIO.—A proposition to issue $8,000 electric light bonds has been carried.

WARREN, OHIO.—An electrical plant for lighting and power is to be installed in the Warren rolling mill, including new engines, new automatic roll machinery, and a new yard crane engine.

BOWLING GREEN, OHIO.—George G. Metzger, of Toledo, has purchased a tract of land at Grand Rapids located along the river and including a dam in the river. From the headgate of the dam to the Detwiler power plant at Maumee there is a fall of 65 feet 5 inches, and it is estimated that this will develop 2500 horse-power. Mr. Detwiler recently secured permission from the State to build a pole line along the canal to Toledo, and it is stated that the parties will endeavor to secure a franchise for furnishing cheap light and power in Toledo.

SALT LAKE CITY, UTAH.—A large electric power plant is being developed near Tempe, Ariz., on the Arizona canal. Electric energy will be transmitted to Phoenix, 20 miles distant.

SALT LAKE CITY, UTAH.—The Twin Falls Land, Water & Power Company will build a 20,000-hp electric plant at Shoshone Falls, also an electric railway up the river about 30 miles.

SALT LAKE CITY, UTAH.—The Cobre Grande mine of La Cananea, Mexico, will put in a power plant for its smelters. There will be five generators, aggregating 350 kilowatts. Oil will be used as a fuel.

SALT LAKE CITY, UTAH.—The Telluride Power Company has completed its Logan extension south to North Salt Lake, while the Provo extension north has reached Bingham. The ends will be connected by Jan. 1.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The City Council of Whittier, Calif., recently awarded to F. E. Newlin the franchise for an electric railway through the town.

SAN FRANCISCO, CALIF.—The Los Angeles & Redondo Railway Company recently made application to the City Trustees of Redondo, Calif., for a franchise for a double track electric line. The company is now operating a steam motor line. The motive power of the road will be changed to electricity and an improved service will be given between Los Angeles and Redondo.

ANDERSON, IND.—It is admitted that from 90 to 95 per cent. of the people are now patronizing the trolley line between this city and Muncie and between Muncie and Indianapolis. The parlor car limited service is popular and the service throughout is first class in every detail.

LOGANSPORT, IND.—The City Council has granted a franchise to the Wabash River Traction Company to enter the city in one of the most desirable streets in the city. This act is bound to precipitate litigation, as the local company claims exclusive rights to the streets of the city.

INDIANAPOLIS, IND.—Work on the extension of the Indianapolis & Greenfield Rapid Transit Company between Greenfield and Knightstown will begin at once, and it is expected to be completed early in January. This is the new property of the Indianapolis & Eastern Traction Company.

WABASH, IND.—An important deal was made here in the purchase of the old towpath between Lagro and Huntington by the Ft. Wayne & Southwestern Electric Railway Company. The consideration was $2,000 per mile. This deal removes the last obstacle to consummation of the plan of building a line to Logansport, thence to Lafayette.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Traction Company has bought, and is now in control of the Indianapolis & Greenfield Interurban road. This company was incorporated last Spring to build a line to Richmond, and this line will form an important link. The company will extend the line to Richmond, Knightstown and Rushville at once.

INDIANAPOLIS, IND.—The managers of the interurban roads which refused to sign the franchise accepted by the Union Traction Company for admission to the city are still undecided. They have petitioned for an independent right of way into the city, but this is opposed by the local company. The Council is inclined to modify the terms of the franchise so as to base the compensation or tax on the length of the line.

BALTIMORE, MD.—R. Lancaster Williams, of Richmond, has been elected president of the recently purchased Knoxville Traction Company.

TRENTON, N. J.—The New Jersey & Pennsylvania Traction Company, with an authorized capitalization of $1,000,000 has been incorporated.

PATERSON, N. J.—There is a report that a new trolley line is about to be started here. The route of the company, according to reports, will traverse Bergen County, running from Hackensack down Market Street to Carroll, and down Sixteenth Avenue to the Susquehanna station on State Street. It is said the new organization is willing to pay the city a handsome sum for the privilege of establishing its proposed line. The incorporators are said to be Thomas McIntyre, a banker and broker of New York City; Preston Stevenson, of New York, and Frank Frost, a silk dealer of Paterson. The company is said to have a capital stock of $100,000.

ALBANY, N. Y.—The Massena & Raymondville Electric Railway Company has been incorporated; capital, $80,000. Directors: W. J. McKinney, H. H. Warren, and W. J. Patch, of Massena.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company has given a mortgage of $4,000,000 to secure an issue of bonds, the proceeds of which will be used in retiring present bonds and completing extensions now in progress.

MT. VERNON, N. Y.—As outcome of the foreclosure sale of the franchises, etc., of the North Mount Vernon Railway Company, the Interurban Street Railway Company, of Mount Vernon, has incorporated with the Secretary of State; capital, $500,000. Directors: Andrew A. Halsey, Frederick C. Cocheu, Joseph F. Coffey and others, of Brooklyn.

MASON, OHIO.—The village of Mason has granted a franchise through town to the Rapid Railway Company of Cincinnati.

UPPER SANDUSKY, OHIO.—The Tiffin & Southern Railway has been granted a franchise for its line through Upper Sandusky.

UPPER SANDUSKY, OHIO.—Citizens of Upper Sandusky are promoting an electric railway to extend from this place to Bellevue.

SHELBY, OHIO.—Milney Roseborough, of Shelby, is securing right of way for an electric line from Mansfield to Norwalk by way of Greenwich.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway has ordered equipment for a second power-house, which will be located at London.

FINDLAY, OHIO.—The Toledo, Fostoria & Findlay Electric Railway Company has completed arrangements to carry United States mail between Fostoria and Findlay.

SPRINGFIELD, OHIO.—The Columbus, London & Springfield Railway is contemplating building two spur lines, one to South Charleston and the other to Mechanicsburg.

AUSTINTOWN, OHIO.—Citizens of Austintown are endeavoring to induce the Mahoning Valley Railway Company of Youngstown, to extend its Mineral Ridge line to Austintown.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company, which is building a line from Columbus to Newark, has increased its capital stock from $1,000,000 to $1,500,000.

AKRON, OHIO.—The Northern Ohio Traction Company is installing a large lighting generator in its Akron power house, and is endeavoring to secure a contract to illuminate the neighboring town of Barberton.

EATON, OHIO.—The Preble County Commissioners have granted a 25-year franchise to the Cincinnati, Hamilton, Richmond & Muncie Traction Company, which proposes to build a line from Cincinnati to Muncie, Ind.

CLEVELAND, OHIO.—The Richmond & Petersburg (Va.) Traction Company, which is composed of Cleveland people, has perfected traffic arrangements whereby its cars can enter both Petersburg and Richmond.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway has placed a contract for rails to be delivered as soon as possible. The road is under construction between Pemberville and Bowling Green.

COLUMBUS, OHIO.—The management of the Columbus, London & Springfield Railway has announced that the road will be ready for operation from Columbus to Springfield about Feb. 1. It will give through connection from Columbus to Cincinnati.

AKRON, OHIO.—The Akron City Council has granted a franchise to the Northern Ohio Traction Company for a new line on South Main Street to South Akron. The franchise ordinance was in the city's favor, and it is quite probable that the company will refuse to accept it.

COLUMBUS, OHIO.—It is reported in Columbus that the Pomeroy-Mandelbaum syndicate is quietly endeavoring to secure an option on the property of the Columbus Electric Light & Power Company. It is believed that this is a step in the direction of extending this line to Columbus.

NORWALK, OHIO.—The Norwalk, Greenwich & Mansfield Railway Company will shortly be organized. The leading promoters are M. J. Roseboro, of Canton, and J. C. Laser, of Norwalk. The road will touch Shenandoah, Rome, Greenwich and Olena. Work of surveying has been started.

FINDLAY, OHIO.—The southern division of the Toledo, Bowling Green & Southern Railway has been placed in operation from Findlay to North Baltimore, and a regular schedule has been instituted. The connecting link between the two sections of the road will probably be completed this winter.

MASSILLON, OHIO.—The Massillon Council has established a street railway route over streets desired to be used by the Northern Ohio Traction Company for its Akron-Massillon extension, and has advertised for bids for a road over the route. This ends a long fight between the company and citizens.

MANSFIELD, OHIO.—The Wellington, Savannah & Mansfield Railway Company has brought suit against the Mansfield Telephone Company, to restrain it from erecting a pole line along the highway from Mansfield to Ganges. The traction company claims to hold an exclusive franchise on the highway mentioned.

FOSTORIA, OHIO.—It is stated that bonds of the Ohio Northwestern Railway have been sold and that construction work will start as soon as possible with a view to placing the line in operation by the middle of next summer. The road will extend from Fostoria to Jerry City. W. D. Marks, of Fostoria, is at the head of the company.

SANDUSKY, OHIO.—The Erie County Commissioners have been asked to grant a franchise over several short stretches of road to the Sandusky, Clyde, Tiffin & Southern Railway. The road will be built largely on private right of way, all of which has been secured, and will extend from Sandusky to Tiffin. J. C. Parker, of Sandusky, is president of the company.

SANDUSKY, OHIO.—A shipment of rails has been received at Sandusky for the Sandusky, Bellevue, Monroeville & Norwalk Railway, a project which has been hanging fire for several years, after much grading had been completed. Contracts have been let for the equipment of the power-house which is partially completed. W. T. Forsyth is in charge of the construction work.

COLUMBUS, OHIO.—The Mt. Vernon, Mt. Gilead & Western Railway Company has been incorporated, with temporary capital stock of $10,000 by John W. Barry, U. G. Denman, C. D. Smiley, N. S. Wayne, Harry Gotz and Albert McVety, to build an electric railway from Mt. Vernon to Marion with a branch from Mt. Gilead to Galion and another from Mt. Gilead to Delaware.

MT. VERNON, OHIO.—A company, headed by J. W. O'Neil, of Topeka, Kan., and C. E. Jackson, of Middletown, Conn., is about to absorb the Mt. Vernon Electric Street Railway and the Mt. Vernon Electric Light & Power Company. The company expects to immediately begin the extension of new lines in Mt. Vernon and Knox County, one line going to Fredericktown and Gambier.

FREMONT, OHIO.—The Lake Shore Electric Railway Company has served notice on a number of parties along its line that electrical power now supplied them will be shut off in the near future. This includes the power furnished the Fremont Street Railway Company from the Fremont power-house. The company finds that the new lines shortly to be opened will tax the capacity of the Fremont station.

BRIDGEPORT, OHIO.—The Wheeling Traction Company, of Wheeling, has finally closed a deal for the control of the Steubenville, Mingoe & Ohio Valley Railway, which at present operates a line from Steubenville to Brilliant. The line will be connected with the line of the Steubenville & Wheeling Railway Company, which is the Wheeling Traction Company under another name, thus making a through line from Wheeling to Steubenville.

MARION, OHIO.—The Columbus, Marion, Tiffin & Toledo Railway has organized at Nevada, with C. W. Stoltz, Marion, president; W. L. Blair, Nevada, vice-president; G. A. Klaper, Sycamore, second vice-president; H. B. Hane, Marion, secretary, and C. E. Sawyer, Marion, treasurer. The road will run from Marion to Tiffin, connecting with lines now building to Toledo and Columbus. Of the 38 miles of right of way, 34 have been secured.

CLEVELAND, OHIO.—Recent stories relative to the sale of bonds by the Everett-Moore syndicate have been greatly exaggerated, according to a member of the syndicate who is in a position to know. The only bonds sold were $3,000,000 of Detroit & Toledo Shore Line and $2,000,000 of Lake Shore Electric. The report that a large block of Detroit United bonds have been sold is said to be ridiculous, since the Detroit United has no outstanding bonds, and the big Michigan consolidation has not yet been fully effected.

CLEVELAND, OHIO.—The Western Ohio Railway Company has been authorized by the Secretary of State to increase its capital stock from $1,000,000 to $3,000,000. The bond issue and mortgage will be increased to provide for extensions. The road is nearly completed from Lima to Minister. Eventually it will be extended south to Piqua and Sidney, where it will connect with the Southern Ohio Traction Company, and north to Toledo, thus making a through line from Cincinnati to Toledo. Work on the Lima-Findlay division has been started.

CLEVELAND, OHIO.—The officials of the Southern Ohio Traction Company have issued an announcement to the stockholders of the company, stating that the directors have in contemplation the consolidation of the property with several other electric railway properties. The properties to be consolidated are the Hamilton & Lindenwald Rapid Transit Company and the Miamisburg & Germantown Traction Company, both of which have recently been acquired by the Pomeroy-Mandelbaum syndicate. The former company has increased its capital from $100,000 to $250,000.

CLEVELAND, OHIO.—Representatives of a Cleveland syndicate composed of H. Clark Ford, L. W. Prior and W. V. Coons have bought up the La Salle-Peru (Ind.) Electric Railway. It is said that $100,000 was paid for the property. Recently the same people bought up the Streator Electric Railway for $160,000, and it is stated that negotiations are under way for the purchase of the Ottawa Street Railway, and that in event of the deal being closed, the syndicate proposes to construct an extensive system of interurban roads connecting Streator, Ottawa, Utica, La Salle, Peru, Spring Valley, Princeton and Ladd. About $2,000,000 will be spent by the syndicate in carrying out the project.

COLUMBUS, OHIO.—Secretary of State Laylin of Ohio, has just completed a report on electric railway incorporations. He states that for the year ending Nov. 1 there were 97 street and electric railway companies incorporated in Ohio, which was far more than any other class of corporations for profit excepting only the general class for manufacturing concerns. The total amount involved in these incorporations was $24,361,000, of which $16,361,000 was in the

form of increases of capital stock of such companies. Secretary Laylin recommends in his report to the governor that a law be enacted requiring corporations to make annual reports to his office giving such facts as may be considered proper and desirable for the State to know concerning them. He suggests also that before a corporation goes out of business, it ought to be required to file a certificate for reference purposes.

HOMESTEAD, PA.—The Homestead & Mifflin Street Railway Company will construct a line to Whittaker & Lincoln place. A $20,000 viaduct across Munhall Hollow will be constructed to reach Whittaker.

MILWAUKEE, WIS.—The Northwestern Electric Railway Company, capital $25,000, has been incorporated by C. A. A. McGee, H. F. Cochems and W. J. Scanlan, to build electric railway lines in Manitowoc and Sheboygan counties.

MILWAUKEE, WIS.—It is reported that a deal is on foot for the construction of an electric railway between Chicago and Milwuakee, apparently independent of all existing roads.

THE AUTOMOBILE.

THE INDIANAPOLIS TRANSFER COMPANY has expended $25,000 for ten automobile cabs and will put them in service at once. If the experiment proves successful others will be added.

THE GREENCASTLE AUTOMOBILE COMPANY, of Greencastle, Ind., capital $25,000, has been incorporated. The directors are Henry Remek, Q. Broadstreet, et al. The company will manufacture automobiles in Greencastle, Ind.

POSTAL AUTOMOBILES.—Several automobiles will be in the service of the St. Louis Post Office before next summer. The first one, it is thought, will be started some time in January or February, and will carry the mail between the Post Office and the branch station at the World's Fair grounds.

AUTOMOBILES ON THE EADS BRIDGE.—The Interstate Transit Company, which was recently organized under the laws of Illinois, with a capital stock of $200,000, will operate an electric automobile line across the Eads bridge at St. Louis, connecting with the street car lines of St. Louis and East St. Louis. The line is expected to be in operation by March 1, 1902. Six automobiles have been ordered from New York. Plans are being made for additional automobiles to carry twenty persons each.

EDUCATIONAL.

LEHIGH UNIVERSITY is erecting a stone laboratory, 90x43 feet, to be used in connection with the steam engineering work of the course in mechanical engineering. Next fall Lehigh will offer a new and extended course in electro-metallurgy—the first of its kind, it is believed, to be established in this country. The departments of civil engineering and of geology have recently received valuable gifts in the shape of surveying instruments, microscopes, and geological specimens for the microscopic study of rocks.

LEGAL.

DRILL GRINDER LITIGATION.—An important decision has just been rendered by Judge Wing in the Circuit Court for the Northern District of Ohio, sustaining the validity of two patents on drill grinding machines owned by the Worcester Polytechnic Institute, and under which the Washburn shops of the Institute are manufacturing. These patents cover important devices essential to the efficiency of drill grinding machinery and this decision is of great interest to manufacturers of this class of machinery and to the trade generally. A suit is now pending against other parties who have been manufacturing drill grinders.

BUCKET SHOP QUOTATIONS.—In an opinion handed down by the Appellate Court in Chicago, the refusal of the Board of Trade to furnish the Central Stock and Grain Exchange market quotations on the ground that it was conducting a bucket-shop business contrary to law, is upheld, and the decree granting a permanent injunction restraining the Board of Trade and the Western Union Telegraph Company from cutting or disconnecting the telegraph wires is reversed. The decision also reverses the decree of the lower court by which an order was issued restraining the Board of Trade from interfering with or prohibiting any person or firm becoming a member of the Board of Trade from doing business with the Central Stock and Grain Exchange the same as they do with other persons.

DELAYED TELEGRAMS.—A judgment secured by Dr. Edward A. Ayers against the Western Union Telegraph Company for damages for its failure to transmit promptly to the addressee a message delivered by him to its messenger, has been reversed by the Appellate Division of the New York Supreme Court. The telegram was sent from Monmouth Beach, N. J., to Far Rockaway. It was in reply to a message asking if he would perform an operation and requesting an immediate reply. Dr. Ayers, who is a specialist in obstetrics, sent a reply by the messenger. For a delay of over five hours in its transmission, whereby he lost a client, a jury gave the doctor a verdict for $200. Justice Ingraham, who gives the opinion of the appellate tribunal, says he does not think the testimony is sufficient to show negligence on the part of the company in the transmission of the message. In none of the cases to which the court's attention had been called had it been held "that the delay of about five hours in the transmission of a telegram from an office located in a country district in one State, to an office located in a country district in another State, especially on Sunday, when telegraph offices, as well as the offices of other persons and corporations engaged in the transaction of business are necessarily closed for a portion of the day, has been of itself held to be evidence of gross negligence." The court also holds that the regulation upon the back of the telegram by which the sender agreed that the messenger to whom he delivered the answer at Monmouth Beach should be considered as his agent, and not the agent of the company, in delivering the message to the company's operator, was, under the circumstances of the case, a reasonable regulation for the transaction of the company's business. "If the plaintiff had wished to insure the immediate transmission of his message he could have taken it himself to the transmitting office; but with knowledge of this regulation, which he agreed to, if he trusted the message to the messenger who had delivered a telegram, the company would not be responsible for its transmission until it was actually received at the transmitting office."

OBITUARY.

MR. A. W. SOPER.—We regret to state that Mr. Arthur W. Soper died at his home in New York this week, after a five days' illness of acute stomach trouble. He was born in Rome, N. Y., on July 16, 1838. Previous to 1889 he was a railroad man, beginning on the Rome, Watertown & Ogdensburg Railroad, and finally becoming general manager of the St. Louis, Iron Mountain & Southern Railroad. After ten years of service for the latter company he came to New York and became engaged in various interests incidental to railway enterprise. He was president of the Safety Car Heating & Lighting Company and of the Pintsch Compressing Company, and a director in the American Mutoscope Company, Sackett Wall-Board Company, Standard Coupler Company, Citizens' Insurance Company of New York, and the Wheeling & Lake Erie Railroad. Outside of business he was a member of the Union League, Lawyers', Engineers', City, Lotus, and New York Athletic Clubs, the Republican Club of the City of New York, the Sons of the American Revolution, the Museums of Art and Natural History, and of the Chamber of Commerce.

PERSONAL.

PROF. GEORGE FORBES has recently brought before the English public a new "one-man portable-base range-finder" which is said to be very accurate up to 3000 yards, for infantry.

DR. F. A. C. PERRINE has returned to Pittsfield from his long visit to the Pacific Coast. He has brought back incidentally a contract for Stanley power apparatus, running, it is said, up to about $150,000.

MR. E. J. BERG, of the electrical engineering department of the General Electric Company at Schenectady, has been visiting Europe and was last heard of at the Berlin factories of the Union Elektricitäts Gesellschaft.

MR. JACOB A. CANTOR, the president-elect of the Borough of Manhattan, is devoting his thought and energies to the question of streets signs, discussed of late in these columns. "Reform" in this respect is, indeed, badly needed.

MR. PHILIP DAWSON, (M. I. Mech. E., M.I.E.E., Asso. M. Inst. C.E.), of London, has severed his connection with Robert W. Blackwell & Company, Limited, and will practice as a consulting engineer at Lennox House, Norfolk Street, London.

MR. PAUL M. KRAHMER, formerly of the Stromberg-Carlson Telephone Manufacturing Company, is now in charge of the Continental Construction Company, Marquette Building, Chicago, which will do a general financing and construction business.

MR. E. H. JOHNSON, the well known electrical engineer, inventor and promoter, is now in this country, and is making his business headquarters at the Quintard Iron Works, East River, New York City. He is engaged on some developments of considerable importance.

DR. N. S. KEITH has recently been employed on some mining expert work for the New Jersey Copper Mining Company, which is to begin work on the Menlo Park deposits which were worked by Indians nearly two centuries ago, and will now have an output of 80 tons of ore a week.

PROF. SIDNEY H. SHORT, accompanied by Mrs. Short, sailed for England this week on the Kronprinz Wilhelm, after quite a long stay, during which he visited several points of interest. He also participated in the recent American Street Railway Convention and attended the recent meeting of the American Institute of Electrical Engineers.

DR. JOSEPH B. DE LERY, who was once well known in the electrical field, has brought suit against Henry H. Rogers, a large stockholder in the Standard Oil Company, and other industrial combinations, for $100,000 damages, to recover possession of the patents upon which the De Lery Light Company is founded. The light is not electric, however.

MR. F. BOELLING, chief engineer of the Prometheus Company, Frankfort-on-the-Main, Germany, sailed for Germany on Monday last after a very successful visit in this country for the purpose of introducing in the American market the electrical heating apparatus manufactured by his company. The apparatus is already coming into very extensive use in Europe.

PROF. R. O. HEINRICH, whose presence in this country was noted recently, found it possible to prolong his stay and enjoy a few more days here than seemed possible. He sailed for Germany on Saturday last by the Waldersee, having made a very enjoyable stay and renewed many old friendships with former American associates. Prof. Heinrich is the European representative of Mr. Edward Weston and the Weston instruments.

DR. R. T. GLAZEBROOK.—It will be remembered that Congress last winter made liberal appropriations for the establishment of a Bureau of Standards at Washington. The National Physical Laboratory of Great Britain was established two years ago, and being thus further advanced than our own serves somewhat as a model. An article by its director, Dr. R. T. Glazebrook, in the last number of *The Popular Science Monthly* is thus of interest at the present time. The author gives full and ample illustrated descriptions of the Laboratory in Bushy Park and of the objects of a national physical laboratory.

Trade Notes.

FIRE.—The factory at New Bedford, Mass., of C. S. Knowles, dealer in electrical supplies, Boston, Mass., was destroyed by fire recently.

INCREASE OF CAPITAL.—The Green Fuel Economixer Company, of Matteawan, N. Y., has increased its capital stock from $50,000 to $200,000.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, reports the success of "Flexduct" to have been instantaneous, and orders are coming in from all quarters, which is most gratifying to this concern.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is calling attention to its I. X. L. weatherproof, slow-burning, and slow-burning weather-proof wire. Prospective buyers of this high-grade wire would do well to obtain prices and further information from the Central Electric Company.

FUSELESS ROSETTES.—A leaflet recently issued by the New England Electric Manufacturing Company, 71 Federal Street, Boston, Mass., contains a pointer as to the advantages of the fuseless rosettes of this company. On a loose sheet is an illustration of one of these rosettes, showing how the device is wired.

THE ELECTRIC APPLIANCE COMPANY, Chicago, sales agent for Gutmann wattmeters, manufactured by the Sangamo Electric Company, is jubilant over the fact that although the factory was doubled within the past six months, the orders it is sending in are forcing the company to again double its facilities. The Gutmann meter has "caught on."

GEARING.—A 48-page pamphlet just issued by the Dayton Globe Iron Works Company, Dayton, Ohio, contains a complete list of the company's bevel and spur mortise gears, iron spur gears and iron bevel gears. In the manufacture of these gears the Dayton Company uses a grade of charcoal iron which is especially adapted to insure great strength and durability.

MR. E. C. MULCEY, electrical contractor, has opened an office at Oak Lane, above Eighth Street, Philadelphia, Pa. Mr. Mulcey will make a specialty of furnishing annunciators, burglar alarms, call bells, electric lighters, electric fans, etc. He will also do all kinds of electric wiring and repairing. Mr. Mulcey has the best wishes of the electric fraternity in his new enterprise.

THE INDUCTOR TYPE OF GENERATOR, a technical treatise by Edward Heitmann, which ran as a serial in Electrical World and Engineer of Oct. 5, 12 and 19, has been reprinted with illustrations in pamphlet form, making bulletin No. 123 of the S. K. C. system. Copies may be had by addressing the Stanley Electric Manufacturing Company, Pittsfield, Mass.

THE C & C ELECTRIC COMPANY, of New York, has appointed as its Pacific Coast agent the old and well known machinery firm of Parke & Lacy Company, located at San Francisco. The Parke & Lacy Company is to be very soon succeeded by Harron, Rickard & McCone, a corporation recently organized to take over the old company and extend the scope of its work.

THE HAINES & NOYES COMPANY, of Chicago, is sending out a most attractive advertising card consisting of a large black owl on a red and yellow background. When the tail of this owl is pulled, it will be found that attached to it is some printed matter and the "platform" of the Haines & Noyes Company. This "platform" or "policy" is short and to the point, but it seems excellent in every way.

CABLE CLIP.—The uses and advantages of the Boston cable clip, manufactured by the Chase-Shawmut Company, 390 Atlantic Avenue, Boston, Mass., are described in a pamphlet just issued by that company. The device is clearly illustrated, the cuts showing progressively the method of fastening the clip. This clip has real merit and should be looked into by those interested but unfamiliar with the device.

INCREASE OF CAPITAL.—The Marshall-Sanders Company has increased its capital from $50,000 to $100,000, to take care of its rapidly increasing business. The company is located at 301 Congress Street, Boston, with branch offices in New York and Chicago. It is manufacturer of electrical specialties, including sockets, switches, cut-outs, etc. Mr. Norman Marshall is president, Mr. Charles A. Sanders, secretary and treasurer.

"A SIGN OF THE TIMES."—This is the suggestive title of a pamphlet issued by the Mason Monogram Company, 11 Broadway, New York, which manufactures automatically changeable electric display and advertising signs. Attention is called to the possibilities offered by this sign in the way of announcements, advertising, etc. The Mason sign was very fully described and illustrated in Electrical World and Engineer, March 2 last.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the demand for line and construction material has been heavier this fall than at any previous time in its business. It is prepared to ship promptly any of the many appliances necessary to fix up lines for the heavy winter strain on them. The company issues a very complete catalogue covering these, representative of one of the very largest stocks in the United States.

STANLEY & PATTERSON, 93 Liberty Street, New York City, the well known electrical supply manufacturers, have in press a 112-page catalogue, entirely devoted to their large line of telephone apparatus and supplies. In this interesting book are illustrated no fewer than 100 different types of telephones in addition to a full line of telephone apparatus. Copies of the catalogue should be applied for immediately.

NEW ENGLAND ELECTRICAL MANUFACTURING COMPANY suffered by a fire which visited on Nov. 20 the large building at Somerville, Mass., near the Arlington branch of the Boston & Maine Railroad. The fire appears to have originated in the explosion of a fresh barrel of lacquer. Damage to the extent of about $20,000 was done, covered by insurance. Mr. Guy H. Proctor, manager, reports immediate resumption. The company is employing 125 hands, and can fill immediate orders.

ELECTRIC FLASHER.—If electricians and electric light men were more familiar with the workingF of the Reynolds Electric Flasher, manufactured by the Reynolds Electric Company, 221 Fifth Avenue, Chicago, they would be in a position to increase the number of electric signs in their territory by reducing the cost of maintaining them, and increase their effectiveness. Some merchants do not use electric signs because they cost so much. The Reynolds Flasher appeals to such because it keeps the light turned off half the time and saves half the current. Descriptive matter can be had upon application.

ELECTRIC FLASHLIGHT.—The advantages of the hand electric flashlight are becoming so well known that the manufacturers find them one of their best selling articles. Mr. Wm. Roche, 42 Vesey Street, New York, makes a flashlight that has very meritorious features. In the first place it is light, weighing only 1 lb.; it is compact, measuring 9½ inches over all by 1⅝ inches diameter; it is always ready for work; it is portable, and it is safe. On account of the latter feature it can be used around gas and gasolene engines, launches and automobiles without danger of causing explosion, and on account of its lightness it can be used as a bicycle light in an emergency. These lights are supplied with Mr. Roche's new standard dry cells, which have long life.

REFERENCE LIBRARY FOR MECHANICS.—For the purpose of showing the scope and high standard of the American School of Correspondence, the trustees have voted to apportion a limited number of sets of their special holiday edition of the "Reference Library of Engineering Practice" to given districts to be awarded to properly recommended students enrolling for full engineering courses during the month of December. This Library consists of the most important instruction papers in its electrical, stationary, locomotive, marine and mechanical engineering courses. It is in five quarto volumes, handsomely bound in half morocco, and contains 2842 pages, and 1975 illustrations, consisting of original drawings, sketches, sections, details, etc., illustrating every detail of the subjects treated, is thoroughly indexed, and is a unique and extremely valuable addition to every progressive man's library. The library is printed solely for students of the American School, and, as the edition is limited, it would be well to apply at once, as applications can be considered only in the order received. A handsome large handbook describing methods of instruction and the library in detail will be sent to any one upon application.

AMERICAN ELECTRIC TELEPHONE COMPANY.—Among the larger and more prominent manufacturers of telephones and exchange equipment, the American Electric Telephone Company, Chicago, has been quite successful in designing and developing a high class of modern telephone apparatus. Its latest type of central energy multiple switchboard contains approved features of electrical and mechanical construction necessary to the rapid service required from a modern plant. The product of the company comprises everything necessary for the construction and operation of a complete telephone equipment, from the small village exchange to the large metropolitan plant. Among the large number of exchanges recently installed or under contract by this company may be mentioned the new 1200-line central energy equipment at Xenia, Ohio, and Reading, Pa.; 4800-line central energy plant, Philadelphia, Pa.; 8000 telephones, 10,000 terminals, Mansfield, Ohio; 2500 central energy exchange, Marion, Ind.; 1200-line exchange, central energy, Harrisburg, Pa.; 3000-line capacity central energy, Trenton, N. J.; 4800-line exchange, Zanesville, Ohio; installing for 3000 ultimate capacity central energy, Austin, Tex.; 3000-line central energy exchange, Oklahoma City, I. T.; central energy equipment, serving 1200 subscribers, Huntington, Ind.; 1000 central energy, El Paso, Tex., and a number of smaller exchanges, ranging from 500 to 10,000-line capacity.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOV. 26, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

687,189. SYSTEM OF MOTOR CONTROL; W. S. Andrews, Schenectady, N. Y. App. filed July 25, 1901. (See Current News and Notes.)

687,195. SYSTEM OF TRAIN CONTROL; F. E. Case, Schenectady, N. Y. App. filed April 24, 1901. (See Current News and Notes.)

687,203. OVERFLOW ALARM FOR REFRIGERATORS; H. L. Cripps, Jersey City, N. J. App. filed July 9, 1901. A float is pivoted to the bottom of the refrigerator in such a position as to rest upon the surface of the water in the drip pan, and close an alarm circuit when the pan becomes full.

687,222. SYSTEM OF MOTOR CONTROL; A. S. Garfield and C. E. D'Ornellas, Paris, France. App. filed July 27, 1901. (See Current News and Notes.)

687,230. INSULATOR SUPPORT; T. E. Hallett, Chicago, Ill. App. filed Sept. 7, 1901. The threaded end of the pin is formed of sheet metal having the thread rolled in it and made in sections to be slightly yielding for difference in sizes.

687,234. RESOPHONE FOR TELEGRAPH INSTRUMENTS; F. W. Inden, Duluth, Minn. App. filed Jan. 26, 1901. The sounder is inclosed in a sound-proof box from which the sound reaches the ear of the operator through a trumpet.

687,261. MOTOR CONTROL SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed June 15, 1901. (See Current News and Notes.)

687,297. ELECTRIC RELEASING APPARATUS FOR PNEUMATIC PRESSURE BRAKES; A. Bruggemann, Breslau, Germany. App. filed Aug. 2, 1900. The circuit of an electrically operated valve is closed by a manometer, when the pressure in the train pipe falls below the working pressure to thereby set the brakes and call attention to the condition of the system.

687,324. GUN SIGHTING APPARATUS; Edw. W. Lloyd, Newcastle-upon-Tyne, Eng. App. filed April 9, 1901. A miniature target is placed a short distance in front of the gun, the target being capable of movement in any

direction by hand, a diagram holder moves with the target and is marked at the moment the electric circuit of the gun-firing mechanism is closed, by a pencil affixed to the gun.

687,386. PROCESS OF EXTRACTING SUGAR; B. Schwerin, Munich, Germany. App. filed May 25, 1901. (See Current News and Notes.)

687,389. COVERING FOR SUBTERRANEAN CABLES; O. Wilhelmi, Dusseldorf, Germany. App. filed June 20, 1901. A cable provided with a covering composed of bags containing beton.

687,422. ELECTRICAL SWITCH; W. C. Calkins, Momence, Ill. App. filed Feb. 23, 1901. A switch comprising a number of pairs of pivoted arms and contact points of U-shape, with their open ends presented towards the arms.

687,440. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed June 10, 1901. A system having means for causing an increased difference of potential between the plugs of the coherer in order to increase the coherence.

687,452. TROLLEY; G. E. Chapman and G. L. Ensign, Cleveland, Ohio. App. filed Feb. 20, 1901. Means for feeding oil continuously from oil chambers to the bearing and at the same time maintaining the bearings dustproof.

687,455. STATIC ELECTRIC GENERATOR; L. Frandsen and L. Holzhauer, Sandusky, Ohio. App. filed Sept. 20, 1901. The capacity of the machine is said to be increased by arranging the sectors on two glass disks in two concentric rows which slightly overlap each other, the upper portion of the inner row and the lower portion of the outer row, being arranged for contact with the neutralizing brushes.

687,457. ELECTRODE; L. Hargreaves and W. Stubbs, Farnworth-in-Widnes, Eng. App. filed April 9, 1901. (See Current News and Notes.)

687,473. ELECTRIC ARC LAMP; L. F. Bogia, Jr., Philadelphia, Pa. App. filed Dec. 31, 1900. Details.

687,479. ELECTRIC WINDING CLOCK; W. H. Hall, Chicago, Ill. App. filed March 15, 1901. The circuit of an electric winding motor is closed, at intervals, by the clock.

687,569. RHEOSTAT; J. Lundie, New York, N. Y. App. filed Aug. 15, 1901. The resistance is composed of units cast or formed into circular spirals connected in pairs together in S form. These units have a perforated hub at the center of the spiral whereby they are threaded on tie rods; insulating and conducting washers placed alternately between the hubs of adjacent units connect the various spiral resistances in series.

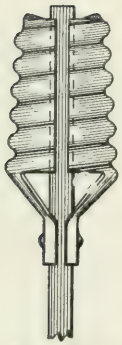
687,576. ELECTRICAL PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed Dec. 1, 1899. (See page 944.)

687,579. MAGNETIC SEPARATOR; F. A. M. Schiechel, Frankfort-on-the-Main, Germany. App. filed April 26, 1898. In a magnetic separator, a magnet having a pole-piece arranged edgewise in a substantially vertical plane and means for projecting the material to be treated in a generally horizontal path or trajectory across the plane of said pole-piece, whereby the influence of the magnet shortens the trajectory of the paramagnetic particles and causes them to fall on the near side of said magnet while the remaining constituents of the mass are carried on and fall on the opposite side.

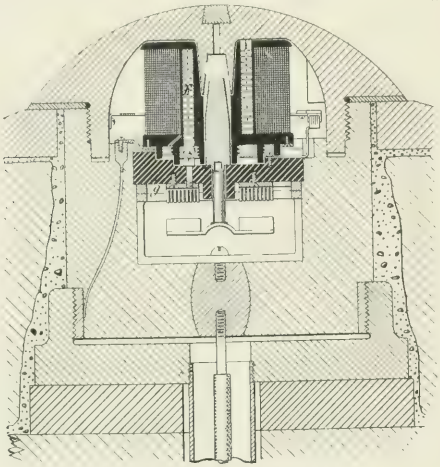
687,615. ELECTROMAGNETIC APPLIANCE; A. Duppler, Jersey City, N. J. App. filed March 25, 1901. A series of magnets and their armatures arranged at increasing distances from their corresponding magnets, means whereby the efforts exerted between such magnets and their armatures may be applied to a body to be moved, and means whereby as such body is moved under the influence of the attraction of such magnets for their armatures, such body is held in the position to which it has at any time been drawn by the effort tending to maintain the nearly closed magnetic circuit between the armature and its corresponding magnet last to come in contact.

687,617. MOUTH ILLUMINATOR; E. Ebi, Cedar Rapids, Ia. App. filed Feb. 1, 1901. A small casing adapted to inclose a lamp and having a tube extending from it, through which the rays are reflected against mirrors at the outer end of the tube.

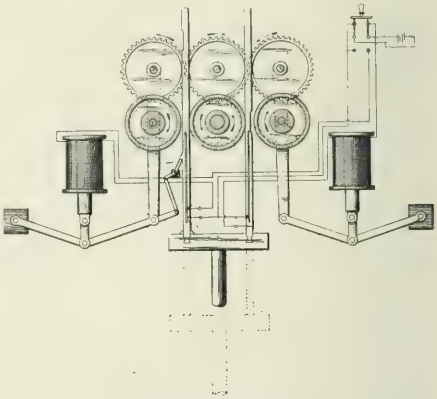
687,622. RAILWAY BRAKE; A. Green, Rochester, N. Y. App. filed May 14, 1901. A single handle applies the mechanical and the electric brake,



687,230.—Insulator Support.



687,522.—Electric Railway.



687,690.—Electro-mechanical Actuating Device for Electric Switches, Valves, etc.

687,499. TELEPHONE TRANSMITTER; William W. Dean, Chicago, Ill. App. filed March 22, 1901. (See page 944.)

687,505. ELECTRIC FURNACE; M. Ruthenburg, Philadelphia, Pa. App. filed Feb. 19, 1901. (See Current News and Notes.)

687,517. INSULATED ELECTRIC CONDUCTOR AND PROCESS OF MAKING SAME; W. S. Clark & G. H. Rupley, Schenectady, N. Y. App. filed Dec. 15, 1899. The conductor is coated with a closely adherent, non-brittle, homogeneous covering containing or composed of amorphous cellulose.

687,518. APPARATUS FOR COATING WIRE OR ELECTRIC CONDUCTORS; W. S. Clark and G. H. Rupley, Schenectady, N. Y. App. filed Dec. 15, 1899. Machine for coating the conductor previously described.

687,522. ELECTRIC RAILWAY; F. C. Esmond, New York, N. Y. App. filed Feb. 21, 1898. Switching apparatus intended to make sure the operation of supplying and cutting off current to and from the working buttons.

687,531. INSULATING MATERIAL; Chas. W. Jefferson, Schenectady, N. Y. App. filed Feb. 7, 1901. Alternate layers of mica scales and a pliable adhesive insulating substance are built up into a sheet; the latter substance is applied when in a liquid or plastic state, and consists of linseed oil dissolved in benzine, to which a very small portion of some gum such as copal is added. A light pressure is applied to the sheet so formed sufficient to smooth out the layers and to expel the benzine gas, after which the sheet is dried by the application of steam heat.

687,532. METHOD OF MAKING INSULATING MATERIAL; Chas. W. Jefferson, Schenectady, N. Y. App. filed Feb. 7, 1901. Method of carrying out above process.

687,561. TROLLEY MOUNTING; F. C. Greene, Lynn, Mass. App. filed March 21, 1901. Details.

means being provided for varying the amount of braking effort applied by the mechanical brake before cutting in the electric brake.

687,623. ELECTRIC TRANSMISSION OF POWER; J. B. Hall, Chicago, Ill. App. filed Feb. 4, 1901. A detail of a peculiar type of electrical generator, called a variarotor, which is described as a torque-producing or accelerating, or variable-speed mechanism which provides a means of obtaining a useful pull with a minimum expenditure of energy. The detail consists of an inductive resistance in circuit with the armature winding.

687,669. ELECTRICAL SNAP SWITCH; G. B. Thomas, Hartford, Conn. App. filed Sept. 3, 1901. Details.

687,681. ELECTRICAL APPARATUS; Merritt Gally, Brooklyn, N. Y. App. filed Sept. 9, 1901. (See page 944.)

687,682. TELEPHONIC APPARATUS; Merritt Gally, Brooklyn, N. Y. App. filed Sept. 16, 1901. (See page 944.)

687,690. ELECTROMECHANICAL ACTUATING DEVICE FOR ELECTRIC SWITCHES, VALVES, ETC.; E. N. Lake, Chicago, Ill. App. filed June 20, 1901. The device comprises a plurality of parallel rollers geared together, a frame embracing a bar adapted to pass between two of said rollers, one of said two rollers being fixed and the other being bodily movable forward and away from the bar in a manner to pinch the bar between the movable and stationary rollers, the adjacent faces of said rollers moving in the same direction and electrically actuating means for forcing said movable roller against the bar.

687,695. ELECTRIC LAMP; K. Ochs, Berlin, Germany. App. filed March 21, 1899. (See Current News and Notes.)

11,952. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed April 9, 1901. The coherer tube is rotated after each impulse, to separate the particles.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, DECEMBER 14, 1901. No. 24.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 14, 1901.

CONTENTS.

PAGE
Editorial 973
Nobel Prizes Awarded 976
Electrical Engineers of the Day—XXIV; G. Herbert Condict 976
Electricity at the Charleston Exposition. By Charles T. Malcolmson, Chief Engineer 977
Electricity in a Newark, N. J., Department Store 979
The Stray Power Method of Testing Direct Current Motors and Generators. By Wm. Lincoln Smith 981
The Economic Design and Management of Telephone Exchanges—II. By Arthur V. Abbott, C. E. 982
Electric Automobile Stages in New York City 983
The Distribution by the Three-Phase System and the Operation of Single-Phase Circuits by It. By W. L. R. Emmet 985
New Telephone Patents 987
The Telephone in French Drama 989
Electric Connection for Refinery Plant 990
Experiments in Wireless Telegraphy 990
Underwriters' National Electrical Convention 990
Telephony on the Pacific Coast 991
A Telephone Money Order System 991
The Telephone in the South 991
New Power Plant for Seattle, Wash. 991
Elocutionary Training for Telephone Operators 992
Telephone Extensions in the Rocky Mountain States 992
Buenos Ayres Lighting and Power Statistics 992
New Forms of Vapor Lamps 993
Current News and Notes 993
LETTERS TO THE EDITORS:
Superposed Alternating and Direct-Current Transmission. By William Smith Horry 995
High Speeds. By A. B. Brown 996
Mileage of Ocean Cables. By E. W. Stevenson 996
Digest of Current Electrical Literature 996
New Series Alternating Current System 999
Fuse Plug Cabinet Panels 1000
Dynamotors for Telephonic Signaling 1000
New Push-Button Switch 1001
DEPARTMENTS:
Financial Intelligence 1002
Commercial Intelligence 1003
General News 1005
Trade Notes 1008
Record of Electrical Patents 1009
Moonlight Table for 1902 ..... Supplement

MOONLIGHT TABLES.

As our readers are aware, this journal has for some years past made a practice of publishing early in December moonlight tables for street lighting work, to be used in the ensuing year. These tables have always been compiled for us by Mr. H. W. Frund, a well-known electric light manager. With the present issue we furnish as a Supplement, in the familiar form, Mr. Frund's tables for 1902, his own table and the standard moonlight system appearing side by side. We are glad to know that this effort is much appreciated, as evidenced not only by the inquiry for tables, but by their frequent appearance on the walls of electric lighting offices and central stations.

TELEPHONE MONEY ORDERS.

Last week and again this week, some of the leading American telephonists have discussed the suggestion that the telephone might be applied like the telegraph, to money order business. It appears from some of the replies that attempts in this direction have already been made, but, of course, they are sporadic and involve no general system. Mr. Kempster B. Miller puts his finger on the great underlying difficulty when he points out that in the case of the telegraph the wires are in the hands of the company, and that with the telephone the wires are in the hands of the public. Unless our memory is at fault, even the telegraph has been tapped or misused by swindlers, to secure the payment of money orders, for which there were no funds in transit, and the telephone would certainly lend itself to collusion and trickery of that kind. Still there is an oportunity for managerial and inventive ability, and in due time a feasible scheme may be worked out.

ELECTRICITY IN GERMANY.

That trade and industry are in bad shape in Germany everybody knows, but we do not see why the *New York Herald*, in its European edition, should be so insistent in loading the whole blame on electrical development. The articles transferred to the local columns of our contemporary are so wild and unfair they seem inspired by a malicious effort to help in depressing German electrical securities. In an article appearing this week, a financier is presented as discussing the situation, and as saying, *inter alia:* "The electric boom came like St. Michael with the flaming sword. The people were as though fascinated under the electric influence. Such a sudden springing up of industries in so short a time with so much capital, with such powerful companies, had been unknown before." * * * "The public was foolish. There has never been in any industry such a desire to finance enterprises in order to obtain special profits as in this electrical boom. But they expected too much." From what we know of the situation this is gross exaggeration. It is true that electrical industries in Germany have been over-stimulated like others, and that some of the methods of financing were injudicious; but to load the whole blame on electricity is little short of an outrage.

We have noted recent events in Germany, and one recollection we have is that the biggest and worst failure had something to do with a grain treatment enterprise quite outside the electrical field. We have discussed the general question with German friends, and have published sober articles from German authorities, and in no sense do we gather confirmation of the *Herald's* attack on electricity. To the contrary, we venture to believe, from the evidence before us, that when German commerce revives, as it will, the electric lighting plant,

trolley road, and electro-chemical industries, will be among the survivors and among the first to prove their permanent earning and dividend-paying capacity.

The Electrified Manhattan.

In our first two issues of this year we gave an elaborate account of the new power house equipment of the Manhattan Elevated, and of the track as adapted to electricity. It now appears that the company hopes to set the plant in practical operation this week, and to furnish current to the Second Avenue line. Mr. Gould speaks hopefully of the early operation of that section of the system by electricity, in which respect we shall be heartily glad to see his expectations justified. Under the regime of steam the Manhattan has made a splendid record of which it can be justifiably proud, but it having been recognized that steam has its limitations for city work, the electrical era cannot now begin any too soon, for the welfare of the road and the benefit of the public. It is a long time since Daft and Sprague and Field did their interesting experimentation on the Elevated, and at one time it looked as though no demonstration would suffice to effect a change; but the electrical period is now beginning and it ought to be good for the road in every way. We note that Wall Street is inclined to take such a view of the situation, for the value of the stock has been steadily higher and rising, making new records. It will, however, be many months before the whole system can be converted and get the full force of the change, and while some of the best talent in the country is engaged on the road, there will doubtless be occasions in the future as now when the public will have to exercise patience if things go a bit amiss.

Efficiency Tests of Direct-Current Generators and Motors.

The article of Mr. W. L. Smith in this issue calls attention to the advantages of the stray-power method of testing the efficiency of direct-current machines. This method is often the only one which can be resorted to in the case of large machines tested singly. When two similar machines are at hand for testing simultaneously they may be connected together as generator and motor, according to the Hopkinson method, in such a manner that when both are operated at full load only the energy losses have to be supplied from the external source, or driving engine. The efficiency found in this way is more reliable than the efficiency computed from losses, partly because two machines are employed, and the resulting efficiency is the mean derived from a pair of machines under simultaneous test, and partly because the machines are each actually subjected to full-load conditions.

When, however, only a single large machine has to be tested, it is often difficult to procure either a suitable load for the full output of the machine, on the one hand, or a sufficient driving power for the input of the machine on the other hand. Under these conditions the determination of the losses is the only method left available, and, if carefully executed, the results are sufficiently accurate for practical purposes. It is customary to assume that this method of testing will be applied when specifications are made for the efficiency of motors and generators. The great convenience of the method lies in the fact that even in the case of a very large machine, say, of 3000 kw capacity, the total losses will only be about 2 per cent of this power, or 60 kw, and this is the maximum amount of power which has to be directly computed, while the losses actually measured will be usually only about half of this, or 30 kw for the case considered. The various requirements for making the test are given in outline in the Standardization Rules of the American Institute of Electrical Engineers.

Facts and Fancies of the "Inner Circle" Arbitration.

For some weeks past we have been watching with no little interest the evidence in the extraordinary arbitration case involving the electrical equipment of the Inner Circle of the London underground road, and as we go to press a cablegram reports that the arbitration committee has decided against the use of the Ganz system and in favor of the direct current. The story of the dispute is rather long and not particularly edifying, but it finally culminated in a series of weary hearings before a referee, at which some of the most distinguished engineers in the world gave testimony. The real parties to the litigation are the Westinghouse and the British Thomson-Houston companies and others, who tendered direct-current apparatus on the one hand, and Ganz & Co., who underbid them with a three-phase tender, on the other hand. The hearing represents the final efforts of both parties to get the business. On one side were marshalled Messrs. E. W. Rice, Jr., Philip Dawson, J. R. Chapman and James Swinburne; on the other, Messrs. Blathy, Kapp, Cardew, S. P. Thompson and Professor Ewing. The former group held tenaciously to the opinion that the system proposed in Ganz & Co.'s tender would prove costly, unreliable and unsatisfactory, the latter that it would fully and certainly meet all the requirements. We had hopes that such an inquiry with such witnesses would throw a great flood of light upon the question of direct vs. polyphase currents for traction, but taking the evidence by and large we must frankly confess that as an exhibition of *ex parte* irrelevancy it stands unique.

It is admitted by all parties that the direct-current equipment proposed by the American "undertakers," as they cheerfully put it on the other side, will do the work and do it thoroughly well, so far as results are concerned. It is maintained by the Ganz Company, and denied by the direct-current exponents, that the three-phase system will do the work equally well, and at a less first and ultimate cost. The former state unequivocally that by going to low frequency and using induction motors in concatenation they have fully solved the troublesome problem of regulation which has been held to disqualify the induction motor for traction service. Ganz & Co., moreover, state that with motors so arranged they have developed the needful power of acceleration and are ready to do business, to which their opponents make answer by denying the equivalence of the conditions, and politely doubting the truth of the allegations. In this stage of the dispute appeared some of the most trivial pettifogging that could well be imagined. For example, learned counsel for plaintiff called attention of plaintiff's witness to the form of trolley car shown in defendant's tender, and elicited the important information that the best practice is tending toward something else, as was doubtless true. But does any one suppose that either party would be shy and bashful about taking a cue from the other when it came to a detail of installation? Assuredly not, unless perhaps the device were patented. And, finally, after the Ganz tender had thus been picked at in detail it was damned in its totality as untried and experimental, quite unworthy an investment on the part of conservative business men. We do not wish to criticize our friends severely, but where would the multiple-unit system on which they rely, be if it had been accorded a similar hearing? On its face it is a nightmare of complication, but, thanks to the skill of our American engineers, it has been worked out into conspicuous and solid success.

The questions at issue are far bigger and broader than the conduct of the dispute. From the large engineering standpoint the first thing to be decided is whether Ganz & Co. have or have not evolved a method of controlling polyphase motors which puts them for traction purposes on substantial equality with direct-current

motors. This is a matter which cannot be ascertained by an *ex parte* investigation of any kind. It is a simple question of fact, to be properly decided by tests on the part of a small and impartial committee of engineers, whose decision ought to be conclusive. If their report were in the negative, we think that no rational board of directors would further consider the Ganz tender. If it were favorable, the next step should refer to the same body the question of relative expense and efficiency on definite assumed conditions of traffic agreed to by both disputants. This step should show definitely whether there is any considerable balance in favor of one or the other. At even money or near it, the direct-current proposition, being for apparatus and methods already approximately standardized, would surely take precedence on the ground of a reasonable conservatism. Finally would come up the broadest question of all, that of general policy in view of extensions and connecting lines—to our minds, a very important matter. This is far more than an engineering question, for it involves not only the adaptability of both methods to conditions of development, but the present and future traffic and financial relations of all the lines involved, which only the insiders know or can guess.

There is an amusing side to the whole matter which must jar upon the nerves of our British cousins. It must be a trifle distressing to see so acrimonious a discussion carried on with the sole object of determining whether a particularly fat British contract shall be taken in by Americans or Austrians. For ourselves, we stand by our countrymen, and suggest that heed be given to such persuasive logic as that of Mr. Parshall, who, unless he has lost his old-time prowess, will come near to having the last useful word. But it is well to understand fully that so far as engineering goes the present investigation has up to date let in precious little engineering light.

Pressure of Radiation.

Maxwell showed, in 1873, that in accordance with his theory of the electromagnetic nature of light, all radiant energy exerts a pressure in the direction of its path, numerically equal to its volume energy. The truth of Maxwell's theory concerning the electromagnetic wave nature of light has since been amply demonstrated, but until quite recently no one has been able to verify the existence of this pressure exerted by light. The reason is that the pressure is so small. For example, sunlight at the earth's surface has a voluminal energy of about 40 micro-ergs per cubic centimeter, and it is supposed that above the atmosphere, that is to say, before the absorption of the atmosphere has come into play, this would represent about 70 micro-ergs per cubic centimeter. Consequently, the push of the sun's radiant heat and light only amounts to 70 micro-dynes per square centimeter, or about 0.7 milligram weight per square meter of normally exposed surface. In other words, a sheet of perfectly black material 1 meter square and supported perpendicular to the sun's noonday rays would only receive a pressure of about 0.4 of a milligram at the earth's surface underneath the atmospheric ocean, while immediately above the surface of the atmospheric ocean it might be about 0.75 of a milligram. If the surface instead of being perfectly black, or wholly absorbent, were absolutely polished, so as to be wholly reflective, these theoretically deduced pressures would be just doubled. With an intermediate surface condition, the theoretical pressures would be between these limits, and would be in the neighborhood of a milligram per square meter.

There would be no difficulty in measuring repulsive forces of this order of magnitude on a torsion balance, but as soon as a vane is supported on a torsion balance and exposed to radiation, either in air or in a highly exhausted chamber, the repulsion which is observed is very much greater than that now considered, and is due to the Crookes effect of molecular bombardment under unbalanced thermal conditions. The Crookes radiometer is nothing more than an apparatus for rendering evident the apparent repulsive forces of radiant energy on a scale much greater than that of the Maxwellian pressure component. It is, therefore, necessary to remove the large Crookes effect from the apparatus before the feeble Maxwellian pressure component can be made apparent.

Two papers on the experimental investigation of this subject have recently appeared, both written about the same date (August, 1901), and both published about the same date (November, 1901), one from Moscow by Lebedew, in the *Annalen der Physik*, and the other by Nichols and Hull from Dartmouth College in the *Physical Review*. Both papers come to the conclusion that after removing, as far as possible, the large Crookes effect, there is an observable residual pressure of the order of magnitude conforming with the Maxwellian law. It is unnecessary to enter into the details of the methods by which the experimenters, working apparently independently of each other, have endeavored to free their observations from the Crookes effect. Broadly speaking, Lebedew, whose results appear to have the greater precision, employed very high vacua. He used an arc lamp throwing about 1-13 of a watt of radiant activity upon his suspended vanes, producing a pressure of about 31 microdynes. These residual pressures were independent of the color of the incident beam, and were within about 10 per cent of the calculated Maxwellian pressure. Nichols and Hull obtained a measured pressure of 105 microdynes against a calculated pressure of 134 microdynes.

The experimental difficulties in the way of accurate observations are quite considerable. The incident activity of the beam has to be measured carefully, and also the mean coefficient of reflection of the surface for the whole spectrum of incident rays, because the coefficient of reflection is not necessarily the same for all waves. These requirements alone call for considerable experimental skill, and when the elimination of the Crookes effect is further taken into account, the difficulties become very great. From a scientific standpoint, however, it is quite important to have the Maxwellian theoretical pressure carefully checked by experiment, and it is to be hoped that still closer and more reliable experimental results may be obtained in the near future.

The total luminous pressure of the sun upon the earth is about 100,000 tons, on the basis of Maxwell's repulsion law; but this is only about the 1-40,000,000,000,000th part of the gravitational attraction, so that the astronomical influence of the radiant pressure becomes insignificant, in the case of the earth. If, however, we consider matter as separated out into a very thin layer of small spheres, each having a density equal to the earth's mean density, then the smaller the spheres, the greater will be the ratio of the radiant repulsion of the sun's light to the gravitational attraction of the sun's mass, because the repulsion varies as the square of the radius of the particle, while the attraction varies as the cube. At any considerable distance from the sun, the attraction and repulsion become theoretically equal upon a spherical particle of matter, about one-quarter of a micron in radius or half a micron in diameter, that is to say, having a diameter about equal to the wave length of violet light. Segregated particles smaller than this would be pushed from the sun, while particles larger than this would be pulled towards it, if it is safe to assume that particles can absorb energy and cast shadows from radiant waves whose lengths are large in comparison with their own dimensions.

Nobel Prizes Awarded.

As recently stated in these columns, the Nobel endowment for certain prizes became available this year, and a cablegram received last Tuesday announces that the prizes for the past year have been bestowed as follows: Physics, Professor Roentgen; chemistry, Professor Van't Hoff; medicine, Dr. Behring, of Marburg; literature, M. Sully-Prudhomme, of Paris. The prize for greatest service tending toward promoting the fraternity of nations, and the abolishment or diminution of standing armies and the formation and increase of peace congress was divided, one-half going to M. Dunant, founder of the Red Cross Society, and the other half to M. Passy, a French deputy and peace advocate. The amount of each of the five prizes, which are to be bestowed annually, is 208,000 francs. The details of the plan for disposing of the Nobel endowment fund have already been given in our pages.

Electrical Engineers of the Day.—XXIV.

G. HERBERT CONDICT.

George Herbert Condict was born in 1862 in Newark, N. J., and received his education in the schools of New York and Philadelphia and the University of Pennsylvania. In 1882 he entered the employ of the Central Gas Light Company, of San Francisco, and the following year built the gas works in East Portland, Oregon, and repaired and extended the gas works in Eureka, Calif. For six months he had an experience in gold mining among the mountains of Santa Catalina, in Arizona. Returning to San Francisco in 1884, he became connected with the Pacific Coast Electrical Construction Company, which had been newly organized to manufacture and install electric lighting and power apparatus, as well as storage batteries under the patents and management of Dr. Nathaniel S. Keith, a former editor of this journal.

In the summer of 1885 Mr. Condict became the Pacific Coast agent of the Van Depoele Electric Company. In order to become thoroughly conversant with the company's apparatus he moved temporarily to Chicago, and became Mr. Van Depoele's assistant in his electric railway and lighting experiments. He installed several lighting plants, and took an important part in the construction of the electric railway in South Bend, Ind., which was the first road with overhead trolley to institute a commercial service in the streets of any city. In 1885 he installed Van Depoele's exhibition trolley line at the New Orleans Exposition, which at the time attracted wide attention. Returning to California in 1886 he installed several lighting plants in mines and sawmills, at the Sacramento State Fair and in other places. In 1887 he took charge of the storage battery street car experiments for William Wharton, Jr., in Philadelphia, which resulted in the organization of the Electric Car Company of America, of which he became the general manager.

It was while engaged in developing the various practical details of the electrical apparatus for the equipment and control of the electric street car of that day, that Mr. Condict invented, patented and first put into service the combined series-parallel and dead resistance controllers with which his name must always be associated. Although it had been considered possible to regulate the speed of electric motors by arranging for different groupings of their coils in series or parallel with each other, yet no successful controller of that type had been made or used. The practice had been to depend solely upon an exterior rheostat connected in series with the motors for the purpose of limiting the rush of current with the armature stationary, and for regulating their speed thereafter, the windings of the motors remaining undisturbed.

Mr. Condict conceived the idea of rendering possible and practical the series-parallel type of controller by combinng with it dead resistances in such relations as to enable the required circuit changes to be made without undue shock and without damage to the apparatus or danger to the operator, all by the movement of the same handle. Economical speed regulation was accomplished by cutting out the dead resistances and then connecting the windings of the fields, the armatures and the motors themselves, in series, parallel or multiple-series or series-multiple combination—that is, in the relation best adapted to the working conditions. Although the controller to accomplish these various combinations among the motors and their coils was initially designed for service in connection with storage batteries, its principles were simple and fundamental. The patents covering the device have conferred enormous advantages upon their owners, and Condict's series-parallel controller when considered as an invention involving far reaching effects commercially and economically, must be classed among the most important factors in electrical development.

In 1887 the Electric Car Company of America undertook to demonstrate the commercial practicability of the storage battery car for city service, and a complete power station and car equipment were subsequently installed by Mr. Condict for the Lehigh Avenue Railway Company, Philadelphia. During the next two years he developed and exploited the storage battery and other inventions of Dr. Isidor Kitsee, which resulted in the incorporation of the North American Electric Storage Battery Company, of Philadelphia, with Mr. Condict as its engineer. In 1893 he became the Pacific Coast agent for the Electric Storage Battery Company, with headquarters in San Francisco, but returned to Philadedphia in 1894 to conduct the engineering work of that company. In 1894, at Merrill, Wisconsin, he installed the first storage battery plant to be used in the United States as an auxiliary to provide for fluctuations of railway load.

During 1896-7 Mr. Condict, as chief engineer and general manager, laid 22 miles of track, built the power house and installed the entire equipment for operating 50 cars for the Englewood & Chicago Street Railway, and afterwards operated the road. The cars were operated by storage batteries, and the important feature of the in-

stallation was the successful handling on a large scale, by mechanical means, and with a minimum of attendance heavy battery car equipments. From a mechanical and electrical point of view this installation was notable and successful, but uncommercial from lack of receipts due to its poor location. Mr. Condict's methods and apparatus established by the operation of the Englewood plant have since been adopted by the Metropolitan Street Railway Company, of New York, in the installation of storage battery apparatus for its Thirty-fourth Street cross-town line, for which he acted as consulting engineer.

In 1897 Mr. Condict entered the automobile field as engineer-in-chief of the Electric Vehicle Company, of New York and Hartford, Conn. He installed in New York in 1897-8 the first electric vehicle station, the batteries of which were entirely handled by machinery. Under his direction, as consulting engineer, practically all the automobiles operated in public service by the New York Electric Vehicle Transportation Company have been designed, built and maintained in service. The large new operating station of the same company, which is equipped with apparatus for handling mechanically the batteries for 500 vehicles, was also installed by Mr. Condict, and he is still connected with that company as consulting engineer.

Mr. Condict is a member of the American Institute of Electrical Engineers, the New York Electrical Society, Franklin Institute and the Engineers' Club.

Electricity at the Charleston Exposition.

BY CHARLES T. MALCOLMSON,
Chief Engineer.

THE illumination of the grounds and buildings at the South Carolina, Interstate and West Indian Exposition is neither as large nor pretentious as the lighting at the Pan-American. It follows rather the more delicate display of the Chateau d'Eau at the "Exposition Universelle de 1900," of Paris. It is interesting and unique, and shows, perhaps, a step onward in what may be called the classic in Exposition lighting.

The grounds are divided into two parts. The Art Section includes the Court of Palaces, combining the Cotton Palace, the Palace of Commerce, the Palace of Agriculture, with their contiguous colonnades into one continuous, horseshoe shaped building; the Auditorium, Administration, Mines and Forestry, Dairy and Live Stock buildings and the Midway. The Natural Section includes the Machinery, Transportation, Art, Woman's, Negro, Fisheries and all the State buildings, the Race Track and Parade Ground.

The general illumination of the grounds and the interior of the buildings is furnished by arc lamps, while incandescents accentuate the lines of the exterior of the buildings. In the center of the Court of Palaces will be found the "Sunken Garden," which is so graded that the lake which surrounds it will reflect the buildings and the myriads of lights to the observer who follows the main walk about this court. The garden is filled with every variety of semi-tropical vegetation, making a beautiful horticultural display. At the head of the sunken garden is placed a pergola with an electric fountain, the water from which, after flowing from the pipes of a Macmonnies Pan and running over basin after basin finally reaches the lake. In the center of the garden is another group representing "The Triumph of Electricity Over Water Power," also with electrical effects. Each shore of the lake is outlined at the water's edge with many colored incandescent lamps, while the whole garden gleams with points of light among the pathways and hedges. At the foot of the Garden is placed a conning tower from which will be flashed great bands of colored light, changing and blending themselves on the facades in the interior of the court.

In Lake Juanita in the Natural Section has been placed the Electrical Island. Here we have the latest development in electric fountains, while on the bridge on the axial line of the Machinery Building will be placed an electrical booth, built up entirely of art glass and gorgeously illuminated by water on which plays an electrical color scheme. This booth is in the form of a half globe representing the southern hemisphere, with Charleston located in jewels. In the electrical booth as well as in the electrical island, day and night effects will be produced. The shore of Lake Juanita will also be outlined in incandescents.

Turning to the practical side of the uses of electricity, the endeavor in this exposition has been to install as nearly as possible a power transmission plant combining a treatment of all the problems that the engineer meets in such an installation. Electricity is used almost exclusively for power and lighting purposes, and every available form or application will be found in practical form on the grounds. The power plant is about two miles from the center of distribution. In it are installed one 500-kw, one 300-kw, one 150-kw and one 100-kw General Electric three-phase, 2300-volt, 60-cycle compensated alternators, belted to one 700-hp, one 500-hp and one 300-hp Harrisburg 4-valve Corliss engines. The boiler plant consists of three 500-hp Babcock & Wilcox water-tube boilers. The current is transmitted to the grounds over two trunk lines composed of six No. 0000 cables. These lines are brought to the substation situated in one tower of the Auditorium Building, and distributed at 2300 volts in ten circuits from a high-potential switchboard of the latest improved type. The switchboard is of blue Vermont marble in five distributing panels 65 by 24 inches, and five sub-panels 25 by 24 inches, and one receiving panel 65 by 30 inches, with one sub-panel 25 by 30 inches. Each distributing panel contains two double-throw, three-pole, 50-ampere oil switches; 12 expulsion fuse blocks, six series transformers. The receiving panel contains two 200-ampere, three-pole, single-throw "G. I." automatic circuit breakers, six series current transformers, 36 ammeter switches, two indicating A. C. wattmeters and a swinging voltmeter scale 1-150. There are the necessary bus-bar connections for two complete circuits, so that any or all of the two trunk lines. By this arrangement all the service lighting load and the interior lights in the buildings can be carried on one set of bus-bars, while the exterior lighting load may be built up, from the machine, giving the impressive effect produced at several previous expositions. Each pole of each current is fused in front of the switch controlling it. The oil switches and circuit breakers were manufactured by the General Incandescent Arc Light Company, of New York, and the switchboard was furnished by the Wagner Electric Manufacturing Company, of St. Louis. To the trunk line is tapped in the arc light circuit board, furnished by the General Electric Company. This board is in four panels of blue Vermont marble, and each panel contains

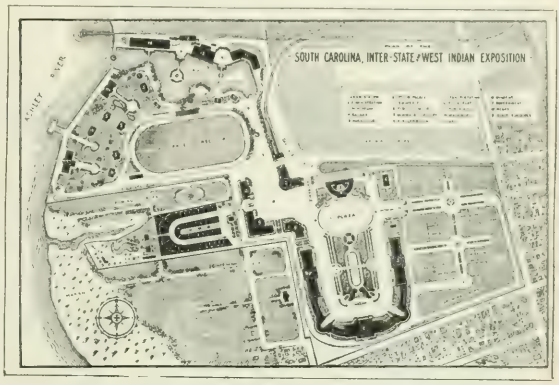


FIG. 2.—MAP OF CHARLESTON EXPOSITION GROUNDS.

FIG. 1.—VIEW OF COURT OF PALACES.

distributing switches for two circuits and an ammeter with current transformer.

All the wiring for incandescent lighting and alternating current for power purposes is on the three-phase system with four-wire secondaries. Each circuit may contain one or more groups, but each group contains three transformers with their primaries in delta and their secondaries in star connections. By balancing each group within itself a fairly good balance of the system is maintained. In this arrangement 200 volts is available for power purposes, and 115

FIG. 3.—AUDITORIUM BUILDING AND TRANSMISSION CIRCUITS.

for lighting in the same circuit; any lag introduced by motor load being compensated on the generator. The transformers are located underneath the buildings at the centers of heaviest demand, and enclosed in rooms thoroughly fireproof. The main circuits for incandescent lighting are carried in wooden subways to the buildings and on glass underneath the buildings in the Art Section. A pole line carries the distributing circuits in the Natural Section.

The arc lighting is in eight circuits of 50 lights each, the lighting in the main building being carried on three circuits to insure constant service. All the arc circuits are carried on leaded wire in wooden conduits, and as accessible as possible to repair. The arc lamps are of the latest type enclosed 1200 cp for alternating current for series lighting, manufactured by the General Electric Company. The arc lamps in the Court of Palaces are supported on decorated poles in keeping with the period of Spanish Renaissance, while the general illumination of the Midway and Natural Section will be established on conventional poles of the street lighting type.

A new departure which had its successful trial at Paris and Buffalo has been made a feature in the motive power branch. All the motors in the Court of Palaces will be furnished to the Exposition Company for the use of exhibitors by the General Electric Company. The exhibitor merely pays a nominal charge to cover the cost of transportation and installation. The Bullock and Wagner companies furnish all motors in the Machinery and Transportation buildings on the same terms.

One of the electrical exhibits which promises to add considerable interest is the 500-kw, 60-cycle rotary converter being installed by the General Electric Company from which the 500-volt direct-current for motor service will be supplied. A one hundred and ten-volt service for small motors and storage battery charging will be furnished by a very handsome automobile charging set manufactured and loaned to the Exposition Company by the Bullock and Wagner companies. A motor-generator set installed in the Auditorium substation will supply 110-volt direct current for use in the Midway and Court of Palaces.

Electricity will play a prominent part in all the main exhibits of this as in preceeding expositions, and its development along lines of motive power and lighting links itself peculiarly with the awakening of this part of our country to electrical possibilities. Since the days of Henry, engineers have realized the adaptability of alternating current to transmission work. The growth of the cotton mill industry, in which South Carolina now leads America, has kept pace with the development and application of polyphase transmission plants, particularly for water powers. No truer forecast of the future of this great Southland can be brought before the world, than will be portrayed in this Exposition, and electricity, most subtle of Nature's forces, will be the agent that, harnessed to the resources of her outlying hills, will bring to her manufacturing and distributing centers, and develop the commercial value of her latent wealth and fertility that have so long lain dormant.

Yerkes' Plan Adopted.

A London cable dispatch of Dec. 10 says that both Metropolitan and Metropolitan District Railway stocks rose considerably on the Stock Exchange that day on the announcement that the arbitrators had decided in favor of Mr. Yerkes' plan for electrifying the "Inner Circle." The really important point, says the writer, was that a decision of some kind be arrived at and speedily carried into execution. Any electrical system would be better than the present state of things. Now that the decision has been given in favor of the plan which most people believe to be the better of the two, there is no doubt that the board of the Metropolitan Company (which favored the Ganz system) will loyally accept it. Mr. Mellor, the newly appointed chairman of the Metropolitan, has pledged himself to that effect. It is expected that the work of electrifying the line will be begun within two months.

FIG. 4.—MACHINERY AND ELECTRICITY BUILDING.

Electricity in a Newark, N. J., Department Store.

THE new department store of Hahne & Co., Newark, N. J., which was opened during the past summer, is one of the largest and most complete establishments of its kind in the world. No expense was spared to make it most modern in construction and equipment, and very naturally electricity enters largely into the plans, although not to so great an extent as might expected in an up-to-date plant where "the best to be had" was the first consideration in its fitting out. Thus we find here a curiously composite operating equipment —hydraulic, pneumatic, steam and electric. The plant is also singular in the adoption of hydraulic elevators instead of electric, which latter have come to be regarded as a necessary part of the equipment of every large modern building.

The lighting of a building of this character and size is necessarily a matter of great moment, and secondary in importance only to the building itself, the other features—elevators, cash carriers, steam generation, etc.—being of relatively minor importance. In the lighting of this store, which is said by experts to be the best lighted store in the country, electricity was, of course, adopted, and science and practice were combined to produce the most effective and harmonious results in the illumination of the immense floor space, the area of which aggregates nearly 12 acres. In developing the plans mere lighting was not the only object in view. Due consideration had to be given to the character of the business carried on in the different departments. In some, incandescent light proves most advantageous in displaying the goods, while in others arc light is more suitable, therefore, in the distribution of the light much care was exercised to obtain the best results. Close proximity of arc light and incandescent light gives an illumination of a reddish cast, which obviously had to be carefully avoided. This was accomplished by separating the lamps of the two classes sufficiently to give the light the proper quality and the greatest quantity of it, resulting in a harmonious distribution which is very noticeable, neither class being preponderant.

The arc lighting system and the incandescent system are interchangeable, so that either may be used, according to the necessities in any particular case. The lighting of the grand court, in the center of the building, is very effectively accomplished, the distribution being so well balanced that the eye is not impressed with any glare or great volume of light at any point.

Before proceeding to describe the plant in detail, a few facts and figures concerning the building may be of interest. The structure is four stories high above ground, and has a frontage of 250 ft. on Broad Street, 275 ft. on New Street, and 200 ft. on Halsey Street, there being an alley at the back. The grand court, upon which, as already stated, special consideration was bestowed in the matter of lighting, is over 200 ft. long, 35 ft. wide and 108 ft. from the floor to the apex of the skylight. In the construction of the building were used not less than 7000 tons of steel, 6,000,000 bricks, 50,000 barrels of Portland cement, 800,000 ft. of flooring, and 75,000 sq. ft. of plate glass, the building, of course, being as thoroughly fireproof as it could be made. This establishment represents the latest development of the department store idea, and embraces some features which are probably not found in any other place of this character. In the toy department, for instance, there is an electrically-driven merry-go-round, which constitutes a great attraction for children. Another new feature is an amusement hall with a seating capacity of 600 persons, and the comfort of smokers has not been neglected, an attractive smoking room having been provided for them in the basement. The restaurant and dairy lunch, which is also in the basement, has a seating capacity of 400 persons—a size equaled by very few restaurants anywhere. The above facts and those to follow will perhaps give the reader an idea of the vastness of this business which began in a small way not many years ago.

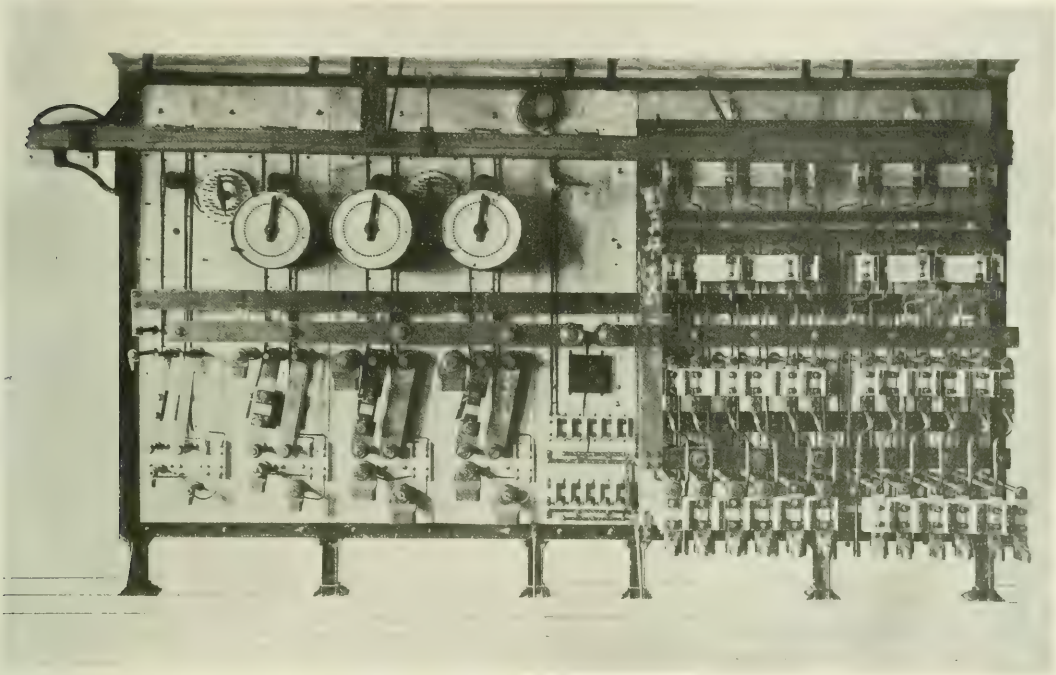


FIG. 1.—VIEW OF BACK OF SWITCHBOARD IN NEWARK DEPARTMENT STORE.

The electric generating plant includes four generators—two 200-kw Crocker-Wheeler multipolar machines, each direct connected to a 325-hp horizontal Harrisburg engine, running at 200 r. p. m.; one 100-kw generator of the same make, and similarly connected to a 150-hp Harrisburg engine; and one 50-kw Siemens & Halske machine direct connected to an 80-hp Ames engine. One of the 200-kw machines is sufficient to carry the ordinary day load, and the Siemens & Halske generator is used for night lighting after the building is closed to the public. The latter machine is of the external armature type, with the commutator on the outside. The Crocker-Wheeler apparatus is the standard make. This latter type of generator was de-

scribed, as to some of its principal features, and illustrated on page 751, of ELECTRICAL WORLD AND ENGINEER, Nov. 2. The future enlargement of the plant is provided for in the allowance of the necessary space for an additional generating unit.

The main switchboard, which was built by the Walker Electric Co., of Philadelphia, is of white Italian marble, and is supported by 12-inch cast bronze feet. It is 8 ft. from the floor to the ornamental marble coping, the length of the board being 14 ft. 3 inches, divided into five panels. There is ample space at the back to permit of work on the connections, etc. The board controls the four generators and 30 feeder circuits. The total output panel of 5000 amperes separates the generator panels from the feeder panels. All the feeder cables were brought to the bottom of the feeder panels and fused at that point. The board contains four Cutter new type laminated circuit breakers, and the usual equipment of generator and feeder switches. The switches are constructed of drawn copper throughout, and are built up on the unit blade principle; that is, there is an independent single-blade switch for each side of the circuit. Each generator switch consists of three such unit blade switches, the third one being for the equalizer bus-bar.

Among other features of the board are a swinging dynamo voltmeter and the arrangement of the pilot lamps to indicate which machines are in operation. The voltmeter is set on a swinging bracket placed at the upper right-hand corner of the board. This permits of readings being readily taken from any part of the switchboard. There is also a voltmeter on the output panel. The pilot lamps are located directly under the ammeters and placed in holes cut through the board, the front ends being covered with ruby glass, and flush with the surface of the board; hence the operation of any machine gives a visual indication by a red light. The indicating instruments are of the Weston standard station dial type, Ward Leonard enamel field rheostats being used. All the fusing is done at the back of the board, and the connections are particularly well arranged for accessibility for re-fusing. The bus-bars are built up of 4-inch copper bars. A noticeable feature in the construction of the board is the absence of cables at the back. The connections between the switch terminals and bus-bars are made by means of studs and heavy copper rods, which arrangement gives great compactness, being at the same time symmetrical in appearance. The dynamo leads are covered with manila tarred rope.

On the front of the board, at the center, is a G. E. 5000-ampere recording wattmeter, which registers the total output of the plant. For so large an establishment the few switches on the board is strikingly noticeable. The main board, however, does not control the general distribution. There are five sub-boards under the control of the main board and from these the mains run to panel boards on the different floors, there being 72 marbleized slate panel boards in all, 8 to 12 on each floor. Most of the sub-boards are fed by four 450,000 cm. cables, run from the main board in multiple. The wiring throughout the building is run in 30 miles of loricated conduits manufactured by the Safety Conduit Company, of Rankins Station, Pa., Grimshaw wire being used.

The electric plant was designed for a total capacity of 13,000 arc and incandescent lights. Four hundred Manhattan enclosed arcs are used in the lighting of large spaces, and 10,000 incandescents supplied by Messrs. Goodchild & Welsh, of Newark, are distributed throughout the building, over 1200 being used in the illuminating of the grand court alone. The distribution of this light in the grand court is effected by means of lamps bunched on fixtures attached to the columns on each floor surrounding the court.

An important feature in the lighting scheme is the showcase lighting, there being 3100 case lights in use throughout the store. The showcases take the place of the old style counter, and are constructed entirely of glass, standing on the floor. The case lights are arranged along the upper interior edges of the cases and by the aid of shields, throw the light downward upon the goods, the lamps being so effectually screened that the eye of the observer does not perceive the direct light at all. These light were installed by the Barker Wire Company, of New York. They are finished in nickel, the wires being run in nickeled tubing. In the illumination of the show windows 450 ft. of Frink's special window reflector are employed. Besides this there are 175 Frink sectional glass cluster reflectors used throughout the interior of the store.

Electric power very naturally fills an important role in the business of the establishment. It is utilized in operating the machinery in eight manufacturing departments, Crocker-Wheeler motors, ranging from 2 to 14 hp, being used for this purpose. They are placed on the floor and belted to floor shafting. The departments requiring power include the shade, cloak and suit manufacturing, millinery, carpet sewing, picture frame, furniture and upholstering departments, carpenter shop, etc. An interesting application of electric power is in the operation of the escalator, or stair lift, which runs from the main floor to the second story. This stairway was built by the Link Belt Engineering Company, of Nicetown, Philadelphia, and is driven by a 10-hp Lundell motor. In its operation this company's silent-chain drive is used. This system of drive is also employed in the operation of the merry-go-round referred to in the earlier part of this article. This ingenious type of stairway was fully described and illustrated in ELECTRICAL WORLD AND ENGINEER, of Sept. 22, 1900, since when it has been considerably improved.

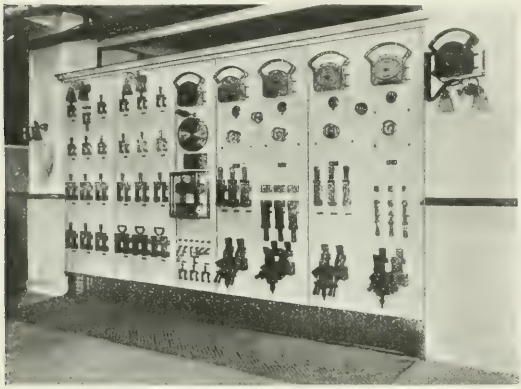


FIG. 2.—FRONT VIEW OF SWITCHBOARD.

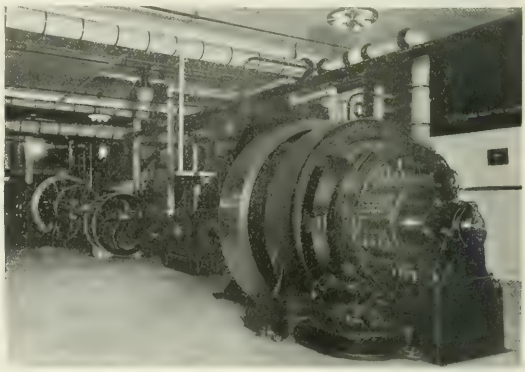


FIG. 3.—ONE OF THE GENERATING UNITS.

The steam-generating plant consists of four 300-hp Caldwell water-tube boilers, arranged in two batteries of two each. They are hand fired, the coal being dumped in front of the boilers directly from the trucks. One of the principal constructional features of these boilers is the design of the header. The header castings, into which the tubes are expanded, are composed of one piece, are quadrangular in shape and are provided with openings or hand holes in front, thus providing access to the tubes. The Caldwell boilers are made by James Beggs & Co., New York.

The steam power equipment is commensurate with the importance and magnitude of the business carried on in this establishment. The refrigerating machine, with a daily capacity of 7 tons of ice, was made by the Remington Machine Company, Wilmington, Del. Three compound Deane pumps are used for the elevator work, one for the surge tank and two for the pressure tanks, a Westinghouse air compressor supplying the necessary pressure for the two last-named tanks.

The telephone equipment for the firm's business consists of 65 in-

dividual telephones connected to a private Bell exchange, through which the public exchanges of the New York & New Jersey Telephone Company is reached from any one of the 65 instruments. There are also a public pay telephone station and a telegraph office on the premises.

The Thompson-Starrett Company, of New York, was the general contractor for the building and its equipment complete; the electrical plant was designed and installed under the supervision of Mr. H. D. Babbitt, the company's electrical engineer. Mr. Benjamin F. Pangborn, chief engineer of Hahne & Co., has charge of the plant. The architect of the building was Mr. G. Starrett and Messrs. Clinton & Russell, consulting architects.

The Stray Power Method of Testing Direct-Current Motors and Generators.

By Wm. Lincoln Smith.

ONE of the simplest methods of testing direct-current generators and motors, while at the same time easy of application, rapid and exceptionally precise in its results, is that known as the "stray power" method. I am led to writing these notes upon this method not because they contain anything novel, nor because they will prove of especial interest to thoroughly trained engineers, but because of the interest I trust they may have for numbers of persons having to do with medium-sized machines in shops, and similar situations, who would appreciate the possibility of making at intervals a test for efficiency quickly and easily, without the necessity of moving the machine or of setting up any large amount of auxiliary apparatus.

In this method the instruments needed are a speed counter, a voltmeter (preferably with a high and low scale) and an ammeter capable of reading the current required to drive the machine as a motor running idle. If the machine is a generator we must provide also a resistance suitable for starting it, and it is well to have at hand a couple of short-circuit plugs so that the ammeter may be readily shifted from armature to field circuit without shutting down. In what follows:

W_0 = output, W_i = input, L = total loss, f = commercial efficiency.
V_t = volts at terminals, I_l = current in line,
V_b = volts at brushes, I_a = current in armature,
R_a = resistance of armature, I_m = current in field,
R_m = resistance of field, P = stray power.
N = speed.

The commercial efficiency of a dynamo is equal to the net output divided by the input, or

$$f = W_0 \div W_i = (W_i - L) \div W_i = W_0 \div (W_0 + L)$$

In the case of a generator where the output can be determined electrically we should use the last form; in the case of a motor for the same reason we should use the second term. If we are working from the "name plate data" the output will, of course, be taken from the plate and no full load readings made.

In either case, if we can determine the losses directly under the desired conditions, we can find the efficiency under rated load (or at any other desired point) without the necessity of measuring any quantity mechanically, so avoiding all errors due to more or less rough mechanical methods.

The quantity L is made up of

1° $I^2 R_a$ in the armature circuit.
2° $I^2 R_m$ in the field circuit.
3° Hysteresis losses.
4° Eddy current losses.
5° Windage, bearing and brush friction, etc.

Although these losses all appear ultimately as heat, the first two are classed together as heating loss, and the remainder are lumped together and called "stray power."

The heating losses are readily determined for any load, provided we know the warm resistances. The stray power will vary from time to time, and is a function of 1° field strength and 2° speed; and other things remaining the same, it will vary in some way with these two quantities, so that we may say with an exceedingly close approximation to the truth, that if at different times tests be made under the same conditions of field strength and speed, the stray power found will be the same.

Now, how may this quantity be determined? Suppose the machine to be run as a motor under no load. Evidently the power supplied is simply that required to balance the losses, and hence if we measure V_t and I_l; the product of these two will give the sum of the losses at no load in watts; and if from this sum we subtract the two heating losses the remainder will be the stray power.

The following example will make the whole process clear. Suppose we have a shunt motor rated at volts 220, speed 1200 and horsepower 5.

Let the machine be run long enough to be thoroughly warmed up and then running idle, measure and find

$$V_t = 220.0 \quad I_l = 2.3 \quad I_m = 0.3 \quad \therefore I_a = 2.0$$

Then shut down the machine and find the armature resistance; or

$$I_b = 5.0 \text{ and } I_a = 10.0, \text{ and } R_a = 0.5 \text{ ohm.}$$

Now, $V_t\, I_l = 220.0 \times 2.3 = 506$ watts = input or loss;
$V_t\, I_m = 220.0 \times 0.3 = 66$ watts = heat in field.
$I_a\, R_a = 2 \times 2 \times 0.5 = 2$ watts = heat in armature.
$P = 506 - (66 + 2) = 438$ watts = stray power.

At full load (by name plate)

$$W_0 = 5 \text{ hp} = 5 \times 746 = 3730 \text{ watts.}$$
$$W_i = 3730 + P + V_t\, I_m + I^2_a\, R_a$$

$V_t = 220.0$, I_m may be assumed as before $= 0.3$, and I_a is given by $I_a = (3730 + 438 + 0.5\, I^2_a) \div 220.0$
or, $I_a = 19.84$ amperes.

Then at full load

$P = 438$, $I^2_a\, R_a = 197$, and $V_t\, I_m = 66$, or
$L = 701$; $W_0 = 3730$; $W_i = 3730 - 701 = 4431$.
$f = 3730 \div 4431 = 84.2$ per cent.

Very often the result as found above is close enough, but it is seen at once that we have taken no account of any possible change in the stray power in passing from no load to full load, and as such change is certain to occur we must for close work either correct for it or else make the run under full load conditions of speed and field. We must then have some quantity to serve as an indicator of field strength so that, the speed being fixed, we can tell when the field strength has been reproduced. The best quantity for this purpose is the voltage developed by the armature, or $V_b + I_a\, R_a$ in the case of a generator, and $V_b - I_a\, R_a$ in the case of a motor, i. e., the armature voltage.

We may now proceed in two ways: First, estimate the full-load current and calculate at what voltage the machine must be run as a motor idle in order that its armature voltage may be that which it would have when running fully loaded under normal conditions. Then by simultaneous adjustment of field resistance, lead and terminal voltage, produce for the idle run the exact full load conditions of speed and armature voltage. We may then feel confident that the stray power found is what we ought to use. Of course, we may apply the same process for any desired fractional part of full load and thus determine the complete curve for the machine.

We shall find, however, that these adjustments are laborious and somewhat difficult to make, and fortunately they are not required in the majority of cases.

Second, it has been found by a careful study of the variation of stray power and speed and of stray power and armature voltage that within not too wide limits it may be assumed that the stray power varies linearly with speed and linearly with the armature voltage, and may, therefore, be corrected in proportion to the changes in those quantities.

Returning to the example, suppose that we had also made a reading of the speed at no load and found it to be 1220 r. p. m.

Since the correction is not large, it will be close enough if we assume the full-load armature current to be 20 amperes.

Our armature voltages then are

Full load, $220 - (20.0 \times 0.5) = 210.0$
No load, $220 - (2.0 \times 0.5) = 219.0$ (at $N = 1220$)
No load, $219 \times (1200 \div 1220) = 215.0$ (at $N = 1200$)

The stray power then will be

$$438 \times \frac{210}{215} \times \frac{1200}{1220} = 421$$

For full-load current, I_a (found as before) will be 19.76, and

$$I_a = 421 + 195 + 66 = 682,$$

$$W_i = 4412, \qquad W_o = 3730, \text{ and}$$

$$f = 3730/4412 = 84.6 \text{ per cent},$$

as compared with 84.2 per cent obtained by neglecting to make the correction. The stray power is, of course, made up of two parts, one of which varies as the square of the armature voltage and the other directly as the speed. These two parts can be separated, but it is sufficiently close to work as above. Again, the several components of the stray power vary among themselves from time to time, but we can assume that they do not all vary the same way at once.

It is safest to get as near to the full-load conditions of speed and armature voltage as convenient without undue waste of time, as in that case the results are, of course, rather better. In regard to the brushes, one should take care not to disturb them in any way after the desired conditions are reached, as a very slight change in position or quality of contact with the commutator will make a serious change in the other conditions of the test.

The chief advantages of this method are that it is simple and accurate, it requires little apparatus, the machine does not have to be loaded, all measurements are electrical, the assumptions are close to the truth for closed-coil machines, and the time required is brief.

On the other hand, it does not bring out faults which might show up under full load, the stray power may be slightly smaller than it should be, and hence the efficiency found slightly higher than the true value. Taking it all in all, however, the method is probably better than almost any other for direct-current machines of moderate sizes except, of course, open-coil machines.

The Economic Design and Management of Telephone Exchanges—II.

By Arthur V. Abbott, C. E.

As a preliminary to entering into the details of the subject, the following definitions of terms that will constantly occur are given:

DEFINITIONS.

General or Fundamental Terms.

a. *Central Office, Central Station,* or *Central.*—The building or office space, switchboard, and all auxiliary apparatus, excluding cable entrance and cable terminals, required for placing subscribers in talking relations with each other, without the use of trunk lines extending outside the building in which the switchboard is located.

b. *Exchange.*—A collection of central offices connected by trunk lines over which any subscriber tributary to any of these offices may talk without paying toll charges, often used synonymously with central office. An exchange must have one central office, and it may have several.

c. *Territorial Exchange.*—A collection of exchanges and connecting toll-lines under the management of one corporation.

d. *Wire Plant* or *Line Plant.*—All of the installation required to provide electrical connection between the outside walls of sub-stations (see *Sub-Station*), and the main distributing boards (see *Main Distributing Board*) of the Central offices to which the sub-stations are tributary, and in addition includes the plant connecting the *Main Distributing Boards* of the various central offices in a given exchange.

e. *Sub-Stations.*—The term "Sub-Station" designates either the place at which the subscriber's outfit is located, or generically all the apparatus required for the equipment of a subscriber.

f. *Branch Exchange.*—There are many cases of isolated groups of subscribers who desire to talk frequently among themselves, and to have occasional connection with other exchange subscribers. To pass all the messages that such a group originates through the central office would require an unnecessary outlay both in apparatus and service. Hence it is customary to place such subscribers in a small switchboard by themselves, connecting them to the central office by one or more trunk lines. Such an installation is called a *Branch Exchange.*

g. *Bridge.*—A shunt, electrical circuits, or pieces of apparatus carrying electrical currents in parallel are said to be bridged or in bridge.

h. *Message,* often called *call* or *connection,* sometimes a *switch.*—The act of signaling the central office, also the conversation which takes place between two subscribers. Messages are divided into (1) originating messages, or those which are made by subscribers in signaling the office to which they are attached, and (2) trunk messages, or such messages as proceed from the office in which they originate over trunk lines through some other office to the called subscriber.

i. *Noise, Induction, Cross-Talk.*—Any line on which any sound can be distinguished other than the conversation of parties at the ends thereof, is said to be *noisy* or afflicted with *induction.* When conversation passing over a neighboring line can be distinguished there is said to be *cross-talk.*

j. *Private Exchange.*—A branch exchange without trunk lines to a central office.

k. *Repeating Coil.*—Two coils of wire so wound on the same core that electric impulses in one will excite corresponding impulses in the other; a transformer. Repeating coils may be step-up, even, or step-down, depending on the mutual relations of the primary and secondary windings.

l. *Retardation* or *Retardation Coil.*—An inductive resistance.

m. *Telephonic Center.*—That point within any group of subscribers from which the sum of the distances, measured along streets, to all sub-stations, is minimum.

n. *Trouble.*—When any piece of apparatus is out of order, or a circuit does not operate in a normal manner, it is said to be in *trouble.* Employes, whose business it is to remedy such defects, are called *Trouble Men,* and the difficulty when removed is said to be *Cleared.*

SUBSIDIARY TERMS.

Central Office Equipment.—The entire outfit, excluding building, cable entrance, and cable terminals needed for a central office, usually divided into four parts: (1) The switchboard, (2) the distributing boards, (3) the power plant, (4) the operator's furniture.

The Switchboard.—The switchboard is that portion of a central office equipment provided to enable operators to answer subscribers' signals, connect them together in talking relations, and disconnect lines when conversation is complete.

Types of Board.—There are two distinctive fundamental types of switchboard in use. One, the *Multiple Board,* in which on each subscriber's line, the jacks (see Jack) are repeated or *Multiplied* a sufficient number of times to place a jack on each line within the reach of every operator that can sit at the board; the other, the *Transfer Board,* in which there is only one jack to each line, and every operator who wishes to connect to a subscriber whose jack is not in front of her must *transfer* the message to some other operator before whom the desired subscriber's jack does appear. These two types shade into each other in all degrees.

There are also three other distinctive switchboard features leading to a subordinate classification under the preceding general divisions. These three features involve the methods whereby electrical energy is supplied for signaling and talking. (a) *Magneto Boards* are those in which the calling and clearing-out signals (see Signals) are actuated by current obtained from a small magneto generator driven manually by the subscriber, and electricity for talking is supplied by a local battery at each sub-stations. (b) *Automatic Signal Boards* are those in which the calling and clearing out signals are given automatically by the removal and replacement of the receiver (see Receiver) on the hook (see Hook), electricity therefor being supplied from a battery at the central office. Under this division also fall a small number of boards, tending to become obsolete wherein the call signal is made by pushing a button, and the clearing out is automatic on the replacement of the receiver, battery being supplied from the central office to actuate the signals only. (c) *Common Battery Boards* are those in which *all* electricity both for automatic signaling and talking is supplied to all subscribers from one *Common Battery* located at the central office. Common Battery Boards are frequently called Relay Boards, or Central Energy Systems, and automatic signal boards are also, though erroneously, so termed. It is obvious that these types of board may be built on either the multiple or transfer system.

Sub-Divisions of Switchboards; A. & B. Boards.—The *Switchboard* in every exchange having more than one central office is divided into two parts, one devoted to receiving calls from the subscribers connected directly to the office under consideration, and in making connection between such subscribers and others either located in the same or other offices. This part of the switchboard is called the *A Board,* the *Subscribers' Board,* the *Answering Board,* or the *Originating Board.* The other portion of the switchboard is

devoted to *receiving* calls made by subscribers connected to *other offices only,* and in making connections only to subscribers in the office under consideration. This portion of the board is called the *B Board,* the *Trunking Board* or the *Connecting Board.* Where there is only one central office, no B boards exist. The construction of these two parts of the switchboard is, in some features, radically different.

Position.—Every switchboard may be considered to be made up of a number of exactly similar yet entirely distinct units, each unit being that amount of apparatus necessary to the vocations of *one single operator.* Such a collecation of apparatus is called a *Position.* As the functions of an operator at an "A" Board are different from those at a "B" Board, the "A" positions will be differently equipped from the "B" positions, so it is usual to speak of any switchboard as consisting of so many "A" positions and so many "B" positions, and as each position of each kind is similar to all the others of the same kind the total cost of the board is easily obtained by multiplying the cost of each kind of a position by the number of each.

"A" Position.—Each "A" position may be divided into three parts. (1) The Subscriber's Line Equipment. This is usually understood to embrace a protector (see Protection), a pair of terminals (see Terminal) in the main and intermediate boards (see Distributing Board), an answering jack and signal (see Signal), together with all connecting cable and other auxiliary apparatus. In magneto boards the signal is a drop (see Drop), but in automatic signal, and common battery boards, it is a small incandescent lamp, operated by a relay (see Relay), and the subscriber's line equipment includes the lamp and socket, relay and cut-off or controlling relay for extinguishing the lamp when the operator answers, together with a unit portion of the relay racks and connecting cables. (2) *The Multiple.*—The *Multiple* or *Multiple Jacks* comprise the entire outfit of jacks needed to enable each operator to transact all the business that comes to her. The Multiple Jacks are divided into two parts, the *Subscribers' Multiple,* or the jacks that are attached to subscribers' lines, and the *Out-Trunk Multiple,* or the jacks that are provided to enable each "A" operator to have access to all of the trunk lines (see Trunk Line) that extend to other offices.

(3) *The Operator's Equipment.*—Each operator must be provided with apparatus wherewith two lines may be connected together, must be able to receive instructions from the calling subscriber, and be able to ring the party called for. To connect lines together it is usual to provide a pair of plugs (see Plug), fitting the spring jacks that are connected by a flexible cord (see Cord); by placing one of the pair called the answering plug into the jack of the subscriber calling, and the other called the connecting plug into the jack of the one called for, the two lines are connected together. Each pair of cords is supplied with a switch or key (see Key), so constructed that when the handle is moved in one direction the receiver and transmitter supplied to the operator are connected to the line and when in the other the operator sends ringing current over the line of the called subscriber. In magneto boards, a drop placed across the cords notifies the operator when conversation is complete, while in Automatic Signal and Common Battery boards, a pair of lamps is attached to each cord informs the operator when each party replaces the receiver. These are called *Clearing-Out or Supervisory Signals.*

Thus the pair of cords and plugs with the associated ringing and listening keys and signals complete a cord equipment of which from 10 to 17 are placed in front of each operator on an appropriate shelf. Each operator is supplied with special lines extending to the chief operator, and to the trunk operators in other offices in exchanges of several central offices. These lines are called *Call Circuits* or *Order Wires,* and the switches connecting them to the operators' talking circuit "Order or Call Wire Keys." In the modern boards, a *Pilot Signal* placed in parallel with all the line and supervisory signals, calls the operator's attention night or day to the fact that business is to be transacted.

"B" Positions.—"B" Positions differ from "A" Positions in two important respects. There are no outgoing trunk jacks, as "B" operators receive calls from other offices only. Each trunk from other offices, equipped with a cord, plug and clearing-out signal, terminates on a shelf before the "B" operator. Hence, the "B" operator has only single cords and plugs of which there are usually 25 or 30 per operator; a key to ring the called subscriber that is frequently arranged to be automatically tripped by the removal of the called subscriber's receiver from the hook, and no listening key.

Electric Automobile Stages in New York City.

Reference has been made from time to time in these pages to the acquisition of the Fifth Avenue stage line by the New York Electric Vehicle Transportation Company, and we are now glad to be able to announce that the electric automobile omnibusses or stages that have been promised are actually in operation. It is the intention that in due course of time the electric shall supersede entirely the horse vehicles, which are recognized as being an anachronism as well as out of keeping with the handsome thoroughfare which they traverse. President Henry Sanderson and Mr. G. H. Condict, the engineer of the company, have been giving a large amount of time and attention lately to this work, and have had the satisfaction of putting in operation this new service at an opportune juncture. Last week when the weather had rendered the streets a mass of ice and it was pitiable to witness the efforts of horses to pull even the lightest vehicle, electrics of every kind were able to circulate freely and swiftly, and to negotiate any of the glassiest hills with the minimum of trouble.

The Fifth Avenue omnibus headquarters are in East Eighty-eighth Street, near Fifth Avenue, and the regular line of route is from the corner of those two thoroughfares down Fifth Avenue straight away to the Triumphal Arch on Washington Square and Bleecker Street. At the present time the new owners have 36 horse busses in service operated normally with 236 animals, and with two hill horses on the

Fig. 1.—Electric Automobile, Fifth Avenue Stage Line.

incline at Thirty-fourth Street. The rate of the fare has been 5 cents for one trip in one direction, without commutation or transfers. The time occupied in a round trip has been 1 hour and 40 minutes, but this is being considerably cut by the electric stages, which already, with stops at every four blocks, have shown a speed of 38 minutes 30 seconds in one direction and 34 minutes 30 seconds in the other, or less than an hour and a quarter. At the present time there is a discrimination of fare in favor of the old horse stages, as 10 cents is charged for a ride in the electric stages. The electrics, however, furnish a superior and luxurious means of travel. The insides are handsomely upholstered and cushioned. A tall man can move around freely without jamming his hat, as in the old stages; the lighting is electric, and everything is clean and sweet. No conductor is carried, fares being placed, as usual, in a receptacle at the driver's end of the vehicle, and the driver is, therefore, in sole command of the vehicle. The driver is trimly costumed in a uniform with brass buttons, and wears the familiar automobile cap. On the sides of the vehicle are neatly painted labels announcing the fare.

The omnibuses have two motors of 4 to 6 hp capacity, each driving on the rear axle, with exposed spur gearing at each side. The vehicles are steered by wheel, and have the standard form of Electric Vehicle Company's controller. The batteries in use for the smaller vehicles are of the Exide type, and there are 48 cells, giving four hours' capacity at a discharge of 70.4 amperes, the average discharge running 60 to 65 amperes on the third notch, or equal to a speed of slightly over 12 miles an hour; the four approximate speeds for the four notches being 3, 6, 12 and 15 miles an hour. The approximate

weight of this battery with the tray is 3800 lbs. The only call upon the batteries outside of propulsion is for the two side lights and the two flat bulb marine lights in the interior of the vehicle. The weight of the smaller busses is given as 10,350 lbs., while the larger busses with battery complete will weigh nearly 15,000 lbs. These busses of

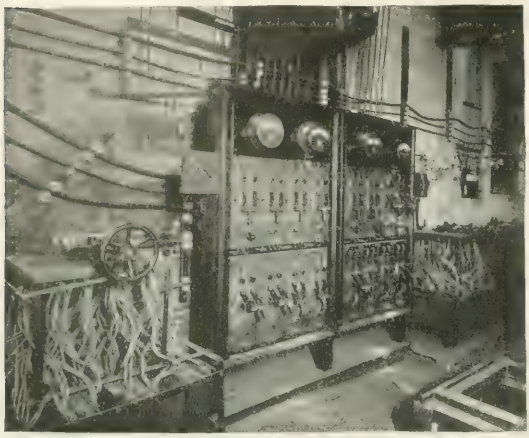


FIG. 2.—SWITCHBOARD OF CHARGING PLANT, FIFTH AVENUE.

the various types owe their design largely to the skill and thought of Mr. A. L. Riker on behalf of the Electric Vehicle Company.

For this new service the New York Electric Vehicle Transportation Company has not encroached upon the facilities of its huge livery plant at Eighth Avenue and Forty-ninth Street, described elaborately in these pages last January, but has, as already stated, occupied the old quarters of the Fifth Avenue stage line at East Eighty-eighth Street. The building there is, in fact, of a very solid and substantial nature, but, of course, has needed some remodeling to render it available for the added work. The company has not put in a charging plant of its own, but takes current from the local mains of

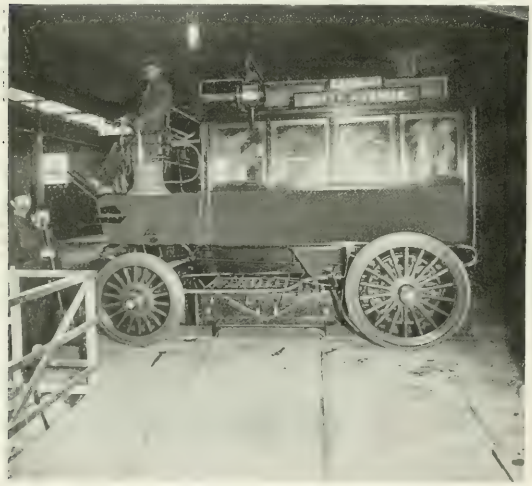


FIG. 3.—HYDRAULIC LIFT FOR BATTERIES.

the New York Edison Company. Up to the present time the apparatus for handling the batteries and charging them has been of a simple but adequate nature, the chief feature of interest consisting in the method for transferring the cells to and from the vehicles. It will be noticed from looking at the views here given of the omnibusses that the battery is not of the end-loading type familiar in electric hansoms and cabs, but is of the under-slung pattern; that is, it is supported underneath the floor of the vehicle instead of being placed under the seats and pushed in from the front or rear.

The apparatus for transferring these battery trays is very simple. It consists of a hydraulic ram, capable of lifting a net load of 5000 lbs., set in a pit under the floor of the charging station, and a few four-wheel trucks. The vehicle which is to receive a battery is run over an opening in the station floor above the ram on which the battery has previously been placed, and the tray is then hoisted into locking position on the vehicle. One of our cuts shows the operation.

When not in position on a bus, the battery is on a truck, which runs in a parallel direction to the length of the vehicle, on short lengths of rails placed on a second or transfer truck. This transfer truck runs on rails at right angles to the length of the vehicle. Thus a battery may be moved in either of two directions until accurately centered under the vehicle. Sixteen charging stalls are provided, as shown, on the station floor level, divided into two rows of eight stalls each, between which is situated the track on which the transfer truck operates. A truck, carrying a battery which has been charged, is pushed from the charging stall on to the transfer truck, which in turn is pushed on to the platform of hydraulic ram and lowered into the loading pit. This pit is large enough to contain four transfer trucks—two on each side of ram—besides a truck on the ram platform.

As it becomes necessary to place a freshly charged battery on a bus, the vehicle is run over the pit and an empty battery truck is raised into position under the battery, lifting the same far enough to allow of the withdrawal of the latches which support the tray in position under the bus, the truck is lowered into the pit and pushed off to one side, and a second truck, containing a charged battery, is brought on to the ram platform and hoisted into operating position on the vehicle. The ram is then lowered into the pit, carrying the trucks with it, and the bus is ready for a run of a maximum distance of 50 miles.

Water is furnished to the loading ram at a pressure of 150 lbs. to the inch, by a triplex hydraulic pump, a storage tank being connected to the piping in order that an even operating pressure may be maintained. With the equipment as outlined a discharged battery may be replaced by a charged battery inside of four minutes, and, therefore, as two batteries are provided for each bus—one operating while

FIG. 4.—CAR BARN, FIFTH AVENUE STAGE LINE.

the second is charging—practically continuous operation can be secured.

The under-slung battery is caught or released by a lever seen at the side of the omnibus body, near the sand box, and manipulated by an attendant. The lever works on jaws or lugs which lock at each end of the battery, and which when closed hold the battery box rigidly in position under the floor of the vehicle, as shown. The bat-

tery can be charged while attached, and, in fact, that is largely being done while the plant is getting into full operation.

The New York Electric Vehicle Transportation Company, it may be added, has other work in view under its franchises, and its service through Central Park up to Grant's Tomb on Riverside Drive is one of the things that is best known among the city's pleasure trips to summer visitors. The running time from the corner of Central Park, Fifth Avenue and Seventy-second Street to the Tomb is 31 minutes, and the return 30 minutes, or just over one hour, actual travel time, and exclusive of stops at either end. The trip is a very popular one, and others like it might well be projected throughout Greater New York.

The Distribution by the Three-Phase System and the Operation of Single-Phase Circuits by It.*

By W. L. R. EMMET.

SINCE the single-phase alternating distribution preceded the use of polyphase currents, there has naturally been a tendency to continue its use, and a full appreciation of the advantages of polyphase currents has not been acquired by many of the practical men who handle distribution problems. The first uses of polyphase currents were for power alone, the old single-phase lighting systems being unchanged. As time has gone, however, the use of single-phase apparatus has steadily diminished, and the production of polyphase apparatus has increased; and although there is still some demand for single-phase generators, an investigation will show that the best informed electrical engineers have now discarded them altogether.

An extensive experience with a single-phase, two-phase, three-phase and other apparatus, has led me to believe that for almost all purposes of lighting and power distribution the three-phase winding is the most desirable for central station generators, and that two-phase and single-phase windings have, in the great majority of cases, no good reason for existence.

It is not necessary to enumerate all the advantages of the three-phase system, but it may be said that among the reasons for its universal adoption are that the three-phase generator is better than the two-phase generator for single-phase operation, where single-phase operation is required, and further, that the three-phase generator when used as a single-phaser is practically as good and as cheap as it would be if it had been designed particularly for single-phase uses. Thus it can meet the two-phaser or the single-phase on equal terms in their own field and at the same time can afford its own special advantages.

When a three-phase generator is to be operated on a single-phase circuit, it is generally desirable to use a "Y" connected winding, although with certain types of windings the delta connection will give equally good results. With such a winding the three-phase machine, as ordinarily designed, will carry from 75 per cent to 85 per cent of its rated load in single-phase current between two conductors with the same heating which would be produced by operation at its rated capacity with balanced three-phase current. If motors or rotary converters are connected to a three-phase generator which is operating with single-phase load, these motors or converters will tend to equalize the load between phases and thus may increase the capacity of the system. When a three-phaser is partly loaded with single-phase currents between two of its wires, the unusual phases may naturally be loaded with other single-phase currents, thus giving various degrees of unbalancing between the three phases and, with normal heating, will vary from 75 per cent to 100 per cent of the total three-phase capacity.

The statement that the three-phaser will carry 75 per cent of its rated load in single-phase current frequently leads the customer to ask: "Why should I buy such a machine to deliver single-phase current when I can get a single-phaser which will deliver its full rated capacity with normal heating?" The answer to this question is that the three-phaser designed for a given single-phase output has about the same size and cost as the machine designed for single-phase alone, the apparent inconsistency lying in the fact that a three-phaser for a given output is cheaper and smaller than a single-phaser.

While purchasers of three-phase generators have frequently made special demand for large single-phase capacity, there are in point of fact, very few cases where it is necessary or desirable to operate three-phase machines exclusively on single-phase load. Companies that operate single-phase circuits can almost invariably divide their circuits roughly into groups, putting some of them on one phase and some on the others. The only portion of a lighting company's load which cannot be advantageously divided between the phases is the low tension, interconnected distributing system, if such a system is used. Even where such systems are used they never include the whole lighting distribution of the company, and there will always be outlying circuits which can be operated from other phases. There are also, in most cases, transformers for arc lighting and other kinds of single-phase load which can be put upon the least used phases, and which will thus tend to help out the balance of the system. Many purchasers think that it is necessary to buy a single-phase generator because they use single-phase circuits, whereas the approximate division of these circuits between the phases would involve no difficulty whatever.

Since the normal single-phase capacity of a three-phaser is about 80 per cent, since all motors and rotary converters tend to equalize the balance, and since there is always scattering single-phase load which can be conveniently put upon the lightly loaded phases, we may practically consider that the three-phase generator can be used at its rated capacity on any system.

If the three-phase generator is operated with single-phase load, or with seriously unbalanced load, there will generally be a marked potential difference between its phases. The phase carrying load will show the drop in potential which such load would ordinarily occasion on a similar single-phase machine; one of the disused phases will generally show a higher voltage and the other a lower voltage. With

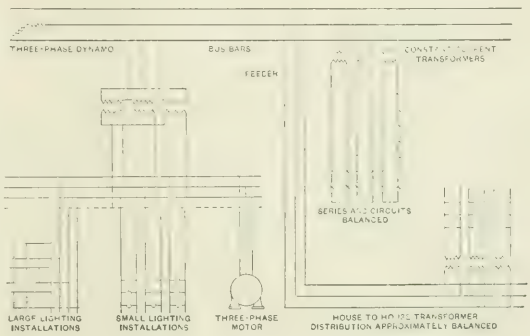


FIG. I.—FOUR-WIRE, THREE-PHASE LOW-TENSION SYSTEM.

machines of good inherent regulation, such as are now generally used for lighting purposes, these differences are small and can readily be taken care of by regulators in feeder circuits. Where three-phase generators are operated on single-phase, three-wire distributing systems, the general practice is to regulate the generator to give the desird voltage on the three-wire system, and to control by regulators the voltage of circuits connected to the other phases. The variations of voltage on these other phases may, in some cases, be actually a convenience, since between the three phases a voltage can often be selected which will nearly suit the requirements of any feeder.

Two systems of low-tension distribution for lighting are used and recommended in connection with three-phase generators, viz., the single-phase, three-wire system and the three-phase, four-wire system. When the single-phase, three-wire system is used, the generator is generally somewhat unbalanced by the large demand for single-phase current which the three-phase wire system creates, and the voltage is regulated with reference to the needs of the three-wire system. The primary circuits are so arranged as to deliver power through transformers to low-tension network. The transformer secondaries are provided with three leads, one for the neutral and one for each of the outside wires. Since the drop in high-tension lines is small and since transformers can be put wherever they are needed, it is easy to arrange an alternating three-wire system in such a manner that it will give very perfect voltage distribution in all parts of the area which it supplies. In direct-current, three-wire systems, we naturally have to deal with large and variable feeder losses, which, in spite of the most careful arrangements, must seriously interfere

*A paper read at a meeting of the American Institute of Electrical Engineers, New York and Chicago, Nov. 22, 1901.

with the maintenance of good regulation. In alternating three-wire systems the regulation should, with intelligent handling, be practically perfect.

The other method which is available for low-tension distribution with three-phase dynamos is the four-wire, three-phase system. This system is supplied from groups of transformers, with three in each, their secondaries being connected in "Y" from a neutral. The secondary voltage of each transformer is that suitable for the lamps which is desirable to use. In action, this arrangement is equivalent to the ordinary three-wire system, except that it has three branches

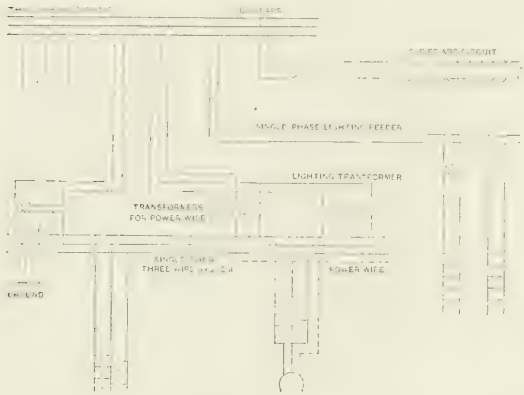


FIG. 2.—THREE-PHASE GENERATOR, WITH SINGLE-PHASE THREE-WIRE LOW-TENSION SYSTEM.

and a neutral instead of two branches and a neutral. The copper economy is practically the same in both, the advantage being slightly in favor of the four-wire, three-phase system, since the neutral need not be quite so large. This system also has the advantage that its outside wires are available for operating motors. Another advantage is that it affords a balanced load to the three-phase generators, if the four-wire system is kept in balance.

The arrangement of these methods of secondary distribution is illustrated by Figs. 1, 2 and 3. From these diagrams it will be seen that it is necessary to use four wires with either, if motors are to be operated. Where the single-phase, three-wire system is used, it is necessary to run a separate power wire which can be energized from a transformer, and which, with the outside wires of the three-wire system, affords three-phase currents for operating motors.

The four-wire, three-phase system cannot be advantageously used in all cases. Where it can be consistently used on a large scale it is probably the most desirable method of secondary distribution. It should not be used, however, where the conditions are such that the three-phase system must be seriously unbalanced by arc light transformers or other unavoidably unbalanced load. Generally, it is not desirable unless its arrangement is complete and the whole plant is arranged and operated with reference to its use. In the rearrangement of existing plants it will generally be expedient to use the single-phase, three-wire system operated from three-phase generators as described above.

In distributing electricity over considerable areas it is desirable to keep in view certain general principles in order that proper voltage distribution may be obtained. Some of the variations which affect voltage regulation are controllable from the station, while others are beyond such control, and consequently can be only partly equalized by the maintenance of a desirable average condition at the main station; even where controlling apparatus is provided in the main station the regulation may be imperfect unless considerable expense is incurred for labor necessary to the intelligent handling of such controlling mechanism. The following simple rules should always be kept in view when distribution systems are being arranged:

1st. Reduce the number of circuits to be regulated to a minimum. 2d. So arrange the system that variations not controllable from the main station are made as small as possible. 3d. Reduce the amount of total drop on all circuits so that frequent changes will not be necessary. 4th. Interconnect the load in large groups so that any variable load unit will be small in comparison to the whole of which it forms a part.

The proper application of these rules will generally lead to an arrangement where the number of feeders is small, each feeder carrying the maximum amount of power which it is desirable to transmit over a single line. Each feeder will supply a compact primary network or a set of short primary branches, the loss beyond the feeder end being small so that a good voltage regulation at the feeder end will ensure good service to all the customers connected to that feeder. To get such a result the load must, of course, be connected near the feeder end instead of being scattered throughout its length.

A method of primary distribution has been used and advocated to a considerable extent which frequently lends itself very well to the accomplishment of the results above mentioned. This system is illustrated by the accompanying diagram. The "Y" connected generator is used with windings arranged to give about 2300 volts between the neutral point and each outside wire. Such a generator may be loaded as if it were three separate single-phase machines, the neutral being used as a common return for all the circuits. The standard 2300-volt transformers are adapted to use between the neutral and any of the outside conductors. The usual method of applying this system is to run out long four-wire feeders. At the end of each four-wire feeder there may be a loop or a branching of the four-wire system so that it is brought near to all parts of the area to be supplied. The transformers for lighting purposes are connected to short two-wire branches, which connect to the four-wire feeder at or near its end, the arrangement of these branches being such as to give an approximately balanced load on the four-wire system. If the load is balanced there will be no current in the neutral. Even if the unbalancing is considerable, the drop in the neutral will be so small that it will only slightly affect the voltage conditions. Regulators can be used in the main stations in each of the outside conductors, and these in combination with compensated voltmeters can maintain the desired potential at the feeder end between each of the outside conductors and the neutral. The neutral conductor should preferably be grounded in the main station so that the maximum voltage to ground on any of the transformers will be 2300 volts.

With a rough approximation to balance we virtually have, by this system, three-phase transmission at 4000 volts, the voltage between the outside wires being about 4000, when we have 2300 volts between each wire and the neutral. The system thus affords means by which

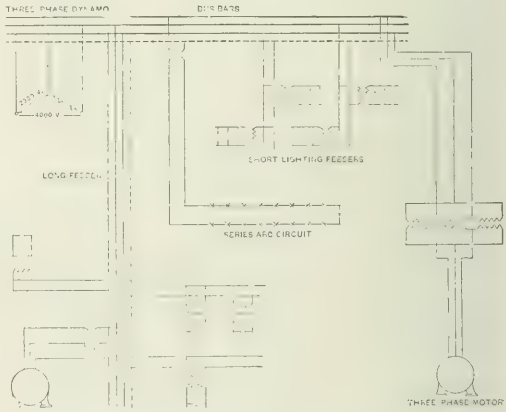


FIG. 3.—HIGH-TENSION FOUR-WIRE THREE-PHASE SYSTEM.

we can economically distribute over large areas without the use of step-up transformers.

When this system is used, it may often be desirable to operate lines in the immediate vicinity of the power station from single-phase branches instead of running out the four-wire feeders. The neutral should simply be used as a common return where convenient, and the long lines should be so arranged that the common return will be as effective as possible. Wherever motors are used it is, of course, necessary to get access to all three of the outside conductors.

The great improvements which have recently been made in auto-

matically regulated three-phase generators have made it economical and desirable to use such machines in many cases where direct-current apparatus would heretofore have been adopted. The alternator is simpler, more efficient and less liable to trouble than the direct-current machine, and it is often desirable to use it even where long-distance transmission is not required. There are also many cases where the principal loads are found in the immediate vicinity of the installation, but where there are certain long branch lines which it is desirable to operate at high voltage. If low-tension alternating-current generators are used, such transmission lines can always be taken care of by step-up transformers. The system recommended for such low-voltage alternating distribution is the four-wire, three-phase system operated from a low-voltage "Y" connected alternator. The winding of the alternator is such that the voltage of lamps is provided between its neutral and its outside wires. A four-wire network is supplied from the machines through suitable feeders, the lights being operated in approximate balance between the outside wires and the neutral, and standard motors being connected to the outside wires where desired. If the standard 220-volt motors are used the desirable lamp voltage will be about 125, and with 440-volt standard motors 250-volt lamps will generally be suitable. The system of distribution with the higher voltage can be extended over considerable areas with small expense for copper, and is very desirable for mill lighting and many other purposes.

Such low-voltage alternating work is desirable for railroad yards, summer hotel properties, colleges, private estates and other similar installations.

New Telephone Patents.

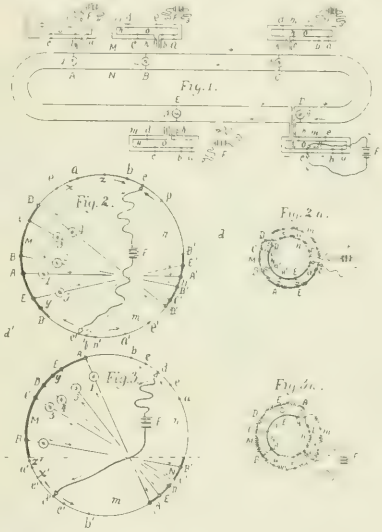
Of the making of telephone receivers there is no end. Of the seven telephone patents of the issue of Dec. 3, four are granted to the same same inventor for novel designs of receiver. In the early days of telegraphy it was said that every telegraph engineer had invented an insulator. Since Bell's invention was disclosed to the world almost every man connected with telephony has devised some kind of variation of the familiar elements of the magnet telephone, and this notwithstanding the fact that any mechanic can put together on standard lines a telephone that is the most sensitive electrical instrument known, and practically from the beginning of telephony has been impossible to improve on, except in minor details of construction.

The most important patent of the issue under consideration is that granted to Mr. Sylvanus Albert Reed, of Middletown, N. J., on a selective system, which not only operates on a novel principle, but has been most ingeniously and thoroughly worked out in its practical application. The systems for selective signaling heretofore known and used are classed under three heads—first, those known as the "step-by-step" systems, in which step by step mechanisms at the subscribers' stations are controlled from the central station in such a manner as to enable the operator to pick out or select the desired station and ring its bell to the exclusion of all others on the same line; second, those known as the "strength" and "polarity" systems, or that class of selective calling devices which depend for their operation on changes in the strength or in the direction of a current or on changes in both; third, those known as the "harmonic" systems, in which a vibrating reed is made to take up its vibration by the action of a succession of impulses of force occurring in the same period as that peculiar to the reed which it is desired to operate. With all of these systems various well-known fundamental objections are associated, of which it may suffice to mention the limitation in the number of stations in the strength and polarity systems and the excessive number of moving parts and delicate adjustment in the receiving apparatus of the other two systems.

Mr. Reed's invention does not fall properly in any of these classes, but is based upon a distinctly new and original application of the principle of the well-known Wheatstone bridge. In the application of this principle to a selective system of telephone circuits, Mr. Reed has devised novel arrangements of circuit and novel apparatus. Mr. Reed claims that on his system a two-wire loop may be used for an indefinite number of stations, limited only by convenience; any station may appropriate the line, may call up any other station exclusively, maintain exclusive communication with it and afterwards restore the line to a normal condition ready for similar use by other stations. During the use by one pair of stations no other station can cut in or overhear, except that a supervising station may be provided with the means of so doing, if desired. The system operates either on a strictly metallic circuit or on a partially grounded circuit, and it may be operated either with local or common sources of current or batteries, and may utilize the telephone instruments in current use.

Figs. 1, 2 and 3 are diagrams illustrating the principle of operation, and Fig. 4 is a diagram of a working line, Figs. 5, 6 and 7 showing enlarged views of details of the apparatus. Fig. 1 is a diagram of a five-station line on the Wheatstone-bridge principle, and Figs. 2 and 3 are graphical diagrams of the electrical circuit employed. In these diagrams relative resistances are represented by relative lengths. In Figs. 2 and 3 the circuit is seen to consist of a loop, *M m, N n*, shown as a circle, and a source of current *F*, which may be connected to the loop by conductors with shiftable contacts, shown in Figs. 2 and 3 as small pointed heads. Connection being thus established, current will pass into the loop at *C'*, say, and will divide, following the direction of the arrows, part of it passing around the loop on the branch *C' M c*, and the rest passing around in the opposite direction on the branch *C' N c*. The current reunites at *c*, where it leaves the loop.

The loop thus constitutes two derived branches in multiple in the circuit. Now, if the bridges be extended across the loop between the branches thereof, as at *AA', BB', CC', DD', EE'*, it is readily understood from the principle of the Wheatstone bridge that these bridges will permit a portion of the current to pass from one branch of the circuit to the other, depending on the differences in potential at the respective extremities of each bridge. If one bridge (say, *CC'*) be



FIGS. 1, 2 AND 3.—REED SELECTIVE SYSTEM.

so related to the point of entrance of the current into the loop that its respective extremities are at points of equal potential, no current will pass and that bridge will be neutral, while all the other bridges will pass current and be active. By interposing a current-indicating device, such as a galvanometer, in each bridge it may be seen which bridge is neutral and which are active. In the diagrams these galvanometers are indicated by the numerals 1 to 5. Now, if the current supplying points are shifted along the loop from the points *C' C* to the points *d' d*, say, and if the location of the points *d' d* with respect to the bridge *DD'* has been predetermined to produce an equality of potential at the extremities of such bridge, then upon the passage of current into the loop at the point *d'* and its division about the respective branches thereof (see Fig. 3), the bridge *DD'* will become neutral, while the previously neutral bridge *CC'*, together with the other bridges, will become active, the conditions in the respective bridges as to activity or neutrality being indicated by the galvanometers, as before. By ascertaining throughout the loop the location of pairs of points, each pair having the special definite relation to one of the bridges that current from it will cause the related bridge to remain neutral, while all the other bridges become active, it follows that the operator is given the power absolutely to select and to control the electrical condition of any desired bridge as to

neutrality or activity by simply applying current at the appropriate contact points. The contacts represented on Figs. 2 and 3 by *aa'*, *bb'*, *cc'*, *dd'*, *ee'*, have been thus determined with this special relation to the respective bridges *AA'*, *BB'*, *CC'*, *DD'*, *EE'*.

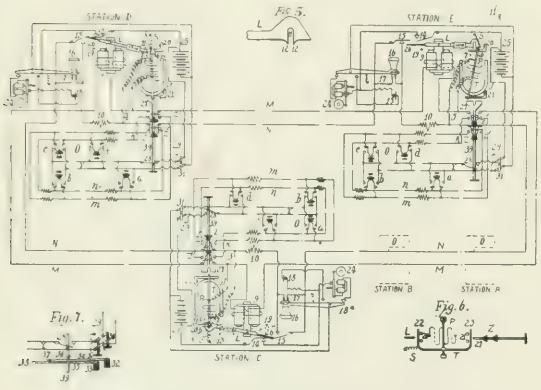
In practice the circuit becomes an endless coil of two turns, in which the bridge extremities and contacts for the source of current instead of being remote from each other become adjacent and assume the proper and convenient sequence. Fig. 1 is a general diagram of the practical selective circuit preferably adopted, and Fig. 2a shows how it is developed from the graphic diagram of the circuits, Fig. 2. Fig. 2a shows the loop folded into a double coil, bringing the heavy lines or bridge segments together, and the light lines or contact segments together, the coil then consisting of the defined bridge region *MN*, and the contact region *mn*. If the double coil is now constricted at the points cut by the dotted line it will assume an hour-glass form instead of the circular form shown. If next the region shown in light lines be made of material whose specific resistance is high compared to that of the region in heavy lines, a construction is obtained which may be developed into the form shown in Fig. 1. In this figure the neck of the hour-glass is shown at *K*, the loops *MN* and *mn* being the respective bulbs of the hour-glass and representing the parts indicated by the same letters in Figs. 2 and 2a.

The circuit consists of an external line *MN* with stations *A B C D E*. Each line *M* and *N* forms in the normal condition of the line a closed loop. At each station is a bridge connecting the two wires *MN* in multiple. Each bridge includes a signal or motor device, indicated by the numerals 1 to 5. At each station is a pair of local conductors *O*, normally disconnected from the line, also a source of current. The local conductors *O* correspond to the regions *mn* of the graphical diagrams. They constitute the selective calling or signal-transmitting apparatus and are made up preferably of high resistance material, each being usually of somewhat greater total resistance than one of the wires *M* or *N* of the external line. The local conductors form each in a certain sense a miniature reproduction of the external line. Each set of local conductors has a sequence of pairs of predetermined contacts *a b c d e*, brought into a convenient position on a keyboard to facilitate the making of electrical connections therewith, and the intermediate portions of said keyboard conductors are coiled into a compact space. The pairs of contacts on the various keyboards are carefully located with a definite relation to the various bridges across the line, so that for each bridge in the line there is a related pair of contacts on each keyboard.

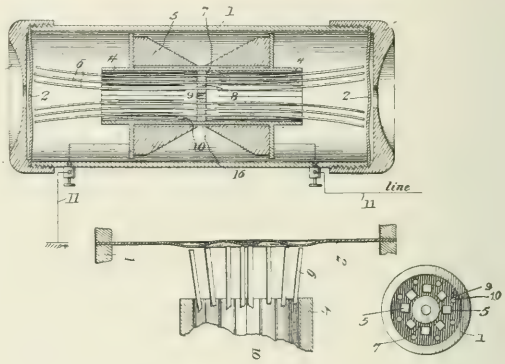
The keyboard conductors are arranged so that they may be looped into the external circuit according to some one of several different methods, all of which accomplish in different ways a similar result—the production jointly with the external line a single resultant combined circuit, in which by adjustments and connections selectively made at the predetermined keyboard—contacts a current of electricity when applied will so divide that at every station except the one selected there will be set up at the junctions of its bridge with the line wires a difference of potential, whereas at the selected station such difference of potential will be zero. Considering any one pair of contacts as the points of entrance and egress, respectively, of an electric current into and out of the loop, it will be found that during the passage of a current through them their related bridge joins points on the loop which are of equal potential, and such bridge is, therefore, neutral, while every other bridge joins points on the loop of different potential and is, therefore, active.

In putting his method practically to work on telephone lines Mr. Reed adopts a relay, in series on one of the lines, which at the station selected clamps the telephone circuits in operating contact and at the non-selected stations displays a "busy" indicator and locks the stations out of circuit. This is effected by a mechanical relation between the selective signal and the relay armature; the station outfit is a fairly complicated collection of apparatus as will be manifest by a study of Figs. 4, 5, 6 and 7. In Fig. 4 *M* and *N* are the looped line wires, passing through five stations, of which three are shown in detail and two merely indicated. The keyboard sets are indicated at *O*, and *Z* are the switches for looping *O* into the main line; 3, 4, 5 are the bridges at stations *C D E*, containing the selective signals *P*; 9 are polarized relays in series on line *M*, and 10 non-inductive resistances in line *N* to balance relays 9. The selector consists of a high-resistance helix *P*, pivoted in the field of a permanent horseshoe magnet *J*. The helix *P* carries a light arm *T*, which plays between stops 6 and 7, and is restored to rest by the spring *S*. Relay 9 has a rocking arm *L* attached to its armature, which is limited in its play in one direction by the stop 19. Arm *T* has at either end a flexible and elastic extension 22, 23 (shown in Fig. 6); 22 plays in front of *L* so that it will block *L*'s descent if 22 has deflected, but if it has not deflected will engage in notch 11 (see Fig. 5), and permit *L* to descend. When *P* at any station is neutral (consequently selected) 22 does not deflect and the relay 9 being energized, *L* is thrown over, engaging 22 in notch 11 and closing the bell circuit at 14 and opening the contact at 15, which normally short circuits the telephone set. At the non-selected stations *T* deflects and 22 is carried over past notch 11 on *L*, and so locks *L* in such position that it cannot operate the bell and telephone contacts. This position of *L* also serves to show a "busy" indicator at the locked stations. A reverse current through the relays throws *L* up and allows *T* to return to its normal position. The switch *Z* mechanically locks *T* in the zero position at the calling station by the depression of the fork 27, which engages in arm 23 of *T*. This allows the relay to throw in the telephone circuit at the calling station. In Fig. 4, station *D* is shown calling station *C*, and it will be noticed that the two telephone sets are by the action of the relays looped into the non-inductive line *N*, which becomes the telephone line proper when communication is established.

The switch *Z* when up leaves *M* and *N* continuous, and when down cross-loops in the keyboard conductors *m n*, and also throws battery switch 28 and reversing switch 29. In practice, the holes or openings for the keyboard plugs are brought together in a row, each marked with its number. The resistances forming the keyboard conductors are preferably coiled into a compact space below the keyboard. A single contact plug may be used for all the calls, and may be left in the hole last used, since the battery current is controlled by switch 28 and the keyboard is connected with the line only when *Z* is depressed. In Fig. 7 is shown a device whereby the reversing switch 29 is in-



FIGS. 4, 5, 6 AND 7.—REED SELECTIVE SYSTEM.



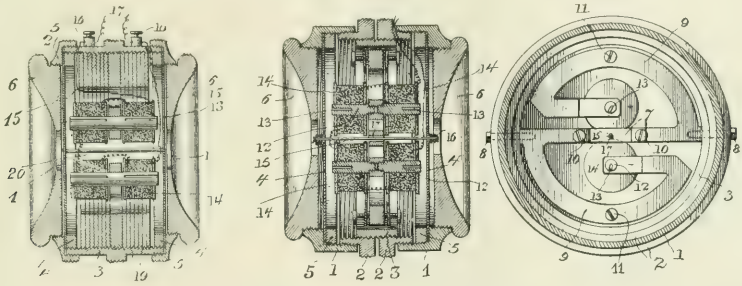
FIGS. 8, 9 AND 10.—LIEBREICH RECEIVERS.

terlinked with switches *Z* and 28, so that all three switches are operated jointly and in proper sequence by a single operation for calling and disconnecting.

This invention takes eight pages of specifications and ten pages of claims, the claims numbering 56, to describe and protect. It is undoubtedly a most ingenious idea, and has been most cleverly worked out. Whether the complication and expense of the station apparatus, the difficulties of installation and the line costs incidental to building the lines in a continuous loop through all the stations will allow of its extensive adoption are points for practical demonstration.

Mr. Hans Liebreich, of Detroit, Mich., to whom a small family of patents on telephone transformers was issued on Oct. 8, now follows on with a quartette of patents on telephone receivers. The receivers bear a strong family likeness to the transformers (see Electrical World and Engineer, page 645, issue of Oct. 19, 1901), and from one of the receiver specifications we derive the interesting information that Mr. Liebreich has christened his improved transformer by the euphonious name of "magnozine," and that a Liebreich "magnozine" greatly improves the action of a Liebreich receiver.

Figs. 8 and 9 show one form of improved receiver, consisting of separate bar magnets held by a block within a split iron core or tube which is surrounded by the coil. The magnetizing of the split core reacts on the magnets, causing them to diverge and vary their pull on the diaphragm, with the startling effect on the latter depicted in Fig. 9. Another form of receiver, the subject of a separate patent, has concentric magnets, the center magnet only carrying a coil, the structure being such that "a series of concentric vibrations" will be produced on the diaphragm. A cross section of this receiver is shown in Fig. 10, looking at the tops of the magnets, 7 being the coil on the central magnet and 55 the tops of the surrounding bar magnet; 10 are apertures in the supporting block to allow air to circulate between the two diaphragms. The third of this interesting family of receivers is of watchcase form (Fig. 11), and has two diaphragms mechanically connected in tandem. The magnets are built up with rings, but only one pair of poles is presented to each diaphragm, each pole piece, however, having two coils on it. The fourth of the quartette is a watchcase tandem diaphragm receiver with specially shaped magnets, whose strength may be altered by means of adjustable leaves or plates. Figs. 12 and 13 show fairly clearly the general construction of this receiver. It does not appear from Mr. Liebreich's specification how the double diaphragm is to be availed of usefully in practice.



Figs. 11, 12 and 13.—Liebreich Receivers.

A patent is granted to Mr. John Ainsworth Rice, of Bland, N. M., on a telpehone attachment, whose object is to operate a local electric bell circuit by means of a circuit closer set in action by the hammer of a magneto telephone ringer. The purpose of this device is to provide a loud alarm bell for the telephone in such places as machine shops. The arrangement of the circuit closer, as illustrated in the patent drawings, appears to have the defect that it would always keep the local bell circuit closed, no matter what the position of the magneto ringer.

Another patent of doubtful utility is issued to Mr. T. B. Lee, of Charleston, S. C., on which is termed by the inventor an "automatic monitor for telephone exchanges." This appliance consist sof a pencil mounted over a moving band of paper, and adapted to be brought in contact with the paper by an electromagnet included in the night-bell circuit of a telephone switchboard. The pencil would make a line on the paper corresponding in length to the interval between the moment of the subscriber's call and the moment of the operator's answer, as indicated by the replacement of the drop. It is conceivable that a device of this sort, placed under lock and key in a small exchange, might act as a sort of automatic night watchman to keep tally on the promptness of the operator in answering night calls, but to term it an "automatic monitor" is somewhat of a misnomer, in view of the modern telepohnic meaning of the word monitor.

The Telephone in French Drama.

The use of the telephone on the stage is not new. One early instance of the use of it is in Bronson Howard's "Henrietta." A more recent case is the rather vulgar comic opera, "The Telephone Girl," in which Mr. Louis Mann is genuinely funny. It is now noted from Paris that of the six new plays last week, one produced at the Theatre Antoine, written by De Lorde and Roley, and entitled "Telephone," deserves special mention, because it owes its extraordinary success to absolutely novel construction, and presents melodrama in a phase of modernity which, in Paris at least, has not hitherto been attempted. A husband hears through the telephone his wife and children being assassinated in a deserted country house 80 miles distant. In the cleverly and realistically staged first act we see the husband taking a hasty leave of his family. He shows his wife a revolver in a drawer for use in case of emergency and confides his family to an old and trusty servant. He promises to telephone during the evening and departs. Afterward a messenger arrives with a letter summoning the old servant away to his mother's deathbed. The messenger, left alone for a moment in the hall, takes note of the premises and steals the revolver. The wife, daughter of 20 and infant get nervous toward sunset and think they hear steps in the garden. To cheer them up they telephone to the husband and the curtain falls.

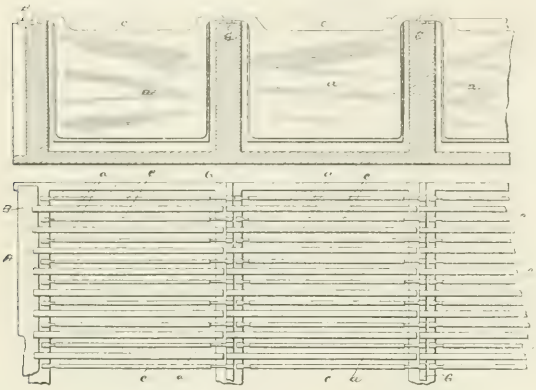
In the next act we are at the other end of the telephone. The husband, called up by the wife, exclaims: "What, you say you hear footsteps in the garden? What nonsense! Anyhow, you have the revolver. What? The revolver is no longer in the drawer?"

Antoine, who plays the part of the husband, thus relates each detail of a terrible murder, as it comes to him over the telephone. Antoine's exclamations as he hears the steps, hears the door open, hears the murderers approach his wife and children, hears their struggles and death wails, and when he quits the telephone and breaks forth into unearthly screams and goes mad, all this has a tremendous effect on the audience, and is the Parisian actuality of the moment, causing the critics to ask: "Is this the melodrama of the future?"

The opinion of the public seems about evenly divided. Some say yes, others most emphatically no. Anyhow, Antoine's realistic innovation causes a sensation, and an effect such that during the first performance, on Thursday night, it is stated by the Paris correspondent of the *New York Tribune*, a woman whose literary attainments are appreciated on both sides of the Atlantic, and near whom he happened to be seated, was seized with an attack of nerves, and, unable to master her emotion, had to be carried away from the theater.

Electric Connections for Refining Plant.

A patent issued Dec. 3 to Arthur L. Walker, of Perth Amboy, N. J., is of interest as disclosing the system of electrical connections employed at the works of the Guggenheim Smelting Company, in Perth Amboy. As diagrammatically illustrated in longitudinal vertical section and in plan, the refining tanks are arranged side by side, the anodes and cathodes, *a* and *c*, in each tank being connected in multiple while the several tanks are arranged electrically in series.



CONNECTIONS OF COPPER REFINING TANKS.

This is effected by allowing the cathodes of one tank and the anodes of the next to rest upon a single distributing bar *G*, lying upon the dividing wall, whereby the current passes directly from the cathodes of the first tank to the anodes of the second, and so on throughout the entire series.

It is stated that this simple device results in saving more than 80 per cent of the copper employed for conductor bars under the best prior practice. For instance, for a current of 4000 amperes a leading-in conductor, *B*, of five square inches cross-section, and a leading-out bar of the same dimensions are used; but these are the only heavy conductors employed, for as will be at once seen, the intermediate or distributing bars *G* carry for each unit of their length only a fraction of the current represented by the reciprocal of the number of cathodes in the tank, or, say, 5 per cent; these bars need, then, be only ½ inch in diameter.

In conceding the magnitude of this improvement in refining practice one can scarcely fail to be struck by the apparent crudity of design, which has left so simple an expedient so long uncovered.

Experiments in Wireless Telegraphy.

We noted recently the intention of Mr. Marconi to visit Newfoundland to make some experiments in wireless telegraphy from balloons. He has reached St. Johns, N. F., and is quoted as follows in regard to his work there: "My principal object is to make experiments so as to ascertain the relative values of different positions along the coast, with the view of locating one of our stations near St. Johns. I have brought with me two balloons of about 15,000 cubic feet capacity. They will be used to suspend the vertical wire and should be valuable for experimenting on account of their portability. The ordinary pole used in permanent stations is about 180 ft. high, weighing about five tons, and it would consequently be difficult to carry one around for experimental purposes. It is proposed to make the first tests at Signal Hill from the Cabot Memorial tower, where the Government has allowed me the use of two rooms for storage of my apparatus.

"In making these experiments I shall closely study the rock formation of the coast, as if it is found that good results can be obtained in Newfoundland, the knowledge gained about the physical character of the ground will be a guide to me in locating stations elsewhere. One has to study geology very closely in these matters. Before erecting a plant it is necessary to test the ground thoroughly and ascertain whether the soil is suitable, as certain kinds of rock formation are more favorable than others, better results in the way of long-distance signaling being obtained. Some of these scientific experiments might perhaps have been carried out in England, but it occurred to me that the tests could be made better here, and, as it is proposed to erect a permanent station near St. John's, I decided to come over and conduct the experiments in person.

"After two or three tests have been made at Signal Hill I intend to move the whole apparatus to Cape Spear, about five miles south of St. John's, and experiment there, afterward making comparisons between the tests. I would like to say that the Newfoundland Government is doing everything possible to assist me. The Governor, Sir Cavendish Boyle, and his Executive Council are much interested in the experiments, and they have offered me the use of any lighthouses on the coast for storage and other purposes while we are at work.

"At present there are 40 stations fully equipped with wireless telegraphy apparatus in different parts of Europe, and we have also five in America. All Lloyd's stations are now being equipped, and the system is in use on about 40 ships of the British fleet, as well as the Cunard and other first-class mail steamers. It is with one of these latter ships that we shall probably communicate with while here.

"I hope before we leave to be able to receive and send messages 250 to 300 miles or even further, but, of course, I cannot definitely say what may be done, as the weather may have a detrimental effect on the experiments. I expect, however, to obtain better results here than from any previous tests. According as the experiments are made we shall be glad to let the public know the results. After Signal Hill and Cape Spear have been tested I shall probably proceed to Cape Race and make similar tests there, and when we have decided upon the most suitable location a permanent station will be erected. The question of the establishment of wireless telegraphy at St. Shotts has nothing to do with the tests referred to, as I do not think a station there will be necessary if we have one located between St. John's and Cape Race. At the same time the Government may decide to erect one there.

"The Canadian Government has already a plant working at Belle Isle, in the Straits. It has been in operation about three months, but it has not yet, as far as I am aware, made communications with passing ships. No doubt it will do so regularly next season. The station is in connection with the system of telegraphic extensions on the Canadian portion of the Labrador coast, which was undertaken this year. It will undoubtedly be a boon, not only to Newfoundlanders, but to the whole world, if a station is erected near St. John's."

Underwriters' National Electrical Convention.

At the recent meeting of the Underwriters' National Association action on several important subjects discussed was put over until after conference with the Code Committee of the American Institute of Electrical Engineers. Among these are the proposed rules for high-potential transmission lines of over 3500 volts. The proposed rules specify that no overhead line carrying more than 3500 volts shall be allowed within 75 ft. of any building, with a proviso that deviations from this rule in the case of isolated property on country streets or roads may be applied for. Another rule is that such high-voltage wires shall not be allowed on the same pole with other wires, nor on the same side of the street or road with pole lines carrying other wires. Finally, it is recommended that when such circuits are overhead they should be run over a private right-of-way and all poles stenciled with the words, "Danger, —— Volts."

Another matter referred to the A. I. E. E. committee relates to high-voltage motors. Proposed rules specify that motors operating on a voltage of 200 or more shall have the switch house located outside the main building, in which shall be placed the main switch, lightning arresters and cut-outs. Motor frames and lead-sheathed cable are to be thoroughly grounded; all switches to be of the oil type and all instruments to be operated from transformers and not connected direct to the line. Motors connected to any circuit having a difference of potential between any two wires of over 750 volts, must not be placed inside the main buildings, except in the case of large machines, when the apparatus must be so located as to reduce the amount of inside wiring to a minimum.

A letter was also referred for conference with the A. I. E. E. committee, asking for modification of the rules with regard to

grounding low-potential circuits, so that the ground might be on one side of the circuit instead of at the neutral point of the transformer.

The Association directed the attention of various inspection departments to be called to the fact that under the National Electrical Code link fuses are only allowed in a few specified cases. In general, the use of other than plug or cartridge fuses is limited to enclosed cabinets, main switchboards or other locations where the flash produced when a fuse melts can do not harm.

A recommendation was adopted concerning the minimum allowable distance between bare bus-bars and similar bare live metal parts of opposite polarity on switchboards and tablet apparatus. It is recommended that up to 250 volts the allowable minimum distance up to 100 amperes shall be 1¼ inches; from 100 to 300 amperes, 1½ inches, and from 300 to 1000 amperes, 2 inches; at voltages from 250 to 600 the distances becomes respectively 2½, 3 and 4 inches. Very full specifications are given for plug and cartridge fuses, the number of heads being 15. Twelve specifications are proposed with reference to rheostats, theater dimmers and main line regulators.

Concerning the present rule for slow-burning weather-proof wire, it was pointed out in reply to a criticism that manufacturers who wish to manufacture wire with an outer weather-proof coating can do so if the slow-burning compound is used underneath.

Telephony on the Pacific Coast.

The United States census of 1900 figured out shows the following percentage of telephones to population, in exchanges of 300 or more subscribers of the Pacific States Telephone & Telegraph Company as of Oct. 31, 1901:

	Population.	Subscribers.	Percentage.
San Francisco	342,782	27,878	8.13
Los Angeles	102,479	10,440	10.19
Oakland	96,638	7,716	7.98
Portland	90,426	8,083	8.94
Seattle	80,671	5,873	7.28
Tacoma	37,714	3,128	8.29
Spokane	36,848	4,282	11.62
Sacramento	29,282	2,391	8.17

These are generally higher ratios than obtain in other parts of the country, as shown by a fuller table given in these columns a few months ago.

A Telephonic Money Order System.

Considerable space was devoted in the last issue of Electrical World and Engineer to a discussion of the proposed utilization of the telephone for money orders and transfers. A number of interesting opinions were presented from telephone managers and experts, both Bell and independent, from all parts of the country. We are now able to add one or two more. Mr. George F. Trier, secretary and general manager of the National Telephone & Telegraph Company, of Fort Wayne, Ind., writes us: "I do not know how desirable a money order system by telephone would be. In this part of the country nothing of this kind has ever been attempted. We have, however, transmitted money over our system by telephone, where the parties desiring to send and receive such money, call at the respective offices and the sender deposits the money with the company's operator and the company's operator instructs the operator at the other end to pay out to the proper party the amount, taking proper receipt. This has not been done very extensively, however." Mr. C. S. Bash, a well-known commission merchant of Fort Wayne, is connected with the same company as treasurer, and has long been known for his active work in the "independent" field and his desire to promote telephonic improvement. He says: "I am connected with the National Telephone Company, of this city, which is the long-distance toll line company covering a large portion of the northern part of this State, and have been looking into the subject which you refer to quite a little. I am free to say that I believe that a telephone money order system is practical and could be used to advantage. It would be necessary to have first-class operators in charge of this department, who were thoroughly skilled in telephony. In addition to this the management would have to be such as would ensure with reasonable certainty the identification of the parties. I believe the plan is feasible." The subject is certainly an interesting and important one, and we shall be glad to hear further from any of our readers in regard to it.

Mr. Kempster B. Miller, the well-known authority on telephone matters, says: "I have had very little time to think out the matter, which is entirely novel to me. I have never heard of anything of the kind before. It seems to me that the great difficulty would be in the proper identification of the persons sending the order. Of course, in the case of the telegraph, the telegraph company has the exclusive control of its wires, while in the case of the telephone, the public has control of the wires. I am not prepared to say that the scheme is in any wise infeasible, but it does seem as though a very elaborate system of identification would have to be introduced."

The Telephone in the South.

The independent telephone interests in the South appear to be in a flourishing condition, from the fact that failures of exchanges of any size are of the rarest occurrence. The leading feature might easily be said to be the tendency towards uniting interests on the part of the independent exchanges. The prediction is made by a leading telephone man that within a few years not only the South, but the entire country will be controlled as to its independent interests by a single corporation with headquarters probably in New York.

The independent interests are already showing a tendency to combine, thus saving largely in running expenses. This fact is well illustrated in eastern North Carolina, where some seven exchanges in as many cities have now combined.

A leading point of difference between the Bell and the independent systems in the South is that the Bell has at present almost a monopoly of the long-distance service, while the independent interests are reaching the local fields, and small towns and making country connections which will eventually be of great value in developing the section. Some of the independent companies in the larger centers already have the territory well covered for a radius of from 20 to 100 or more miles.

There are several points of interest, regarding the fight between the Bell and independent systems, which characterize the South as compared with other sections, according to an independent telephone man. "The most important one is in the matter of rates. The Bell company seems to have offered lower rates in the South than elsewhere, thus rendering competition sharper, and the independent system has a hard row to hoe on this account. If the small systems unite they can give much better service and make many needed improvements, especially where they are barely existing under present conditions."

While it is not the policy of the Bell company to discuss its plans, still the work accomplished has assumed large proportions in the South, where this company now offers the only long-distance service in the field at present. The Bell people believe in expansion in the South, and are carrying out this policy to its fullest extent. While the Bell company does not attempt to reach to any extent the smaller hamlets, the large centers are all covered, and as the smaller towns grow to a sufficient population the Southern Bell is generally found on the field establishing an exchange.

New Power Plant for Seattle, Wash.

Most labor-saving devices known to modern engineering will be used in the new power station, now being erected for the Seattle Electric Company, of Seattle, Washington. Megrath, Gribble & Duhamel are the contractors for the building, and the American Bridge Company for the steel work. Engineer Hanford, of the firm of Stone & Webster, has charge of the construction. This building which will furnish current for the entire electric lighting, railway, heat and power system controlled and owned by the above company, is 108 ft. square, situated at the intersections of Yeslar, Way, and Western avenues. The materials used in its construction are steel, stone, concrete and pressed brick. The structure will be absolutely fireproof as far as it is possible for one of its kind to be. Over 1000 tons of structural steel will be used in the building, as floors will be constructed of concrete and expanded metal. The building rests on a solid foundation of 4000 piles, on which is built a solid foundation of concrete 8 ft. thick. A granite bulkhead will keep the waters of Puget Sound from reaching the pilings in the foundation. The main

floor of the building will be 10 ft. above the level of Western Avenue, and will be occupied by the engines and electric generators. A room 52 by 108 ft. in area, running clear to the roof, 60 ft. above, will be occupied by the steam engines. The plant to be installed in the engine room at present will consist of two vertical cross-compound McIntosh & Seymour engines, each havnig a rated capacity of 4000 hp, coupled direct to Westinghouse alternating-current three-phase generators. Each generator will have a capacity of 2500 kw, capable of being increased in an emergency to a little over 3000 kw. One of the features of the engine room will be a large 50-ton electrical traveling crane.

On the Post Street side of the main floor there will be located a number of transformers and rotary converters. Directly above this room will be a pipe gallery and ash conveyors. The piping system of the station will be very complete and unusual for Western power construction. Steel and gun-metal castings will be used for all high-pressure work, and bronze fittings and brass pipes for all feed-water piping about the station.

The next story will be 40 ft. above the street level, and will be used for the boiler room. On this floor are located three batteries of Babcock & Wilcox water-tube boilers, which will supply steam for the engines, pumps, hydraulic elevator service and the heating system. Over the boiler room will be the fuel room, the feature of which will be a Berquist suspension coal bunker, with a capacity equal to 24 hours' supply. The coal will be carried to this bunker by automatic conveyors taking it from the street below, and will be fed from the bunkers through chutes to the hoppers of automatic stokers. The waste gas from the boilers will be discharged through a steel stack 195 ft. high and 12 ft. in diameter. The draft through the stack will be assisted by a large steam-driven exhaust fan. When finished, the station will represent an investment of over $850,000. It is expected the plant will be in operation by February, 1902.

Elocutionary Training for Telephone Operators.

In view of the reports that have been going the rounds of the daily papers recently in regard to elocutionary training for telephone operators, it may be of interest to review the system of training and examination which the Chicago (Bell) Telephone Company has practiced for the past six years. Applicants for the position of operator must first pass an examination in hearing, quickness of perception and good enunciation, before they will be further considered as candidates for the position. For this purpose a dummy switchboard is used, and three examiners converse with the applicant; the chief operator listening in meanwhile. The examination, which lasts about 15 minutes, is for the purpose of bringing out several points. The matter of distinct enunciation, while important, is probably the thing that is most easy to secure in an operator. The general tone of voice in the use of the rising inflection is taken note of. It has always been the aim of the company to get operators who would carry on conversation in a pleasant tone of voice. But the point which needs to be looked after most closely, according to Mr. Hibbard, is that of perception. A girl may be able to hear and talk perfectly well, but if slow in perception—that is, slow to catch a conversation or number, and slow to act upon what she hears—she is not a desirable candidate. Quickness of perception is dependent partly on previous training and temperament, and partly on nationality. A large percentage of the operators in the Chicago Telephone Company's exchanges are American girls of Irish parentage, as these are found to have to the highest degree the necessary quickness of perception and action. Girls raised in the city are also found to be better in this respect than those raised in the country. In addition to passing an examination at first, operators are examined from time to time to satisfy any possible doubts as to their competence to continue in their positions.

The New Long-Distance Telephone Company, of Indianapolis, has also adopted the innovation of having its operators undergo training in elocution. President S. P. Sheerin states that the matter of giving the operators lessons in elocution has been turned over to Mrs. Edward W. Fenger, who is a very capable elocutionist of that city, a graduate of the Boston School. The young ladies take their lessons in her schoolroom at such times and in such numbers as her convenience and theirs will permit. Mrs. Fenger has condensed her course and methods to meet the requirements as nearly as possible of long-distance operators, to enable them to give quick and satisfactory service in operating. The instructions cover the points of correct breathing, vocal delivery, articulation, reserve force, pitching the voice and acuteness of comprehension or perception. Mrs. Fenger has noticed gratifying progress by her pupils since the work began, and President Sheerin says that there is a marked improvement in the service. He is certain that when the training shall have been completed, the young women will do their work not only with very much greater satisfaction to the company's patrons, but with very much greater ease and comfort to themselves. The training is, of course, at the company's expense, and will apply to all new operators as they are enlisted.

Telephonic Extensions in the Rocky Mountain States.

Through the courtesy of Mr. George J. Wallace, president of the Rocky Mountain Bell Telephone Company, whose territory comprises the States of Montana, Idaho, Wyoming and Utah, with headquarters at Salt Lake, the writer learns that the prospects for a busy season during the coming year are very flattering. The company will double the size of its present building at Salt Lake and install a new and modern switchboard with a central station energy plant at Salt Lake. It will also erect a fine exchange building with all modern improvements, at Cheyenne, Wyo., to provide for its rapidly increasing business in that territory.

In reference to the business for the ensuing year, Mr. Wallace said: "Our lines and circuits now extend from the Colorado line south of Cheyenne through the entire State of Wyoming, north through Eastern Idaho, then through Western Montana and the Pan-Handle, or Coeur d'Alene region of Idaho, to the Washington State line just east of Spokane, with lines radiating this territory in almost every direction. It is surprising to note how parts of this unsettled country, taken up only by mines, have compelled the erection of long pole lines to the mines and mills, thus connecting up their properties with the Salt Lake exchange, where direct communication may be had with the stock exchange and smelters. We have built this year so far 2100 miles of toll lines, which has added about 50 per cent to our exchange subscribers. This increase of subscribers has been brought about by the following extensions: Eureka to Nephi, via Mona, Beaver to Frisco, via Milford, Ogden to Syracuse, via Hooper, Rawlins, Wyo., to Colorado State line, via Dickerson, Cheyenne to Douglas, Logan to Cache Junction, via Mendon and various branch lines.

"In the year 1902 we propose first to build a line to the newly discovered gold fields in the Thunder Mountain district in central Idaho; next to finish our line from Haily, Idaho, to the junction of the north and south line at Blackfoot, Idaho, then to continue the line from Douglas, Wyo., through Casper to Lander, and to a junction of our Montana system at Red Lodge, Mont., and extend our east and west line in Montana from Billings, our present terminus, to Miles City. With the building of the exchange at Cheyenne, Wyo., we propose to cover the whole State of Wyoming, within the next two years with a series of long-distance lines that will place the remotest corner of Wyoming in perfect touch with the capital.

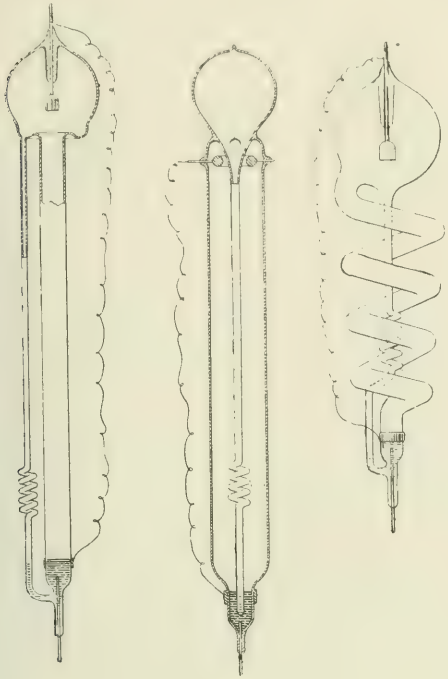
"Our manager, Mr. D. S. Murray, is at present in Boston, and is expected home about Dec. 10. This trip was made with the intention of visiting the larger cities of the East which have recently installed the latest improvements in switchboards and other telephonic equipment. Upon his return it is expected he will have a number of suggestions to offer that will add to the proficiency of the local service."

Buenos Ayres Lighting and Power Statistics.

The report of public lighting of the city of Buenos Ayres during the year 1900 shows the following statistics: Number of kerosine lamps, 8590, consuming 795,200 liters of oil, at a total cost of $220,-550; number of gas lamps, 14,084, consuming 6,165,550 cubic meters of gas, at a total cost of $1,024,181; electric lights, 380 incandescent and 1335 arc lamps, at a cost of $8,459 per month. In the private service of the three gas companies the length of mains was 8636 squares. The number of cubic meters consumed was 26,573,502. The four electric light companies had a total of 5704 subscribers, to whom were furnished 135,359 incandescent and 1418 arc lamps. The cost per kilowatt, gold, averaged $0.201 for light and $0.103 for power. The output in kilowatts of the four companies furnishing electric light and power shows the following aggregates: Light, 5,510,372; power, 704,881; traction, 2,862,859; total, 9,078,112.

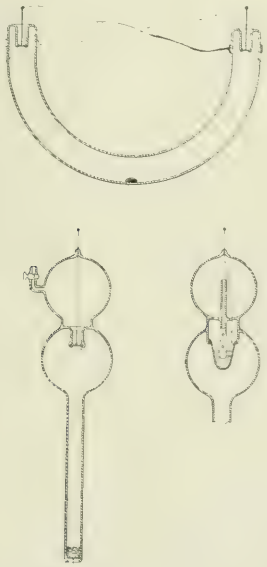
New Forms of Vapor Lamps.

Several new forms of vapor lamps are the subjects of patents issued Dec. 3 to Peter Cooper Hewitt. It will be recalled that the principal features of the Cooper-Hewitt vapor lamp are the use of



FIGS. 1, 2 AND 3.—VAPOR LAMPS.

sulphide of mercury to assist starting; a definite relation with respect to the resistance of the vapor or gas path and the heat radiating surface of the tube, and an electrical connection between the upper



FIGS. 4, 5 AND 6.—TERMINALS FOR VAPOR LAMPS.

electrode and a conducting surface, such as tinfoil on the exterior of the tube surrounding the mercury of the lower electrode. By properly proportioning the cross-section and length of the tube, some of the mercury is cooled and returned to the bottom of the tube, thereby controlling the density of the vapor and rendering the lamp self-regulating.

The accompanying Figs. 1, 2 and 3 show three forms of the lamps in which the condensed mercury is returned to the lower end of the tube through a special return tube. In Fig. 1 this tube is exterior to the vacuum tube, and one part has a spiral form to provide for contraction and expansion. In Fig. 2 the return tube is inside the vacuum tube, and in Fig. 3 the vacuum tube has the form of a spiral and surrounds the return tube.

Another patent relates to terminals for vapor lamps, three forms of which are illustrated in Figs. 4, 5 and 6. In Fig. 4 the terminal consists of a corrugated platinum disk for each electrode. The lamp illustrated, to which these terminals are applied, is in itself a new form, the mercury being represented by a small globule; when the lamp is in operation more or less of this mercury is volatilized to afford the requisite density of vapor. In order to dissipate the heat generated at the electrode, a cooling chamber may be supplied, as in Figs. 5 and 6. In Fig. 5 it will be seen that there is a cup-like cavity to contain some cooling fluid, as water or mercury, and above the same is a cooling chamber for condensing the vapor generated from the liquid. In Fig. 6 the electrode has also a cup form and the cooling chamber communicates to the electrode chamber through holes, as indicated. A tube extends from a point near the bottom of the electrode chamber to a point in the cooling chamber, and suitable openings are provided so that the emitted fluid may enter the tube and passing upward escape to the top, thus causing a continuous circulation. Another form of terminal employs a re-entering cavity in the top of the tube, which is packed with wires, the heat from the electrode being conducted to the upper ends of the wires and dissipated into the air.

Another patent granted the same date relates to automatic means whereby upon starting, a Wehnelt interrupter gives a high voltage, the interrupter being automatically cut out of circuit when the tube approaches its normal lighting condition.

CURRENT NEWS AND NOTES.

ELECTRIC AUTOMOBILE CABS have given a good example of their ability during the recent slippery weather, when horses were down in every direction, all over New York City, while the automobiles skated around with the utmost indifference and perfect success. The horse was often helpless and more than ever a nuisance.

FRENCH TELEPHONE RATES.—A cable dispatch from Paris of Nov. 30 says: The Minister of Posts and Telegraphs, M. Millerand, announces a general reduction in the price of telephone service throughout France. In Paris the rates are reduced from $80 to $60 a year from January. Another reform is the reducing of the charge for pneumatic-transmitted messages—the "petit bleu"—from 10 to 6 cents.

CAUSTIC SODA FROM FUSED ELECTROLYTES.—The issue of ELECTRICAL WORLD AND ENGINEER for June 1 of the current year described and illustrated the Acker process for the production of anhydrous caustic soda by electrolysis of molten sodium chloride with a cathode of lead. Acker's improvement over prior methods consists in effecting a rapid circulation of the fused lead, and particularly in accomplishing this by injecting steam directly into the metal, for, thereby, not only is the lead amalgam transferred from the field of decomposition, but the contained sodium is oxidized to the hydrate. Thus the steam is called upon to perform two functions, and, as is always the case under such circumstances, the question arises whether the two effects are proportionate, whether an amount of steam just sufficient to yield anhydrous caustic is capable of circulating the lead at the rate which corresponds to take the maximum current efficiency of the cell. Since the two factors are not mutually dependent, it is probable that this desirable relation does not exist, but that enough steam to properly fulfill the mechanical part will be in excess of that required for the chemical reaction, the result being a diluted caustic. That this is in fact the case would seem to be indicated by the latest patent, issued to Acker Dec. 3. The new cell differs from that previously figured in one respect only, the steam is no longer solely depended on for the circulation, but the lead is kept in motion by a bladed propeller immersed therein at the bottom of the injection well.

PACIFIC CABLE.—The Seattle Chamber of Commerce has adopted resolutions addressed to Congress urging very warmly an American cable from Puget Sound to Alaska, the Philippines and Asia.

TESTING SUBMARINES.—The electric submarine boat "Fulton" has been tested again at Peconic Bay for the benefit of Commodore V. Geelmuyden, of the Norwegian Navy. While submerged at a depth of 10 ft. and traveling rapidly, she fired a dummy regulation Whitehead torpedo and struck a given mark.

ANNOYING TELEGRAPH EXECUTIVES.—An operator named Lambdin has been arrested in New York City on the charge of sending anarchistic letters of a threatening nature to Mr. George J. Gould and other officials of the Western Union Telegraph Company. In the letters received, all typewritten, a defective "s" appeared. This erratic discharged operator had a machine that lisped.

THE KAISER'S TROLLEY PLANS.—A cable dispatch from Berlin of Nov. 21 says: The committee of the municipality appointed to deal with the Unter den Linden controversy between the Emperor and the municipality has capitulated, and to-day adopted, by a vote of 9 to 2, the Emperor's plan for the projected alterations, which are to have the proposed electric connecting road across Unter den Linden pass underneath that thoroughfare. The municipality planned to have the electric road pass over it.

PAN-AMERICAN DIPLOMAS.—The Buffalo Pan-American Exposition Company is so deeply embarrassed financially that it is unable even to provide diplomas for exhibitors who won them. This announcement was made yesterday, when it was stated that diplomas costing 82 cents each would be too expensive, and that the best the company could do would be to furnish two kinds of diplomas, one costing 33 cents and another costing 25 cents. About 10,000 in all are to be issued, and the total expense will be $3,000, which the company is unable to meet.

DIRIGIBLE TORPEDOES.—It is stated from London that Commander Richardson Clover, the Naval Attache who has just sailed, takes back for the inspection of the Navy Department yet another invention for controlling torpedoes by wireless telegraphy. The inventor's experiments are claimed to have shown that torpedoes not only can be steered by etheric waves, but can be stopped, started and fired at will by means of this agency. There is, however, nothing new about such an idea. It was proposed, among others, by Captain G. O. Squier, United States Signal Corps, about 1897-8, before the Spanish-American war, and later on Mr. Tesla took out some patents on the subject and showed a working model.

PACIFIC CABLE.—Mr. John W. Mackay said recently, while in Los Angeles, with regard to the Commercial Pacific Cable Company's plans: "We have already chosen San Francisco for the Pacific cable terminal. The work of laying the first section of the cable, from California to Honolulu, will be started as soon as the cable can be furnished and shipped to the two starting points of the section. This ought to take about 75 days, and telegraphic communications with Hawaii may confidently be looked for by early fall." Mr. Mackay added that the United States Government would have no proprietary interest in the trans-Pacific cable. In the times of war the cable would be turned over for Government purposes.

A. S. M. E. OFFICERS.—The following are the new officers of the American Society of Mechanical Engineers, elected in New York City, on Dec. 4: President, Edwin Reynolds, V.-P. Allis-Chalmers Company, Milwaukee, Wis.; treasurer, W. H. Wiley, John Wiley & Sons, New York; vice-presidents, Wilfred Lewis, president Tabor Manufacturing Company, Philadelphia, Pa.; M. E. Cooley, professor mechanical engineering, University of Michigan; M. P. Higgins, president Norton Emery Wheel Company, Worcester, Mass.; managers, R. S. Moore, superintendent Risdon Iron Works, San Francisco, Calif.; H. A. Gilliss, superintendent Richmond Locomotive Works, Richmond, Va.; Charles H. Corbett, V.-P. Continental Iron Works, Brooklyn, N. Y.

BEAUTIES OF GOVERNMENT TELEPHONY.—One morning last week the people of Caracas, Venezuela, who use the telephone, were very much surprised and alarmed at receiving no reply to their repeated calls on "Central." Any unexpected occurrence, in these troublous times of revolution, is sufficient to cause alarm. An investigation resulted in showing that the Government had got wind of a revolutionary plot, and had taken possession of the central telephone office and stopped the service, in order to prevent easy communication between the conspirators and in order to use the system exclusively for its own purpose of effecting the arrest of the suspected conspirators, their friends and relatives without loss of time. This was done.

GOVERNMENT TELEGRAPHY on the European plan is often urged in this country. A special dispatch from London of Dec. 7 says: Here is an instance of intelligent telegraphic service as it is conducted under government supervision in rural England. A telegram was sent from Dunwich to Wessleton, Suffolk, villages about two miles apart. It took one and one-half hours in transit. Inquiry showed that it was first telephoned from Dunwich to Southwold, four miles as the crow flies, then telegraphed from there to Lowestoft, 11 miles. Then from Lowestoft, which lies in the extreme north of Suffolk, it was telegraphed to Ipswich, in the south a distance in a straight line of 38 miles. From there it was retransmitted another 18 miles to Saxmundham, then a few miles more to Dursham, whence it was sent by foot messenger to Wessleton. A boy could have walked the distance in about a third of the time.

INCREASE OF NICKEL TELEPHONES IN CHICAGO.—As noted in these columns something over a year ago, the nickel-in-the-slot telephone was first introduced in Chicago. The demand for this class of instruments is enormous, as it fills a place hitherto unprovided for in the telephone service of that city. Two classes of nickel-in-the-slot machines are used—one on a two-party and the other 10-party line service. The rate at which these instruments are put in is limited only by the rapidity with which they can be turned out from the factory and the necessary wires run and provisions made on the exchange switchboard; in fact, the company is overwhelmed with new business and is even going to the extent of letting out different portions of its work of placing instruments, running wires and building pole lines to various contractors. The number of five-cent telephones put in since this service was started about a year ago is in the neighborhood of 7000, which means an enormous additional load on the company's exchanges.

NEW YORK ELECTRICAL SOCIETY.—At the 218th meeting, Nov. 26, 1901, the following new members were elected: Walter A. Houghtaling, 15 Dey Street, Room 404, New York; Leonard T. Horner, Crocker-Wheeler Company, Ampere, N. J.; E. J. Wehrley, 15 Dey Street, Room 404, New York; T. P. McCray, 101 Main Street, Fairmont, Va.; J. Roberts Wilson, Crocker-Wheeler Company, Ampere, N. J.; Lyman P. Hammond, 39 Cortlandt Street, New York; F. S. Blackall, 39 Cortlandt Street, New York; H. W. Olin, 330 Lenox Avenue, New York; G. A. Callahen, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York; W. L. Conwell, 120 Broadway, care Westinghouse Electric & Manufacturing Company, New York; Frank Clark Cosby, 120 Broadway, New York; W. S. Rugg, 120 Broadway, New York; George Wacker, 3638 Park Avenue, New York; Charles E. Monroe, 296 Broadway, New York; Lloyd Reed, 54 Hicks Street, Brooklyn, New York; Frank Mauro, 37 Stanton Street, New York; A. T. Jenks, General Electric Company, 44 Broad Street, New York.

STEAM AND TROLLEY.—The Pennsylvania Railroad Company has given formal notice that steam trains will be substituted for the trolley service between Mount Holly and Burlington, N. J., which was interrupted by the burning of the power house at the former place several weeks ago. The Pennsylvania Railroad officials selected the short line between Mount Holly and Burlington for the experiment with electricity. With the aid of the Westinghouse Electric Company, which was greatly interested in the project, a thoroughly up-to-date power plant was installed at Mount Holly, and large modern electric cars provided. The line was opened on June 18, 1895. The operation of the system was closely observed by the officials of the company, and while they refrained from public utterances on the matter, it became known, after the line had been in operation for some time, that it did not meet their expectations, and that there would be no extension of the electric system. The line has been most curiously mismanaged—some people say intentionally—since the change to electricity was made.

THE NERNST LAMP is to be used in Unionville and Farmington, Conn. A number have already been installed in the latter place for street lighting.

NEW TESLA PLANT.—That work is going on actively at Mr. Tesla's new laboratory and factory at Wardenclyffe, Long Island, is shown by the fact that two men were badly hurt there last Saturday while blasting with powder for a foundation.

LECTURE ON POLARIZED LIGHT.—A meeting of the New York Electrical Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, at 8 o'clock on Thursday evening, Dec. 19. Professor Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, will lecture on Polarized Light. This will be one of the most important lectures of the season, and members are requested to be on hand early. Ladies will be welcome.

A MEMORIAL TO FULTON was unveiled in Trinity Churchyard, at the head of Wall Street, last week by the American Society of Mechanical Engineers, then holding their annual meeting. Preliminary exercises were held in the adjoining Real Estate Exchange when Rear Admiral Melville and Dr. R. H. Thurston delivered addresses appropriate to the occasion, describing and eulogizing Fulton's work. A short service then followed in Trinity Church, conducted by Dr. Morgan Dix, at which the Rev. R. F. Crary, of Poughkeepsie, a grandson of Fulton, spoke in behalf of the family of the great inventor of the steamboat. The monument is of granite, bearing on its face a bronze medallion of Fulton in high relief, made from designs by J. W. Gosling and Albert Wennart, after an oil painting of Fulton made by himself and now in the possession of the society.

NEW YORK CENTRAL.—According to report, officials of the New York Central Railroad have considered plans relative to the feasibility of running through trains from the Battery over the elevated railroad and then via the Putnam Division of the New York Central to Yonkers and other suburban points. President Newman, speaking of the possibility of such an arrangement, said: "We would have no objection to the running of through trains by electricity in connection with the Manhattan elevated. Such a plan would be entirely feasible. But in order to make such an arrangement we don't intend to purchase any Manhattan stock. It would not be necessary, as such an object could be accomplished by a traffic agreement." He added that at the present time there was no such agreement under consideration. Manhattan Elevated stock has been optimistically active on these rumors.

ELECTRIC DENTAL FURNACE.—A patent issued Dec. 3 to Dr. John F. Hammond, of New York, represents the latest construction in a highly developed art. The device is a furnace for dental work and is based on familiar principles, the heat being electrically developed in a platinum resistance wire embedded in the inner surface of a fire clay muffle. Successive concentric layers, respectively of loose sand, baked fire clay and metal surround the muffle and act as heat retainers, while the front is closed by a mica door for convenience in observation. The whole is mounted upon upright front and rear standards, carried by a base provided with suitable contacts, a rheostat and other accessories. The furnace carries several minor improvements in construction, all of which are directed to facilitating the interchange and repair of parts, the most important of these relates to the construction of the heating wire, which is provided at short intervals with loops extending outwardly through the muffle walls, whereby expansion and contraction are allowed for and any break in the circuit is readily located and bridged.

CHICAGO ELECTRICAL ASSOCIATION ELECTION.—The election of officers for the Chicago Electrical Association, held Dec. 6, 1901, resulted as follows: Professor P. B. Woodworth, president; C. Wiler, vice-president; H. G. Dimick, treasurer; W. B. Hale, secretary and librarian; A. M. Blumenthal, auditor; R. F. Schuchardt, J. G. Wray and C. H. Roth, directors. At the same meeting Mr. Van Rensselaer Lansingh delivered a lecture on recent advances in illumination. He took up especially the matter of diffusion of light so as to produce an even illumination without glare or shadows, as accomplished by holophane and other globes. The lecture was illustrated with practical demonstrations in which the advantages of scientifically constructed globes for diffusing and directing light were very forcibly and clearly demonstrated. The most striking point in the lecture, however, was when Mr. Lansingh had his audience critically trying to decide whether there was any difference in the illumination of a given surface by a globe covered and an uncovered light, both lights supposedly being of the same candle-power. Some of the more critical thought the uncovered light illuminated the surface below it a little the best, but admitted that there was not much difference and that the quality of the illumination was better under the globe covered light. When it was then suddenly revealed that the globe-covered lamp was of only half the candle-power of the uncovered light, and that the audience had been comparing a 16-cp uncovered light with an 8-cp globe-covered light, the hit made can be imagined.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—A movement was recently initiated, having for its object the founding of a national electro-chemical society to be modeled on the same general plan as the American Institute of Electrical Engineers. The products of electro-chemical industries in this country at the present time amount to about $100,000,000 per year. The growing importance of these industries and the fact that scientists and engineers interested in electro-chemistry are now distributed among at least half a dozen different societies, and heretofore have had no common medium of communication, are considerations which are believed to fully justify the movement. As noted at the time in our columns, a preliminary meeting in the interest of such an organization was held Nov. 1 at the Engineers' Club, of Philadelphia, Prof. J. W. Richards, vice-president of the American Chemical Society, acting as chairman and Mr. Carl Hering, past president of the American Institute of Electrical Engineers, as secretary. All those present were heartily in favor of forming such a society, and numerous encouraging letters were received from all parts of the country, those from representatives of the electro-chemical industries being especially favorable. It was unanimously decided that such a society should be founded as soon as a sufficient number of members could be secured to insure success. Committees were appointed to secure members and to arrange for a meeting in the near future, at which the society will be formally organized. It was the opinion of those present at the preliminary meeting that the annual dues for membership should not exceed $5, and that there should be only one class of members. Those who desire to become members of the society may send in their adhesion to Dr. Charles A. Doremus, 17 Lexington Avenue, New York City, chairman of the committee on membership.

Letters to the Editors.

Superposed Alternating and Direct-Current Transmission.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with much interest your description of a recent patent granted to Dr. Bedell relating to a saving of 50 per cent of copper that can be effected by causing both direct and alternating currents to traverse the same wire, and I remark what you say as to the discovery of a principle.

If my memory serves me correctly, this is simply a rediscovery. The fact was recorded by English electricians some six or eight years ago, that several various currents when traversing the same wire showed something less than the sum of their various amperes in that wire. I saw this stated in the technical papers at the time. The principle is a beautiful one, and a useful application of it would be very interesting.

Niagara Falls, N. Y. William Smith Horry.

High Speeds.

To the Editors of Electrical World and Engineer:

Sirs.—In an editorial in your issue of Nov. 23 on the Zossen high-speed traction experiments, it is stated that a speed of a mile in 30 seconds would have to be made before the record leaves us. Has it occurred to you that ice yachts on the Hudson every winter exceed railroad speeds? If not mistaken, I think the record mile is 26 or 27 seconds, and established by a girl from Albany on a steel frame yacht built specially for record purposes. I think this speed record was made some two or three winters ago. This is probably faster than any other human has ever traveled—willingly at least. I have made more than 90 miles per hour myself on the St. Lawrence River in

a home-made affair. There is also the record made by old "999" of World's Fair fame, with her record between Albany and Syracuse on a stormy night of 112½ miles per hour, a speed which was maintained for over 3 miles with a regular train.

MANSFIELD, OHIO. A. B. BROWN.

Mileage of Ocean Cables.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23 you must have misquoted so great an authority as Mr. G. G. Ward when you make him say that the Silvertown Company has laid most of the deep-ocean cables throughout the world. In the 1894 issue of the Telegraph Construction & Maintenance Company's map it distinctly shows that out of a total of 175,000 knots they have laid 125,000. A copy of this map can be seen in the superintendent's office of the Anglo-American Telegraph Company, 8 Broad Street, New York. Since then the St. Helena-Cape Town-Australia cable has been laid, and many others. I think the Silvertown Company must be conceded to play at least second fiddle.

WILKESBARRE, PA. E. W. STEVENSON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS MOTORS AND TRANSFORMERS

Heyland Induction Motor.—HEYLAND.—A brief communication to the editor of *L'Eclairage Electrique,* the translation of which is as follows: "I take pleasure in adding to the note which I sent you, that the first tests have completely confirmed the theory which was questioned. I have just seen running, on Nov. 18, in the workshops of the United Electric Company, of Vienna, a 12-hp non-synchronous motor, which had been modified according to the indications of my article of Aug. 8, published in the *Elektrotechnische Zeitschrift.* The phase difference between current and e. m. f. was completely annulled, and the magnetizing current reduced from 15 to 3 amperes. Disconnected from the supply mains and connected to transmission mains, the motor ran as generator. It excited itself, exactly like a direct-current shunt dynamo, and was capable of lighting a certain number of incandescent lamps. The results shall be published shortly."—*L'Eclairage Electrique,* Nov. 30.

Properties of Collector Rings.—LATOUR.—An article in which he replies to the criticism of Leblanc and Bunet (Digest, Nov. 23). It appears that he had anticipated Heyland in the fundamental idea concerning the properties of collector rings, upon which the new Heyland motor is based. On March 15, 1901, he received a French patent for a self-exciting alternator. He has had experiments made by Boucherot regarding the fundamental question, and reproduces his report. "The experiments were made with the armature of a small direct-current dynamo with four poles. There were 24 nearly closed slots, 48 drum-wound coils, the diametrically opposite coils being connected in series, and the groups of two, thus formed, were connected to 24 segments of a commutator, which had 48 segments; the other 24 segments were connected to the first by a connector; four carbon brushes were placed at 45 degs. from one another on the commutator. The armature was placed in a laminated stator, identical with that of an induction motor, with eight nearly closed slots, and open circuit windings, well insulated from one another, so that no current could flow through them. The air-gap was about a millimeter. The measurement of the resistance between the brushes for direct current gave about 1.8 ohm, just as well between the first and third brushes, as between the second and fourth brushes. The brushes were then connected to a source of two-phase currents, for which a direct-current dynamo with four slip rings was used. The problem to be found out by the experiments was not to determine the conditions under which the commutation takes place, but only to determine the variation of the impedance. A first experiment with a frequency of about 25 showed that the impedance varied from about 15 ohms at rest and about 2 ohms in the neighborhood of synchronism and increased after that. A second experiment with a higher frequency, 35, showed that the impedance at rest was about 25 ohms and about 2 ohms near synchronism, for the proper direction of rotation; for the opposite direction the impedance increased constantly up to about 50 ohms for a speed equal to that of synchronism. It was also found that the impedance does not vary, whatever the direction of rotation, for single-phase alternating currents." The author gives a detailed mathematical theory and points out that the sparkless commutation is also an indispensable requirement of practice. He shows that good commutation is possible only at synchronism. Synchronism, which corresponds to the case that the reactance of the ring is zero, gives good commutation. The expression of the reactance and of the sparks are two allied phenomena. He quotes the following from his patent. He supposes a commutator provided on the stator of a polyphase induction motor. He considers the special case of three-phase currents with Gramme winding and delta connection; the three-phase currents are supplied by three brushes placed at 120 degs. between one another. When the brushes are fixed, there is an ordinary rotating field, revolving with a speed S, in synchronism with the frequency. But when the three brushes are revolved together in the opposite direction with a speed s, the revolving field becomes fixed in space. Instead of revolving the brushes, he has them fixed and revolves the stator. This principle enables him to devise a self-exciting alternator. This alternator consists of an armature stator, and a primary rotor. He has indicated in his patent that these alternators would have the property common with synchronous motors, in producing magnetizing currents when the motor is overexcited.—*L'Eclairage Elec.,* Nov. 23.

Eddy Current Loss in Dynamos.—PICOU.—A mathematical article on the eddy currents in the pole pieces of direct-current machines. The hypothesis that the resistance of the eddy currents can be neglected, compared with the self-induction, seems probable at the first glance, on account of the large mass of the pole pieces which offers a broad path to the eddy currents; but the high frequency has the effect of localizing them in a rather thin layer near the surface, so that the resistance may be quite large. The conclusion that the power lost by eddy currents varies as the square of the speed, would be correct only when there is no phase difference; but if the phase difference is very great, the power is more directly proportional to the speed.—*L'Ind. Elec.,* Nov. 10.

REFERENCE.

Synchronous Converter.—RUSHMORE.—The first part of an illustrated article on "The design and action of the rotary converter." He discusses the general principles of its construction, the influence of frequency, and ratio between the direct and alternating-current e. m. f.'s.—*Eng. Mag.,* Dec.

POWER.

Electrically-Driven Printing Press.—An illustrated description of the Hoe printing press, used at the Glasgow exhibition for printing special issues of a newspaper. It is a four-roll web-printing machine and folder, and prints the newspaper in 4, 6 or 8 pages at a speed of 48,000 per hour, and in 20, 24 28, or 32 pages at a speed of 12,000 per hour, delivering the sheets folded to half paper size. The electric motor gives 50 hp when running at the normal speed of 400 revolutions, taking current at 500 volts. It develops 100 hp at starting. When "making ready," the speed of the motor has to be reduced to a crawl of about 20 to 30 r. p. m., and to effect this a reduced voltage is necessary, which is accomplished by means of a rotary transformer. A flexible steel coupling connects the motor shaft and the first motion shaft of the printing press. The rim of the coupling acts as the drum of the electromagnetic brake. The solenoid of the electromagnetic brake is in series with the 50-hp motor, and can thus be brought into action at any moment to stop the printing press. Push-buttons are arranged all around the press, so that should any accident happen it is only necessary to press the nearest push button; this throws out the main circuit breaker

on the controller and the electromagnetic brake at once comes into action.—Lond. *Elec.*, Nov. 22.

Electric Power in a Manufacturing Plant.—An illustrated description of the power plant of the Silvertown india-rubber works. The new power station contains four direct-current dynamos, each giving 1500 amperes at 210 volts. The number of motors at present installed is 83, ranging from small motors of 1 hp up to motors of 150 hp. There are 50 arc lamps and the equivalent of 14,000 incandescent lamps of 8 cp.—Lond. *Elec. Rev.*, Nov. 15.

REFERENCE.

Steam Engine.—An illustrated description of a new three-cylinder compound engine of Allen, Son & Co.—Lond. *Elec.*, Nov. 22.

TRACTION.

High-Speed Railways.—A note giving the following official information on the experiments made by the "Studiengesellschaft" on the trial road at Zossen. The experiments at the beginning of September. The experiment with the two motor cars were first made with the aid of a locomotive, in order to get the two wagons into good running condition. After these preliminary runs the experiments with electric traction were begun, starting with a speed of 60 km. per hour; this speed was gradually increased to 100, 120, 140 km., and reached the maximum of 160 km. per hour (96 miles per hour), at a voltage of more than 10,000 in the supply circuit. On European railways the maximum speed is said to be 130 km., and on American railways the highest speed obtained is said to be 140 km. per hour. The experiments are said to have been successful, and important results have been obtained regarding the starting speed and the braking at maximum speed, also regarding the visibility of the signals, the consumption of power, the air resistance, etc. The total electrical equipment of the cars, the conductors, and the contact devices for taking off the current, have proved extremely satisfactory, so that in this respect it is doubtless that still higher speeds may be obtained. But the track is not considered to be safe enough, so that before the experiments are to be continued, the track and roadbed will be strengthened in the interest of safety.—*Elek. Zeit.*, Nov. 21.

Alternating vs. Direct-Current for London Underground Railway.—A full account of the proceedings at the Underground Railway electrical inquiry at London, Lyttleton being the arbitrator appointed by the Board of Trade to decide what system of electric traction should be applied to the Metropolitan Railway and the Metropolitan District Railway. The latter favors the direct current system of the Thomson-Houston Company, the former the alternating-current system of Ganz & Co. Expert witnesses on the direct-current side were E. W. Rice, of the Gen. Elec. Co., of this country; J. Swinburne, T. R. Chapman, of Chicago, and P. Dawson. On the alternating-current side were O. T. Blathy and Kando, of Ganz & Co.; G. Kapp, Ewing, Cardew and S. P. Thompson. Counsel for the direct and alternating-current sides were Moulton and Cripps, respectively. The inquiry has been closed, but no decision has yet been given.—Lond. *Elec., Elec. Rev.*, Nov. 1, 8, 15, 22.

Long-Distance Electric Railroads.—HOSPITALIER.—An article in which he discusses briefly the problems involved in the introduction of electric service on long-distance railroads. He endeavors to show that the use of single-phase alternating current is not as impossible or impractical as it might seem at first glance. It would be the most simple and economical system. To overcome the difficulty of starting, he recommends having a single-phase induction motor ordinarily running loose at a speed near synchronism; for starting, this motor is connected to the wheels mechanically by means of a cone coupling.—*L'Ind. Elec.*, Nov. 10.

Long Runs of Electric Automobiles on one Charge.—JOEL.—The limit distance of the run of an electric automobile on one charge is a test of the merits of the carriage as a whole. The construction of the carriage to bear the weight of the batteries and useful loads, the distribution of those weights over the wheels, the diameter of the wheels and method of gearing are all of importance. The earlier electric carriages of Rackenzaun and others were limited to from 20 to 30 miles' run on one charge, and the percentage of weight of the battery to the total weight was only about 20 to 25 per cent. The percentage in recent electric carriages is from 40 to 50 per cent, and that is one reason why the limit run now possible is increased from 20 miles to 100 miles. The latest record run is 190.3 miles on one charge, the battery being 50 per cent of the total weight. The unit now accepted as a measure of efficiency is "watt-hours per ton mile." He gives data for six long-distance runs on one charge; the total miles were 100, 162.5, 53, 94.8, 187.5, 190.3, the watt-hours per ton mile 130, 130, 140, 138, 78, 115, respectively. He has analyzed different proportions, costs and useful ton-mileage of many types of electric automobiles, and as a result, has found that cars made with proportions of 33.3 per cent weight of car and motor, 33.3 per cent weight of batteries, and 33.3 per cent passengers or load, best fulfill all the economic conditions. Such proportions are adopted to the construction of any type of electric automobile. The cost per ton-mile of useful or paying load, passengers or goods, for electric current in such cars comes out at 2 cents per ton-mile at a charge of 6 cents per unit for electric current and 0.15 cent per mile for each passenger. This compares favorably with the cost of petroleum or steam motor cars, and in considerably less than the cost of horse-drawn vehicles.—Lond. *Elec. Rev.*, Nov. 22.

Electric Automobile.—Some notes on a Krieger automobile which took part in a recent run of the London Automobile Club. The weight of the car in running order is 3700 lbs., and it carried 5 passengers. The total time distance was 90.5 miles, the total time 6 hours and 26 minutes, and the average speed 14 miles an hour. A charge of 30 units was put into the cells before starting and 6 units at a stop on the way.—Lond. *Eng'ing*, Nov. 22.

WIRES, WIRING AND CONDUITS

High-Tension Cables.—SCHAEFER.—An article with several tables, giving the results of tests made at the cable works at Duisburg, Germany. Cables with fibrous insulation require some sort of protection against the entrance of moisture at exposed ends, and this protection cannot, under all circumstances and in all positions, be satisfactorily applied or kept in efficient order. To avoid any trouble with such end protections, he has for many years used vulcanized india-rubber insulated, lead-cased and armored cables for house-connections, feeding points of electric tramways, and, in fact, in all cases where ends of cables had to be exposed. The joint between fibrous and rubber cables was generally made in a box, placed underground. India-rubber insulated cables being, however, very expensive, he decided after numerous experiments to use in their place cables insulated with "kabelit," a material which is mainly composed by hydrocarbons, does not necessitate the use of tinned conductors, and is considerably cheaper than vulcanized india-rubber. Kabelit-insulated cables have since been extensively used for low-tension work and have answered uniformly well. He determined the breakdown pressures for six sizes of kabelit cables, each of five meters' length and varying in the cross-section of the conductor from 16 to 150 mm., and in the thickness of insulation from 1.45 to 2.5; the break-down voltage of the six samples was 18,000, 19,000, 21,000, 16,000, 20,000, 23,000 volts, respectively; the time during which the breakdown voltage was applied was 18, 20, 3, 8, 6, 8 minutes. The results fit pretty well in Baur's formula, recently noticed in the Digest. As kabelit is somewhat softer and more yielding than the insulating materials which have hitherto been used, he endeavored to render it stiffer and less yielding. He tried an insulation of alternate layers of kabelit and vulcanized india-rubber, paper and other materials which can be applied in thin layers. He gives the results of several tests made with such cables. It appears that cables insulated with alternate layers of kabelit and paper, stand a higher pressure than cables insulated with kabelit alone. He finally refers to experiments made since September, 1898, with two lengths of cables at the Etsch Works, Meran, in the Austrian Alps, in order to find out experimentally whether underground cables can be used in connection with bare overhead conductors, without great danger of being damaged by atmospheric discharges. The first cable contains three cores, each composed of a strand of 19 tinned copper wires, each 1.53 mm. in diameter, insulated with vulcanized india-rubber—no pure rubber next the conductor—of a thickness of 4.25 mm., taped and drawn through colored wax. The three cores are stranded together, wormed and served with ozokerite-impregnated jute yarn, cased in lead and armored with steel hooping. The second cable contains three cores, each composed of a strand of 19 copper wires, each 1.53 mm. in diameter, insulated with kabelit of a thickness of 4.25 mm., taped, ozokerited, and cased in lead; the three lead-cased cores are stranded together, wormed and served with tarred jute yarn, between layers of asphalt compound and armored with steel hooping. The cables were laid underground and connected

to an overhead circuit of bare copper wires, leading from Meran to Bozen and having a length of about 25 miles. The load was about 25 amperes at 11,000 volts, and varied from this amount to no load in either, and in all three phases. As the experiments were meant to last for about 12 months, no special arrangements were made to protect the cable ends against surface leakage. The cable ends were fully exposed to all atmospheric influences. After more than two years' exposure to all kinds of weather, the cable with vulcanized india-rubber insulation burned through at the spot where the three cores separate, which was doubtless caused by surface leakage from the badly protected ends. After cutting off the damaged end, about half a yard, the cable itself was found to be in a perfect condition. The kabelit insulated cable has never been injured yet, although severe atmospheric discharges have passed through both cables and have done considerable damage in the station.—Lond. *Elec.*, Nov. 22.

ELECTRO-PHYSICS AND MAGNETISM.

Pressure Exercised by Light.—LEBEDEW.—He has succeeded in demonstrating both qualitatively and quantitatively, the pressure exercised by light, which is postulated by Maxwell's theory. The obstacles hitherto met with were the radiometer action, which is thousands of times stronger than the action sought for, and the disturbing effect of convection. He eliminated the latter by reversing the illumination repeatedly, and the former by high exhaustion, a large bulb, and the exclusion of rays capable of heating the walls of the bulb. To facilitate a rapid equalization of heat in the radiometer vanes, he made them of very thin aluminum foil, suspended torsionally by a glass thread arranged as in the Cardani suspension. The light used was that of an arc lamp, and its incident energy was determined calorimetrically. The surfaces of the radiometer vanes which were either plain or blackened, were tested with regard to their reflecting powers. The absolute error of the aggregate measurements was 20 per cent. The result agrees with the theoretical values of Maxwell and Bartoli within 10 per cent. The pressure is directly proportional to the energy of the incident light, and independent of its color.—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

Electron Theory of Light.—VOIGT.—An attempt to formulate an electron theory of the changes in the optical properties of ponderable bodies produced by mechanical and thermal deformation. The electron theory assumes the existence within ponderable bodies, of corpuscles oscillating about approximately fixed positions. But both the quasi-elastic force which drives the particle back to its mean position and the resistance it experiences in its vibrations or revolutions, hitherto lacked electrodynamic explanation. He shows, however, that the quasi-elastic forces decrease when a liquid undergoes compression, so that the stability of oscillatory electrons is lessened. A rise of temperature under constant pressure leads, on the other hand, to an increase of the quasi-elastic force and of the stability. In solids the exact reverse is the case. He explains how in gases and liquids, compression produces a displacement of the spectrum lines towards the red, owing to the decrease of the quasi-elastic forces, and investigates in detail the effect produced by adding the same solution to different solvents.—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

Ionic Velocities in Gases.—VON WESENDONCK.—The ratio of the velocities of negative and positive ions in point discharges through gases, has been put at values ranging from 1.32 to 1.58, the negative ions being invariably the more mobile. He inquires whether this peculiarity can be brought into harmony with the conductivities of the various gases for point discharges. It is well known that oxygen does not encourage negative discharges more than positive ones. Sieveking found, in fact, that a positively charged point discharges more easily in oxygen than a negatively charged point. In nitrogen, on the other hand, the negative current is several times, and according to Warburg, several hundred times stronger than the positive current. As the ionic velocity is always greater for negative than for positive ions, it follows that these velocities cannot be the determining element in facilitating the discharge. He suggests other determining elements, such as dust, disintegration, occlusion and chemical attack.—*Phys. Zeit.*, Nov. 1; abstracted in Lond. *Elec.*, Nov. 15.

Model Imitating the Behavior of Dielectrics.—BUCHANAN.—An abstract of a British Phys. Soc. paper on the model, described recently by Fleming and Ashton. The action of this model depends on the viscosity of a liquid, and the diagrams derived from it show by their form that the motion of the pencil which traces them, approximates closely to what may be expressed by the term "motion of a viscous fluid by diffusion." The present author shows that the motion of the model and the diffusion of electricity in a dieletcric are subject to one and the same mathematical law. He suggests that the inventors should obtain hysteresis diagrams by cyclical loading of the springs. In the discussion, Fleming said that there might be something more than a mathematical analogy between the theory of the model and that of diffusion in a cable. He would like to know if a dielectric has a true conductivity, and suggested that experiments should be made by subjecting a dielectric to constant electric pressure at constant temperature, for years if necessary, and observing whether the curve of current becomes asymptotic to the zero line or to a line parallel to it. The model could be made to represent a conduction as well as a displacement current by so arranging the bottom piston that it could descend but not return. The fact that the movements of the model were similar to the diffusion of current in a cable, suggested that the process of conduction in a metal is similar to that of displacement in a dielectric.—Lond. *Elec.*, Nov. 15.

Chemical Effect of Radium Rays.—BECQUEREL.—In connection with the chemical actions, described by Berthelot, the present author mentions several more. The photographic action of Becquerel rays is well known, and was indeed the property which led to their discovery; but it must be noted that though uranium and radium rays act upon silver gelatino-bromide, they produce no effect upon Daguerre plates or upon some photographic papers. The coloring of glass, porcelain, paper and certain crystals, as well as the painful physiological effects of radium rays upon the skin, also belong to this class of phenomena. Three new cases have been discovered by the author. One is the exothermic transformation of white phosphorous into red phosphorous in about 24 hours, another is the reduction of mercuric chloride in the presence of oxalic acid, with precipitation of calomel, and the third is the destruction of the germinating power of seeds by prolonged exposure to radium rays. A week's exposure is amply sufficient to deprive the seeds of mustard and cress of their powers of germination.—*Comptes Rendus*, Nov. 4; abstracted in Lond. *Elec.*, Nov. 22.

Thunderstorm Indicator and Recorder.—ODENBACH.—An illustrated description in detail of an instrument devised and tried by him for detecting an approaching thunderstorm and recording the electromagnetic waves. It consists of a coherer, a relay, a sounder which acts at the same time as decoherer, an induction coil, two condensers and two batteries of two and four dry cells. With an older form he made extended observations in the meterological observatory of St. Ignatius College, in Cleveland. He could detect an approaching thunderstorm at least an hour earlier, but generally several hours earlier, so that there is time to warn tugs, fishing boats, yachts. A new form of his instrument is still better.—*West. Elec.*, Nov. 30.

Secular Variation of the Earth's Magnetism.—RAULIN.—A paper in which he claims to have discovered a revolution of the north magnetic pole about the geographical pole along the 70th parallel of latitude, and maintains that such a revolution would explain all the secular variation observations made in Europe and in the Atlantic. He suggests as a cause of this motion a lagging of the liquid or viscous center of the earth behind the crust in its revolution towards the east.—*Comptes Rendus*, Nov. 4; abstracted in Lond. *Elec.*, Nov. 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Purification of Water by Ozone.—ERLWEIN.—A long illustrated article on the experiments made by Siemens & Halske in an experimental station for the use of ozone for the purification of 250 cubic meters of water per day. The experiments have extended over three years and have been very successful. The water is first cleaned from the suspended dirt by passing it through a quick filter. It then flows into small brick towers filled with gravel. While it flows down through the gravel, it is subjected to the action of the ascending ozone. For making the ozone, Siemens plate and tube apparatus are used, which are operated at 8,000 to 12,000 volts and yield on the average 20 to 25 grams of ozone per hp-hour, with an ozone concentration of 2 to 3-gram per cubic meter of ozonized air. The bacteriological results of the experiments were as follows: The raw water contained 100,000 to 600,000 germs per cubic centimeter; it could sometimes be entirely sterilized, and in all cases the number of germs

was reduced to 2 to 9 per cubic centimeter, which is far below the number regarded in practice as permissible, namely, 100 germs per cb. cm. The consumption of ozone per cubic meter of sterilized water is 2 grams. The total cost of sterilizing 1 cubic meter of water, including cost of operation, interest and amortisation, is 1.26 cents. The ozone apparatus consists of pairs of plates placed above one another and insulated from each other; the metal is at one side and glass with tinfoil at the other; they are connected to the high-tension poles and dried air is driven through the discharge space. The construction and arrangement of the plant is described in detail and illustrated.—*Schilling's Journ. fuer Gasbel. u. Wasservers.*, v. 44, No. 30, 31; *Die Gesundheit*, 1901, No. 15.

Electrolytic Production of Oxygen and Hydrogen.—A note on the Schuckert electrolyzer which consists of a cast iron tank containing a large number of iron bells, one of these latter being used to cover each electrode and to collect the gas liberated at its surface. A 15 per cent solution of caustic soda is used as electrolyte, and a continuous feed of distilled water is required to replace that decomposed by the electric current. The best efficiency is obtained with this apparatus at 70 degs. C. with an e. m. f. of 2.8 volts, and in order to guard against loss of heat the electrolyzer is embedded in a wooden box filled with dry sand. Rubber tubing is used to conduct the gases from the "bells" to the gas-holders, rubber being used to prevent short circuitings between the latter and the cell. An installation with 40 electrolyzers, each producing per hour 220 litres hydrogen and 110 liters oxygen, costs $4,500. If power costs $37.50 per kw-year, the total cost, including the compressing for storage in cylinders, is given as 2 cents per 7 cubic meters of gas. The use of hydrogen gas, in gas engines of special design, as a motive agent for motor cars is thought likely to receive practical study now that a supply of compressed gas at low rates is at the demand of motor-car engineers.—Lond. *Elec.*, Nov. 22.

Alkali Industry.—Seibert.—A summary of several processes in actual use. The different steps of diaphragm processes with aqueous solutions are described and illustrated. The Kellner process with mercury cathodes is briefly mentioned; also the Acker process with fused electrolyte and fused lead cathode. He gives a plan for the installation of a plant for electrolysis of brine solutions with diaphragm and iron cathodes; the cost of operation, wages, interest and amortisation, for producing daily 10,000 kgr. of solid KOH of 91 per cent and 15,500 kgr. of chloride of calcium with 35 per cent of active chlorine, is estimated to be $986 per day.—*Elektrochem. Zeit.*, Nov.

Persulphate Cell.—Peters.—A continuation of his series on experiments with primary batteries. He recommends the use of persulphates as depolarizers, or mixed with other depolarizers. He gives the results of tests made with two dry cells, one containing the ordinary depolarizer, the other a mixture of it with ammonium persulphate. The latter has a higher e. m. f. and a greater capacity, and when it has given out current, it regains its initial e. m. f. in a shorter time.—*Centralblatt. f. Accum.*, Oct. 15.

Catalysis.—Ostwald.—An interesting and systematic review of the numerous different cases of "catalysis"; i. e., those in which the development of a chemical reaction depends upon the presence of another body or material which, however, does not give the energy required for the reaction, nor enters into the reaction at all. In general a catalyzer may be regarded as a material which, by its presence, changes the speed of chemical action, and causes the chemical system to change from a less stable condition to a more stable condition.—*Zeit. f. Elektrochemie*, Nov. 14.

REFERENCES.

Theory of Ions.—Paul and His.—Two papers read before the Association of German Naturalists and Physicians, the one by Paul on the importance of the theory of ions for physiological chemistry, the other by His on the importance of the theory of ions for clinical medicine.—*Zeit. f. Elektrochemie*, Nov. 7.

Storage Battery Factories in Prussia.—Heffter.—An abstract of the report of the Prussian Board of Trade on the storage battery manufacturing plants. There are 30 such factories in Prussia, having together 2196 workingmen. As sanitary rules are enforced, the number of lead poisoning cases has decreased.—*Centralblatt. f. Accum.*, Nov. 1.

Units, Measurements and Instruments.

Alternating-Current Terminology.—A communication, recommending the suppression of the effective values of alternating waves. He prefers a voltmeter and an ammeter which give directly the "active" values, where the "active e. m. f." is defined as the effective e. m. f. multiplied by the square root of the power factor. The product of active e. m. f. and active current give directly the true power.—*L'Ind. Elec.*, Nov. 10.

Wehnelt Interrupter.—Codd.—An illustated description of some experiments with the Wehnelt interrupter. By using two breaks in series the spark length can be increased, especially with certain coils which have a comparatively high self-induction. In some cases the spark length may be doubled, and the current in the primary considerably diminished. The spark obtained from the secondary is not so heavy as that obtained by the use of a single break, yet is sufficient to work a Crookes tube in the way that an ordinary single Wehnelt break would work it, when using a larger coil. The effect of the two breaks in series is not so marked at comparatively low voltages. When the electrolyte becomes warm, the interrupter ceases to work, or fatigues. This is shown to be due to heating only, and the limiting temperature is within 1 or 2 degs. of 75 deg. C.—Lond. *Elec. Rev.*, Nov. 15.

Interrupter for Induction Coils.—Turpain.—An illustrated French Ass'n Adv. Sc. paper. When a Ruhmkorff coil is supplied with direct current, interrupted by means of an ordinary Foucault or Wehnelt interrupter, the e. m. f.'s at the moment of closing and breaking the circuit differ greatly. To make the dissymmetry of the e. m. f. curve disappear, it is sufficient to reverse the direction of the primary current after each interruption. He describes a simple device for this purpose.—*L'Eclairage Elec.*, Nov. 2.

REFERENCE.

Permeameter.—Baily.—His Brit. Ass'n paper in full, with illustrations, on a direct-reading permeameter, an abstract of which was noticed before in the Digest.—Lond. *Elec.*, Nov. 22.

Telegraphy, Telephony and Signals.

Tables for Conversion of Rates of Cable-Speed.—Raymond-Barker.—The trouble taken and time devoted at up-to-date cable stations, in the compilation and maintenance of reliable speed tables based on half-hourly chronometric observations, afford testimony of the importance attached by modern cable experts to the correct expression of cable-speed rates in tables constituting thereafter an ever-present incentive to maximum efficiency. He gives a table of multipliers by which statements of telegraphic speeds, whether in siphon recorder or in Morse codes, may be reduced from one mode of expression to another with due regard to the varying space factor. He also gives some explanatory examples. The criterion by which the signaling capacity of any given cable should be judged is the maximum number of legible letters which can be signaled in a given time expressed, with due regard to the variable space factor, in terms of words of that number of letters which previous experience has taught one to expect in certain given classes of traffic, viz., 5-letter words in the case of press traffic and 8-letter words for commercial code.—Lond. *Elec. Rev.*, Nov. 22.

REFERENCES.

Central Battery System.—Tobler.—An illustrated article on some recent improvements of the central battery.—*Jour. Teleg.*, Oct. 25.

New Series Alternating Current System.

The Helios-Upton Company is placing on the market a new type of regulator for alternating-current series arc circuits, which consists of an impedance coil in which the impedance is varied automatically by changing the relation of the iron core to the coil, this impedance coil being in series coil with the lamps. This form of regulator is claimed to have many things to recommend it over the constant-current transformer. It can be used directly upon the primary circuit without any transformation, if so desired, which would give the system a greater efficiency, and it can be made extremely simple in construction. The type illustrated is one in which the simplicity of construction has been carried out to the greatest refinement. It consists simply of two coils which are supported horizontally on a pivot above them, so that they can swing up on an incline U-shaped iron core. These coils are drawn up by their own attraction to such a point that their impedance always keeps the current constant. This is accomplished largely by the weight of the coil as an opposing force and a small weight, used only as an adjustment.

The advantage claimed for this construction is that the regulator

is very much more compact, and on account of dispensing with the large counterweight that has been used previously, the susceptibility to changes of load is very much increased by removing a large part of the weight from the supporting pivots.

FIG. 1.—LAMP.

For use with the regulator the differential type of lamp has been adopted. Among the advantages of this lamp are that it can be made extremely simple, having only a mechanical cut-out. When the lamp is not burning, the carbons are together, and consequently no amount of jarring when the lamp is not in operation, will interfere with its start when the current is thrown on. Besides this, a differential lamp helps to regulate the circuit, so that no oscillation of current can possibly occur. The only objection that can be used against it is the small additional loss in the series coil and its non-adjustment to current changes without re-adjusting, which points are considered of such small moment in comparison with the superior operating qualities, that this type was adopted as superior to the shunt type.

This lamp is shown in Fig. 1. It consists of four coils mounted on a central tube, the series coils being above and the shunt coils below. They act on two U-shaped laminated cores connected together. These cores, through the medium of a flat spring, are connected with the clutch rod which lifts the carbons directly. To reduce the loss in the series coil to a minimum, consistent with good operation, the weight of these plungers is counterbalanced by a weight.

The lamp has an outside cable connection with the upper carbon holder, and a number of other good features. The cut-out is purely a mechanical one, and the inner globe is of the closed type with a simple device for holding it in place, so that the trimming of the lamp is a very simple matter.

The object of the Helios-Upton Company in designing this system

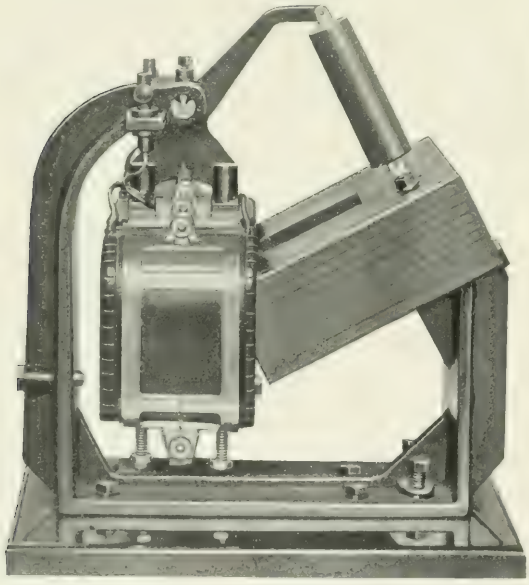


FIG. 2.—REGULATOR.

was not to obtain the greatest economy and the highest power factor, but to produce a system that would always operate well, for it is well known that when great economy has been obtained by delicacy of operation it has always led to disaster. A conservative middle course has always been found the best.

Fuse Plug Cabinet Panels.

In all modern buildings the electric systems require controlling panels at the various centers of distribution. Inasmuch as the type of cut-out known as the Edison fuse plug has been widely adopted in the wiring of buildings, it is a natural consequence that a line of cabinet panels should be brought out by the General Electric Company, embodying the same idea in connection with the necessary switches constituting a panel controlling the circuits at any center of distribution. The general designs of these are indicated by the illustration. The entire line has been approved by the Board of Underwriters.

As indicated above, the most important feature in connection with these panels is the use of the Edison fuse plug, which permits a compact arrangement of great convenience. These plugs are easily connected by any one, without danger, and the operation, as is well known, does not necessitate the use of any tools whatever, while repeated tests show that the plugs will safely interrupt short circuits and confine the arc to the interior of the plug. They are now made for 125 and 250 volts. The various metal parts are designed with

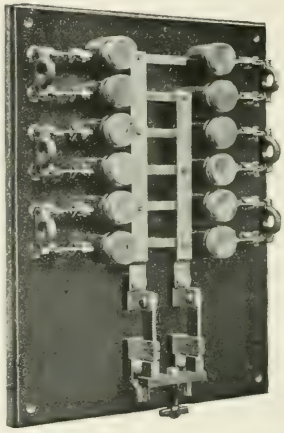


FIG. 1 —CABINET PANEL.

FIG. 2.—PLUG.

ample cross section, the standard capacity for this work being, however, 15 amperes. The metal parts are mounted on a black enameled slate base, the whole being finished in a manner suitable for installation in buildings of the finest construction.

The standard line of panels, which can, of course, be supplied much more quickly than special panels, have the following arrangements of circuits: Two-wire mains with right, left or double branches, 2 to 20 circuits; three-wire mains, with two-wire right, left or double branches, 2 to 20 circuits; three-wire mains with three-wire double branches, 2 to 20 circuits.

The mains are brought to the bus-bars through cable terminals or knife blade switches with cable terminals. When desired, cabinets for these panels can be furnished.

Dynamotors for Telephonic Signaling.

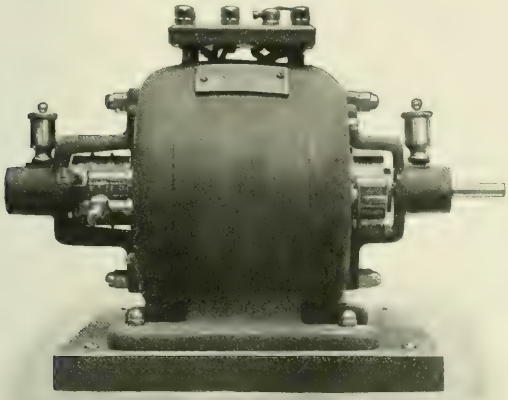
With the gradual introduction of the central energy system into telephone exchanges, there has arisen an increasing demand for dynamotors and motor-generators to perform the work of transforming the available electric current, whether that of a storage battery or electrical supply circuit, into a current of the proper character to perform the work of ringing or signaling. These machines are to perform from the central office the work hitherto done by the individual magneto. The cut represents a form of dynamotor recently placed upon the market by the Holtzer-Cabot Electric Company, of Boston, Mass., constructed especially for this class of work. It

may be used advantageously wherever the source of supply is of the direct-current variety.

The armature is double wound, one winding taking current from the primary circuit and driving the machine as a motor, the other operating as a dynamo and delivering the current for ringing. It will thus be seen that the primary or supply circuit is brought very close to the secondary or ringing circuit in the armature of the dynamotor. In the case of high voltages, such as 500 or 600 volts, there is a possibility of a "cross" or metallic connection forming in the armature, thus placing the supply circuit and the ringing circuit in electrical connection, which might give rise to unpleasant results. For this reason, it is considered discreet in the case of voltages above 220 to use two machines coupled and thoroughly insulated from each other.

The pole piece and poles of these ringers are of soft steel and the armature is of the drum type, laminated and slotted. This the makers consider to be a distinct advance, the drum winding being far superior to the ring winding in this as in most classes of electrical machinery. The drum winding gives a much higher proportion of active wire, and the required voltage may be secured with less weight of wire on the armature. The output is thus increased by reason of the resistance and self-induction of the armature being greatly reduced.

The brush studs are held by a ring, which is held in a machined seat in the end case, thus allowing the brushes to be readily adjusted. The brush holders, commutator and collector rings are designed looking especially to minimum attention and long wear. It will be observed that a third collector ring appears at the secondary end. This is a split ring, which is connected to the secondary winding in such a way as to give a pulsating current; that is, it delivers but half of each cycle. Leads are brought from the brushes of the secondary windings to four binding posts, the arrangement being made as follows: No. 1 to No. 2, alternating current; No. 1 to No. 3, pulsating current, No. 1 being negative with respect to No. 3; No. 1 to No. 4, pulsating current, one in each case being positive with respect to No. 4.



DYNAMOTOR.

This pulsating current is used in selective party line signaling in connection with a bell of special construction which will respond only to the pulsating wave. With this attachment upon the generator it is possible to greatly increase the number of subscribers that may be selectively called, thus adding to the scope of the party-line system. The alternating-current winding is usually proportioned to give 80 volts, and as the field is of the bipolar type and the speed usually 1000 r. p. m., the frequency will be 1000 cycles per minute, which will ring satisfactorily through a toll line of 100 miles. The pulsating voltages are usually about 60 volts. As stated, the machine shown may only be operated on direct-current circuits. In cases in which there is only alternating current available, it becomes necessary to use a combination of two machines connected together, one being the alternating current motor and the other the generator. This will be similar in appearance to the one shown, the direct-current winding being used in this case to supply current to the fields of the generator.

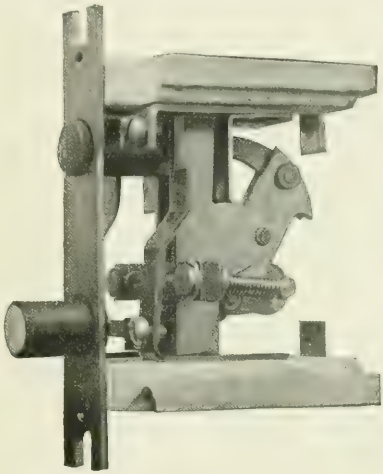
New Push-Button Switch.

One of the minor devices of the electric art involving a good many more problems than appear "on the surface," using that phrase both figuratively and literally, is the push-button switch, and it requires considerable ingenuity to deal satisfactorily with the subject. In the accompanying illustration a form is shown which has lately been put upon the market by the General Incandescent Arc Light Company, and its inventor, it will be seen, has aimed specifically at the points calling for attention in order that the device should give proper results and stand up to the work imposed upon it.

The switch herewith shown is so designed so that the contacts are mounted on separate blocks of porcelain, which being straight, can be moulded in such a way as will insure absolute uniformity after baking. Should the porcelain parts of the G. I. switch become broken, it is very easy to replace them without disturbing any of the other parts of the switch.

The contacts of the switch have a capacity of more than twice the rated capacity (10 amperes), and the moving contacts being in themselves movable, so adjust themselves as to insure perfect contact and afford necessarily a safe carrying capacity. The operation of the switch is such that the movable contacts tend to clean themselves, and thus insure continued good contact.

The mechanism of the switch is of a simple but peculiar construction, which insures absolute certainty of a quick make and break of the contact parts. After the buttons have been pushed a certain distance the making and breaking of the contacts is absolutely beyond the control of the operator's hand. This special construction has the further advantage of avoiding the possibility of a switch being left on any dead center.



NEW PUSH-BUTTON SWITCH.

These switches are made with specially designed tools, insuring absolute interchangeability of parts and the desirable feature that repairs may be readily made by inexperienced people. This in many cases avoids the expense of a new switch. The switch is also designed with an unusually large break distance, so that it may be used with perfect safety on 250-volt circuits.

The switch has a removable cover, giving easy access to the working parts so that the operation of them can be easily seen, and should adjustment be necessary, can be readily made. In this respect the G. I. switch has a great advantage, it is claimed, over ordinary switches enclosed in the usual type of porcelain boxes, since in the latter type of switch it is difficult to tell whether or not the contacts are operating properly and without undue heating, while they are inaccessible should adjustment be necessary. The switches are furnished with the metal face plates of any finish desired, and are designed to go into any standard switch outlet box that will fit any of the other makes of standard push-button switches on the market.

The connections of leading-in wires to the switch are very readily made, since the contact screws are easily accessible, and ample space is allowed for wires. All switches are thoroughly tested with double their rated capacity before leaving the factory.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 4 per cent; time money, which showed a firm tendency, closing at 4 per cent for 60 to 90 days, 4½ for four months and 4½ to 4¾ for 5 to 6 months. Stock values declined on selling induced by the harder tone of the local money market. The heaviness of the market continued throughout the week up to its close, in spite of the strength exhibited by Manhattan Elevated and a few other leading stocks. One of the disturbing elements was Amalgamated Copper, which broke to 69⅞, while copper stocks and copper prices abroad are also badly demoralized. Manhattan advanced to 145 on the strength of divers favorable reports concerning the property, but on Friday the stock had relapsed to a condition of extreme weakness, heavy realizing sales carrying the price down to 135¾. General Electric was conspicuous by reason of its advance to 289¾, based on reports that a large stock dividend might be declared. The week's range of prices was between 275½ and 289¾, the closing figure being 280⅛—a net gain of 2⅝ points. The sale aggregated 21,400 shares. Western Union fluctuated between 91 and 93, closing at the lower figure. Brooklyn Rapid Transit showed some weakness, closing at 63, one point lower than last week's closing quotation. The sales were 87,685 shares. Metropolitan Street Railway also shared the weakness of the general market, closing with a net loss of 5⅛ points, at 160½, the extreme prices being 160⅛ and 167¾. The sales aggregated 48,300 shares. Westinghouse Electric & Manufacturing Company, which is now listed on the New York Stock Exchange, closed at 149½, the sales for the week aggregating 3400 shares. Following are the closing quotations of Tuesday, Dec. 10:

NEW YORK.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
American Tel. & Cable...	—	—	General Electric.....	276¼	282
American Dist. Tel.....	—	—	General Carriage.....	1	1¾
Brooklyn Rapid Transit..	63	62¼	Hudson River Tel.....	112	110
Ches. & Pot. Telephone..	67	66	Metropolitan Street Ry..	164⅛	159
Commercial Cable.....		—	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	19	19	N. Y. Elec. Veh. Tran...	11	10
Electric Boat pfd.....	45	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1⅞	1⅞	Tel. & Tel. Co. of Am...	—	—
Electric Vehicle.....	2¾	2½	Western Union Tel.....	91⅛	91⅛
Electric Vehicle pfd.....	5	4½	West. E. & M. Co.....	—	148½

BOSTON.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
Am. Tel. & Tel.....	160	160½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	133*	132
Boston Electric Light....	–	—	Westinghouse Elec.....	—	*74½
Erie Telephone.....	16	16	Westinghouse Elec. pfd.	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
American Railways.....	44⅞	44	Phila. Traction.....	97½	97¼
Electric Storage Battery.	64	61	Philadelphia Electric....	4¾	4½
Elec. Storage Batt'y pfd.	64	61	Pp. Electric Vehicle.....	¾	¾
Elec. Co. of America....	6⅜	6⅛	Pa. Elec. Veh. pfd.....	1	1⅝

CHICAGO.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
Central Union Telephone.	—	–	National Carbon pfd....	83	84*
Chicago Edison.....	160	155	Northwest Elev. com....	—	36¼
Chicago City Ry.....	185	185½	Union Traction.....	—	10½
Chicago Telep. Co.....	—	240	Union Traction pfd.....	—	47
National Carbon.....	19	20			

*Asked.

ERIE TELEPHONE FINANCES.—It is stated from Boston that the Erie Telephone notes for $9,000,000 will be paid on Jan. 10, and that there is every prospect that important banking interests will undertake the reorganization of the Erie Telephone Company. It is also stated that no plan for a reorganization has been evolved. Sufficient is known, however, to make it plain that an assessment of at least $25 per share on Erie Telephone stock will be levied through the means of a new company, to the securities of which company Erie stockholders will be invited to subscribe at a price which will amount to an assessment of about $25 per share. They may be invited to subscribe to a preferred stock issue, and receive a bonus in common stock. It is said to be very unlikely that Mr. C. W. Morse will interfere with the proposed reorganization. Boston financiers identified with the Bell Company now hold Erie's $9,000,000 of floating debt, and the control of the company, without, so far as is known, any substantial ownerships in the stock. Mr. Morse, by reason of his control of the Bell opposition company—the Telephone, Telegraph & Cable Company of America—represents 21,000 shares of Erie stock, or nearly one-third of its capital. It is still an open question if he was not also the purchaser of 30,000 shares of Erie stock thrown over by the Lowell people at about $60 per share. If Mr. Morse really owns a majority of the Erie stock, he persistently refuses to reveal his ownership or control. He has, however, opposed the partition of the property by the sale of the Michigan Telephone Company to local people in Michigan who desire to secure it, as noted recently in these columns.

BIG PITTSBURG CONSOLIDATION.—The stockholders of the Philadelphia Company met at Pittsburg on Dec. 4 to conclude one of the largest deals in the history of the company, as well as in the financial world of Pittsburg. It was proposed to conclude negotiations by which all but one traction line in Allegheny County—the West End Company—will come under the control of the Philadelphia Company. The stockholders also voted on increasing the capital stock of the company from $21,000,000 to $36,000,000, and the authorized bond issue from $6,500,000 to $22,000,000. When the meeting had adjourned it was announced that the several propositions were unanimously voted for, and the traction, lighting and heating combine for Allegheny County was completed. The new regime will commence Jan. 1 next. Of the 375,460 shares of the company, 302,808 were voted. Separate meetings were held. The first meeting voted to increase the capital stock by $15,000,000 common shares; the second voted to issue the $22,000,000 in bonds, and the third meeting voted to approve the several leases. The Widener-Elkins syndicate did not vote its holdings for an additional director on the board. This matter was deferred until some future time. There were no changes made in the officers of the Philadelphia Company. It is said J. D. Callery will be the general manager of the consolidation.

DIVIDENDS.—Commercial Cable directors have declared the regular quarterly dividend of 1¾ per cent and a bonus of 1 per cent payable Jan. 2 to stockholders of record on Dec. 20. The directors of General Electric have declared the regular quarterly dividend of 2 per cent on the common stock. The dividend is payable Jan. 15 to stockholders of record Dec. 31. The Philadelphia Company directors have declared the usual dividend of 1½ per cent on the common stock, payable Jan. 15. The directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2.

CHICAGO TELEPHONE EXPANSION.—The board of directors of the Chicago Telephone Company, at a meeting Dec. 4, instructed the treasurer to offer for subscription at par 30,000 shares of stock of the Chicago Telephone Company to stockholders of record, 3 P. M., Jan. 11, 1902, pro rata to their respective holdings on that date. Each stockholder will be entitled to purchase one share for each three shares of his holdings. This will give the company $3,000,000 more capital with which to increase and extend its service in Chicago, especially in increasing its nickel service in the residence districts.

STROWGER AUTOMATIC.—A telegram from Chicago states that papers have been sent to Springfield for the incorporation of the Automatic Electric Company, with a capital of $2,000,000. It has secured manufacturing rights for the United States, and the plant of the Strowger Automatic Telephone Exchange. The incorporators are Edwin W. Gearhart, James C. Law, Albert G. Wheeler, Jr., Thomas H. Watkins, Scranton, Pa.; Charles E. Eddy, Alamogordo, N. H., and J. B. Russell & Co., bankers, of Wilkesbarre, Pa.

VULCANIZED FIBER CONSOLIDATION.—The American Vulcanized Fiber Company, of New York City, to manufacture and deal in vulcanized fiber, has been incorporated at Dover, Del., with a capitalization of $3,400,000. This is a consolidation of all the fiber companies of the United States, except two. The incorporators are Richard B. Constance, Frank L. Arnold and C. Arthur Coon, of New York City; Gardner W. Kimball and J. Ernest Smith, of Wilmington, Del. Details have already appeared in these columns.

BOSTON EDISON ILLUMINATING.—At the adjourned meeting of the stockholders of the Edison Electric Illuminating Company, of Boston, it was voted to increase the capital stock of the company from $7,102,700 to $7,850,400, and the number of shares from 71,027 to 78,504. Net stock is offered to stockholders of record Dec. 4, 1901, at $200 per share, at rate of two new shares for every 19 old shares now held.

WESTINGHOUSE STOCK ON NEW YORK MARKET.—During the past week the stock of Westinghouse Electric & Manufacturing Company was listed on the New York Stock Exchange, and will be regularly dealt in hereafter.

CALIFORNIA LIGHTING.—We note the incorporation of the California Gas & Electric Corporation, capital $30,000,000, to furnish light to all cities near San Francisco.

PENNSYLVANIA ELECTRIC VEHICLE.—It is announced that the Pennsylvania Electric Vehicle Company will reduce the par value of its $6,000,000 capital stock from $50 to $10 a share.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions *Bradstreet's* says that the retail distribution stimulated by the cold weather and holiday influences has been very large. The holiday trade, in fact, promises to be of unprecedented volume with demand for a better class of goods. In the great industries such as iron, coal, lumber, etc., activity has been widespread. The demand for iron at the highest prices of the year, except in wire and nails, has been limited only by the question of obtaining supplies. A switchmen's strike affects Pittsburg and aggravates the car shortage trouble. Some mills are closed for want of steel, and some furnaces for want of fuel, while merchant furnaces are reported running only half their capacity. Plates are stronger and structural mills are crowded with orders. Orders for railroad cars are very heavy, hardware is in good demand, copper is unsettled, and the tin boom has collapsed. The number of failures for the week, as reported by *Bradstreet's*, aggregated 237, as against 189 the week previous, and 224 the same week last year. There were fewer failures in November than in October, but the liabilities were larger. On the other hand, compared with November last year the failures are more numerous, while the liabilities are smaller. Owing to the depreciation of the principal copper stock, interest in the copper situation has become more acute; as to active trade conditions, however, the situation is unchanged. Prices remain unaltered, Lake being quoted at 16¾c., electrolytic 16.30 to 16⅝c., and casting stock 15⅝ to 16⅝c.

ROCKINGHAM COUNTY LIGHT & POWER COMPANY'S PLANT.—Sanderson & Porter, engineers and contractors, of 31 Nassau Street, New York City, have just determined on the contracts for the equipment of the Rockingham County Light & Power Company's plant at Portsmouth, N. H. The initial installation will be capable of developing 2500 kw, but the buildings have been planned so as to permit of the capacity being trebled, which it is stated will be an accomplished fact in the near future. The company —in which prominent New York and Boston capitalists are said to be interested—proposes to light the city of Portland and to feed some 150 miles of street railways in that vicinity through 12 sub-stations. The central power plant is to be equipped with five 520-hp Cahall boilers, ordered from Thayer & Co., Incorporated, of 39-41 Cortlandt Street, and to be built by the Aultman & Taylor Machinery Company. Westinghouse, Church, Kerr & Co. have secured the contract for the mechanical stokers, which will be of Roney make. The gravity buckets and conveyers are to be furnished by the Link Belt Engineering Company, of Nicetown, Pa. The International Pump Company is to supply a Blake compound duplex plunger type 10 by 16 by 8 by 12 pump, also a 14 by 20 by 26 by 24-inch stroke circulating compound duplex pump of the same manufacture. The Worthington branch of the International Pump Company has secured the order for a 36-inch elevated central condenser. The two main engines each having a capacity of 1600 hp, will be of the Rice & Sargent type. These machines will be manufactured at the Providence (R. I.) Engineering Works. The auxiliary engines to be utilized for exciting purposes are to be 12-inch vertical compound Westinghouse machines. The lighting engine—an 18-inch vertical compound machine—will be of Westinghouse build. The General Electric Co. has been awarded the contract for furnishing two 1000-kw, 13,200-volt, three-phase, 25-cycle, and 94 r. p. m. units. The same concern has also obtained an order for two 100-kw, 125-volt exciters, each to be connected to the 12-inch Westinghouse engines. The large generators will be direct connected to the Rice & Sargent engines. There will also be two 200-kw G. E. 60-cycle, two-phase, 2300-volt alternators for lighting, one of which will be direct connected to the 78-inch Westinghouse engine, while the other will be driven by a motor. The plant will, it is stated, entail an expenditure of fully $500,000 before completion. The steel for the buildings—about 350 tons—is being supplied by the American Bridge Company. It is expected that everything will be in readiness to begin active operations by May, 1902.

THE SITUATION IN COPPER.—He is a wise man who can make head or tail of the present copper situation, but if all that is going on has any industrial significance at all, it would seem to imply that copper may go lower, though not very much. We quote D. Houston & Co.'s recent circular as follows: There has been a very large business done in copper since our last circular on basis of recent market quotations, with deliveries up to next April, and said to aggregate 85,000,000 to 100,000,000 lbs.; but the understanding is that the contracts include certain conditions which may be considered equivalent to a guarantee. These recent important sales have consequently taken a very large quantity of copper off the market. Consumption of copper in the United States this year has been on a great scale, and there has been a fast moving current of copper going regularly into the home channels of distribution. The great brass and copper mills of the country have been absorbing millions of pounds of the metal in the aggregate each week in the course of legitimate business. Consumers lately have been compelled to run their works at the maximum capacity, owing to the multiplicity of orders. The home consumption has been at a higher level this year than when copper sold much below present prices, and an increasing American demand for articles of copper and brass manufacture is demonstrated. It is worthy of note that the copper consumers of the world have been operating their establishments on small stocks of copper, and that trade requirements must naturally be in heavy volume between now and spring. The projected new Pacific cable having a total length of 7000 to 8000 miles, will take considerable copper, and new electrical projects on both sides of the Atlantic will also create further demand for copper. Consumption of copper in England and France for the first ten months of this year is returned at 98,838 tons, compared with 104,067 tons for same months in 1900. The amount of foreign copper (pyrites not included) consumed in Germany during the first nine months of this year, is officially reported at 41,522 tons, against 59,375 tons in first nine months last year.

WORK ON NEW YORK METROPOLITAN.—President Vreeland, of Metropolitan Street Railway, says: "Earnings of the Metropolitan lines for the month of November showed an increase of about $40,000 as compared with the corresponding month last year notwithstanding that business is being lost through interruption to traffic caused by the subway work on Fourth Avenue and upper Broadway. The increase for the Third Avenue, 'Huckleberry' and other lines amounted to $28,000. We will finish up our construction work for the year on Dec. 15, and will then have opportunity to consider the work for next year. Early in the spring we will begin to change the lower section of the Ninth Avenue line, which is now operated by horse-power from Fifty-third Street down, and put it in shape for electric operation. The Fourteenth Street line will also be taken up so that it may be used for distribution of traffic from the trunk lines and operated as a part of them. The line runs through a very good business section, and cars from the north and south lines will be run east and west through this thoroughfare as is now being done with good results on Twenty-third and Fifty-ninth streets. The importance of the connections thus made will justify the expense, though it is doubtful if as much could be said in the case of lines further downtown, such as Houston Street or Spring Street, which do not run through such a fine business section. The question of how the money for these improvements is to be provided has not been definitely settled."

DR. F. A. C. PERRINE, the president of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., was in New York last week for the first time after his long trip on the Pacific Coast, where the company has so many notable transmission plants. He brought with him on his return an order for a $150,000 equipment, and speaks most hopefully as to the electric power outlook in California, etc. He knows the region well, having been, as will be remembered, professor of electrical engineering at Leland Stanford, Junior, University. He describes the Bay Counties 200-mile transmission as working admirably, and states that even against the cheap oil now obtainable on the Slope, electricity holds its own; in fact, the Los Angeles Edison Company, which owns oil wells, is extending its water power equipment. Dr. Perrine will, we are happy to learn from him, favor the New York Electrical Society in January with a lecture on the power plants of the Pacific Coast, embodying also his valuable observations made on the ground.

PLANT FOR KEESEVILLE, N. Y.—The Keeseville, Ausable Chasm & Lake Champlain Railroad Company, Keeseville, has been reported by some of our contemporaries as in the market for an electric lighting plant that will supply 6000 16-cp incandescents and 100 arcs of 2000 cp. Turbines will also be needed. Mr. G. N. Kingsland, general manager, writes us, however, that the reports are rather mixed and erroneous. He says: "We are not going to put in a lighting plant, but are contemplating the changing of our system of operation to electricity. Should the plan be carried out, the project is to extend the road up along the bank of the Ausable River to Ausable Forks, Jay, Keene Valley and Lake Placid, a distance of about 60 miles. This route is very picturesque, and would, we think, attract the thousands of tourists who come up into this country in the summer time. We hope to carry out this electric railway scheme in the next 12 months."

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, of Providence, R. I., has arranged for representation on the Pacific Coast with the Kilbourne & Clark Company; for Hawaii, with Mr. Guy Owens, of Honolulu; for Mexico, with Mr. Louis L. Lomer, and with Mr. J. H. Quick, of Sioux City, for the State of Iowa. Among the recent new contracts that the Clark Automatic Telephone Switchboard Company has received are the Stillings Press, Boston, six stations; Trenton Iron Company, Trenton, N. J., 15 stations; La Salle Academy, Providence, R. I., 24 stations, and E. F. Roth, Wilkesbarre, Pa., 12 stations.

ELECTRIC POWER FOR PACKING PLANT.—The Schwarzschild & Sulzberger Company, large meat packers, at Forty-fifth Street and First Avenue, are shortly to reconstruct their plant in New York on the plan of their Chicago branch, which has just been completed. E. E. Matchette, general manager of the Western interests of the concern, is in New York at the Waldorf, with Samuel B. Weil, vice-president of the company, who are to confer with the board of directors regarding the details to be followed in the reconstruction of the plant. He states that the Chicago plant has already shown such remarkable results from the application of modern machinery and electricity to the packing industry in the saving of labor and expenses, as well as in the utilization of what were formerly waste materials, that it was immediately decided to entirely rebuild the New York plant, following that at Chicago as a model. The plant will be absolutely fireproof and operated by electricity. The building will probably be about eight stories in height, like that in Chicago, the idea being to have the cattle carried to the building when slaughtered, from which point the different parts of the animal are carried down to all sections of the plant by means of gravity chutes, which are labor-saving devices of considerable value. The work of slaughtering and packing will be done almost entirely by machinery, and a saving in power will be effected by the use of a large number of motors, which will do away with the necessity of having all the machinery in motion at once when only part of it is in use. "The packing business has been revolutionized in the past ten years," said Mr. Matchette, "and we find in our Chicago plant a reduction of 25 per cent in the expense of labor alone below that of the methods heretofore employed. The reduction in the expnses of the New York plant, with its present antiquated methods, will be considerably greater." The cost involved in the reconstruction of the New York plant will approximate $850,000, and it will probably take about eight months to put the new methods in operation.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 4: Argentine Republic—124 pkgs. material, $2,465; 1 pkg. machinery, $555. Antwerp—21 pkgs. material, $1,724; 11 pkgs. machinery, $200. Brazil—30 pkgs. material, $505; 3 pkgs. machinery, $200. Bremen—12 pkgs. material, $654; 4 pkgs. machinery, $300; 67 pkgs. wire, $1,690. British Guiana—22 pkgs. material, $376. British West Indies—22 pkgs. material, $193. British East Indies—9 pkgs. material, $88. British Possessions in Africa—1 pkg. machinery, $15. Cuba—120 pkgs. material, $1,740; 1 pkg. wire, $88. Chili—2 pkgs. material, $137. Copenhagen—2 pkgs. material, $56. Central America—14 pkgs. material, $413. Danish West Indies—3 pkgs. material, $33. Frederickstad—36 pkgs. machinery, $720. Glasgow—3 pkgs. machinery, $90. Havre—20 pkgs. material, $776; 1 pkg. machinery, $20. Hamburg—4 pkgs. machinery, $3,910; 44 pkgs. material, $2,045. Leicester—8 pkgs. machinery, $160. Liverpool—47 pkgs. machinery, $6,500; 91 pkgs. material, $7,565. London—126 pkgs. machinery, $1,465; 91 pkgs. material, $7,565. Mexico—249 pkgs. material, $2,072. Newfoundland—11 pkgs. material, $110. Newcastle—19 pkgs. machinery, $3,300; 1 pkg. material, $16. Nantes—1 pkg. machinery, $152. Peru—8 pkgs. material, $300; 1 pkg. india rubber, $65. Rotterdam—5 pkgs. material, $160. Southampton—4 pkgs. material, $157; 27 pkgs. machinery, $2,610. Uruguay—3 pkgs. material, $159. U. S. Colombia—21 pkgs. material, $244. Vienna—1 pkg. machinery, $125. Zurich—1 pkg. material, $86.

ELECTRICAL IRRIGATION PLANT FOR PORTO RICO.—The South Porto Rico Sugar Company, whose New York address is 44 Wall Street, has just let the contract for the pumps, etc., required for irrigation work at its Guanica property, located on the south side of Porto Rico. The contract calls for four rotary pumps of 4,000,000 gallons capacity each. These outfits will be supplied by P. H. & F. M. Roots, of Connersville, Ind., whose New York offices are at 109 Liberty Street. The pumps will be direct connected to General Electric motors. These outfits will operate over an area of three square miles. The irrigation plant, some further particulars of which have already appeared in these columns, will entail an expenditure of $100,000.

WATERWHEEL PLANTS FOR MEXICO.—The Pelton Waterwheel Company, New York offices, Central Building, 143 Liberty Street, has secured a contract calling for the shipment of three 700-hp waterwheels and some 120 tons of pipe to the Toluca Electric Light Company, of Toluca, Mexico, which concern proposes utilizing same for its hydraulic plant. Another Mexican contract just to hand requisitions for a 300-hp waterwheel outfit, including 3200 ft. of pipe. Among recent domestic contracts awarded to the Pelton people is one from the Niagara Falls Power Company, which concern calls for a fair-sized lot of riveted pipe, cast iron columns, etc.

PHILIPPINES PUBLIC PRINTING OFFICE.—The National Electric Supply Company, contractors of complete power and electric plants, of 1417 New York Avenue, Washington, D. C., are at present placing numerous contracts for electrical equipments, etc., intended to be installed in the Philippines Public Printing Office. Barber & Co.'s steamship "Morven," which sailed this week for Manila, carried some hundreds of tons of this material. The National Company's shipments comprised oil tank, pipe and fittings from the Crane Company, Philadelphia; switchboard, etc., furnished by W. H. Weston & Co.; iron conduit supplied by the Sprague Electric Company; motors and dynamo from the Crocker-Wheeler Company; circuit breakers provided by the Cutter Electrical & Manufacturing Company, of Philadelphia; asbestos pipe covering, etc., from the Philip Carey Manufacturing Company, of Lockland, Ohio; boiler from the Erie City Iron Works, of Erie, Pa.; telegraph wire from the Washburn & Moen department of the American Steel & Wire Company; miscellaneous supplies from Patterson, Gottfried & Hunter; drill press and motor, also shaper and motor sent by Gould & Eberhardt, of Newark, N. J., and testing instruments supplied by the Western Electric Company.

THE ST. LOUIS EXPOSITION BIDS.—Representatives of the leading electrical firms of the country were in St. Louis last week obtaining material from which to make bids on work at the Louisiana Purchase Exposition. Among the represetnatives were Guido Pantaleoni, representing the Westinghouse Electric & Manufacturing Company; B. F. Sunny, General Electric Company; C. W. Wetmore, of the North American Electric Manufacturing Company; George Bullock and J. J. Kennedy, the Bullock Electric Manufacturing Company, of Cincinnati; Ernest G. Bruckman, the Imperial Electric Light & Power Company. At a meeting of the Grounds and Buildings Committee four of the competing companies submitted bids for the plant, setting forth in some detail prices and proposals. The bids were only informally considered. Director of Works Taylor, speaking of the needs of the electric plant, said that it was the intention of the World's Fair people to sign a formal contract within the next two weeks. Time is required to build the boilers and engines for so gigantic a plant, and it was their intention to give the contractor an early start.

CONTRACT IN ENGLAND FOR GERMANY.—A cable dispatch from London of Dec. 5 says: There was an interesting discussion before the City Council of Manchester yesterday over a contract of £113,000 for an electrical plant, which it was proposed to give to a German firm, as the lowest British tender was £36,000 higher than the German bid. The chairman of the Council explained that if the difference between the two bids had been but a few thousand pounds, the British firm would have had the contract. A member of the Council proposed that the contract be given to the British Westinghouse Electric Company, Limited, whose tender was £16,000 higher than that of the German firm, as then part of the work would be done in Great Britain. The chairman explained that the Manchester factory of the Westinghouse Company would not be ready until next July, therefore, if the contract were awarded to that company all the work would be done in Pittsburg. The German tender was finally accepted.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has secured the contract for the electrical equipment for the Omaha (Neb.) and Pocatello (Idaho) shops, for the Oregon Short Line Railroad, and the shipping of material and work will commence at once. L. M. Cargo closed the contract for the Westinghouse Company. There will be electric cranes, electric transfer tables, etc., and the engines will be of 400 hp. It will be a very complete outfit. The contract figures for the electrical work are about $60,000 for the Pocatello shops.

BIDS FOR BOISE POWER PLANT.—Bids are asked for by the Boise-Payette River Electric Power, of Boise, Idaho, for the construction of its power plant on the Payette River near Horseshoe Bend. They will include the construction of 3½ miles of canal, ¼ mile of flume, masonry head works, waste gate, culverts, bridges and power house of concrete masonry; the hauling of freight from Boise to the plant, and the distribution of poles on the transmission line from the power house to Boise, and on the branch line to Pearl. Plans and specifications may be procured at the office of the company at Boise, Idaho, or from A. J. Wiley, chief engineer.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, has taken the third, fourth and fifth floors of the B. F. Sturtevant Building, corner of Harrison and Clinton streets, for the manufacture of a complete line of generator call and central energy telephone equipment, for private and public plants of any size. The details as to the management of this enterprise were given in this department last week. An important indu[illegible] is thus added to the already large representation of indepe[illegible]t telephony in Chicago and vicinity.

CINCINNATI RAILWAY ENGINES.—For the new generating equipment of the Cincinnati, Georgetown & Portsmouth Street Railway, Hooven, Owens & Rentschler have been given a contract for two 900-hp cross-compound condensing engines, direct connected.

NILES-BEMENT-POND COMPANY has an order from the Lewis Foundry & Machine Company for a 60-ton double-trolley electric crane for a new factory at Groveton, near Pittsburg.

General News.

THE TELEPHONE.

HOPE, ARK.—A telephone line is being built from Hope to Washington.

SAN FRANCISCO, CALIF.—A new independent telephone company has been incorporated by A. B. Thompson, O. F. Thompson, Jesse Moore, J. B. Saylor, R. N. Stanfield and Dr. C. J. Smith, of Pendleton, Ore. A line will be constructed from Echo, Ore., a station 20 miles north of Pendleton, to Sloan Bros.' Ranch on Butter Creek.

TAMPA, FLA.—The Peninsular Telephone Company has decided to increase its capital to $500,000 to build long distance lines recently decided upon.

OCALA, FLA.—The Ocala Telephone Company uses apparatus of several makes. It operates a 125-drop board and has 119 subscribers. Increase is steady.

DIETERICH, ILL.—It is reported a local telephone company will be organized here.

FREEPORT, ILL.—Messrs. Bills & Wortham have been granted the right to construct a telephone system in Freeport.

NEW HOLLAND, ILL.—The Central Union Telephone Company is building a new line from Buttonview to New Holland.

MACKINAW, ILL.—It is rumored that the Davis telephone system of Tremont, will put in an exchange at this place before long.

STREATOR, ILL.—The officers and stockholders of the Streator Independent Telephone Company have voted to increase the capital stock to $100,000.

NEWTON, ILL.—The Jasper County Mutual Telephone Company, capital stock $5,000, has been incorporated by Wm. Kilgore, R. S. Hunt and J. L. Forester.

ALTON, ILL.—The Calhoun County Telephone Company has decided to extend its lines into St. Louis. S. J. Merida, S. A. White and W. A. Skeel are interested.

ONTARIO, ILL.—The Oneida & Ontario Telephone Company reports business first class. It operates Swedish-American apparatus; has a 100-drop board and 25 subscribers.

HENDERSON, ILL.—The Farmers' Telephone Company has all the business it can manage, and new orders continually arriving. Eureka and Stromberg-Carlson apparatus is used and a 250-drop board supplies 350 subscribers.

CHICAGO, ILL.—Mr. R. F. McPhetridge, 989 West Monroe Street, Chicago, informs us that he is looking for a good location for the purpose of establishing a telephone system. He has in mind a town of from 2000 to 5000 population in the south or southwest.

HIGHLAND, ILL.—The Kinloch Telephone Company has secured from the St. Louis, O'Fallon and Lebanon Electric Railway a right of way for the extension of its telephone over the abandoned roadbed between Lebanon and O'Fallon. The telephone line, which is being extended from Belleville to O'Fallon, will be continued to Lebanon.

JOLIET, ILL.—The directors of the Interstate Independent Telephone & Telegraph Company, a $3,000,000 corporation recently organized in New Jersey for the purpose of acquiring and controlling telephone companies, held its first business meeting here on Nov. 29. Officers were elected as follows: President, Senator H. H. Evans, Aurora, Ill.; vice-president, Frank Tracey, Springfield, Ohio; secretary and general manager, E. R. Conklin, Joliet; treasurer, A. B. Conklin, Aurora. The principal offices will be in New Jersey, with branch offices in Chicago and Aurora.

GRAY, IND.—The Carmel Telephone Company will extend its lines to Gray in the near future.

BLUFFTON, IND.—The contract for the erection of the new exchange building for the United Telephone Company was let to John Barnes & Son, of Logansport.

HAGERSTOWN, IND.—It is proposed to establish an automatic telephone exchange here. The plant now in use is thorough and extensive. Its lines reach Economy, Williamsburg, Cambridge City, Dalton, Greenford and other towns, while many villages are in direct communication.

INDIANAPOLIS, IND.—The Indiana Central Telephone Company has filed articles of incorporation with the Secretary of State, with a capital of $3,800. The directors are John Grimes, Wm. D. Bowers, John Wilson, James and Fletcher Goff. The company is made up of Russellville citizens, who propose to maintain an exchange at Russellville for free communication between stockholders and their friends. A nominal charge will be made to others who receive service.

DUFF CITY, IND.—At a recent meeting here of the "Farmers' Mutual Aid & Benefit Association," the object of which is the suppression of crime and vice and the arrest and conviction of thieves, it was said that the telephone had enabled the members of the association to apprehend thieves to the extent that wrongdoers give this part of the State the go-by. Similar commendation is had from the Indiana Horse Thief and Detective Association. It is now such an easy matter to apprehend, arrest and convict thieves that the attempts to steal horses and get out of the State is scarcely heard of any more. This is largely due to the telephone, it is said.

COUNCIL BLUFFS, IA.—F. H. Eckles, of Tama County, has purchased the Cedar Valley Telephone Company, which runs into Shell Rock.

PANORA, IA.—The Panora Mutual Telephone Company has been organized at this place to operate an exchange and connect with various country lines.

WYOMING, IA.—A telephone company has been organized at this place by Dr. J. W. Kirkpatrick, P. C. Jansen, W. S. Garrison, J. W. Waite and E. M. Babcock.

OGDEN, IA.—The Ogden Telephone Company informs us through Mr. Gardner that Kellogg apparatus is used. It operates a 200-drop board and has 90 subscribers. Growth is steady and the outlook bright.

DES MOINES, IA.—The Mutual Telephone Company increases steadily, and we are informed by the superintendent, Mr. Gray, that a new plant will be built soon. About 15,000 feet of cable are now being installed. The company operates a Sterling 2000-drop board and has 1971 subscribers.

LOUISVILLE, KY.—The Louisville Home Telephone Company, of Louisville, has been incorporated; capital, $1,000,000.

EMINENCE, KY.—The Eminence City Council has ordered sold a franchise for the establishment of a telephone system in this city at not less than $50 per year for twenty years.

MAYSVILLE, KY.—The Maysville Telephone Company has just been given a franchise and will begin at once to extend lines throughout the county in every direction. Connection with Aberdeen, Ohio, will be secured by cable laid across the river, and meeting the Independent Long Distance Telephone Company at that place from Portsmouth, Ohio.

DONALDSONVILLE, LA.—The American Telephone Company has applied for a franchise to construct and operate a telephone and telegraph system.

HAGERSTOWN, MD.—The Chesapeake & Potomac Telephone Company is constructing a line from this city to a point near Middletown, in Frederick County, to connect with the main line of its system.

DENTON, MD.—The Maryland & Delaware Telegraph & Telephone Company, of Wicomico County, has been incorporated; capital stock, $100,000. Directors: John Walter Smith, Walter B. Miller, Thomas H. Bock, Harry A. Richardson, Wm. H. Baker, Dupont Walker and Fred. R. Owens.

BALTIMORE, MD.—The Faller Automatic Telephone Exchange Company has been chartered to manufacture automatic telephone exchange appliances. The capital is $5,000,000. Ernest A. Faller, the inventor, is secertary of the company. A description of this system was published in last issue.

WINTHROP, MASS.—The Suburban Telephone Company has been incorporated, with a capital stock of $30,000.

MENOMINEE, MICH.—The Green Bay & Lake Michigan Telephone Company was given a franchise by the City Council to construct lines in Menominee.

HATTIESBURG, MISS.—The People's Telephone Company, capital stock $20,000, has been incorporated by A. U. Montgomery, T. E. Ross, W. A. Dozier and others.

AMORY, MISS.—The Amory & Tupelo Telephone Company operates Sumter apparatus, a 110-drop board, with 103 subscribers. Toll lines have recently been constructed and more are projected. Mr. Camp, general manager, reports business prosperous.

BOSWORTH, MO.—The Bosworth Telephone Company, capital stock $4,000, has been incorporated by W. J. Williams, W. S. Windsor, G. L. Reavis and others.

SEA ISLE CITY, N. J.—The lines of the Delaware & Atlantic Telephone Company are being extended to Corson's and Townsend's Inlets.

JERSEY CITY, N. J.—The reorganization of the Hudson Telephone Company has been followed by the announcement that the reorganized company intends to try once more to spread out and to extend its lines in all directions. Wm. J. Foster, of New York, is interested.

CORTLAND, N. Y.—The Cortland Home Telephone Company operates Stromberg-Carlson apparatus, a 700-drop board, not including toll lines, of which there are 100 miles with 26 stations. There are 670 subscribers and good prospects of increase.

ROME, N. Y.—It is the intention of the Rome Home Telephone Company to make an application to the Utica Common Council in the near future for a franchise to extend its lines to that city. Some years ago the Mohawk Valley Telephone Company obtained a franchise in Utica, but it has not yet made use of it.

RAY, OHIO.—The Ray & Vigo Telephone Company, capital stock $5,000, has been incorporated.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company has completed a new line from Portsmouth to Gallipolis.

SPRINGFIELD, OHIO.—The Springfield Board of Public Affairs has granted permission to the Springfield Home Telephone Company to lay conduits.

FREMONT, OHIO.—The Fremont Home Telephone Company has established a new exchange at Lindsey. Business in that section of Sandusky County is growing rapidly.

ADDISON, OHIO.—The Addison Telephone Company, of Addison, has been organized, with Frank Vanden, president; Asa Bradbury, secretary, and T. J. Daniels, treasurer.

XENIA, OHIO.—The Miami Telephone Company will shortly build a direct line from Xenia to Washington, C. H., by way of Jamestown and another to Wilmington by way of the Burlington Pike.

STEUBENVILLE, OHIO.—The Phœnix Telephone Company has received a number of new instruments which are to be installed on its lines in Steubenville. The business of the company is growing very rapidly.

ATHENS, OHIO.—The Irvin Valley Telephone Company has been incorporated by S. Woodyard, J. F. Carbaugh, Thomas Towsley, L. Jeffers and C. C. Johnson. The company will build lines in southern Athens and northern Meigs counties.

COSHOCTON, OHIO.—The Coshocton Telephone Company has received a large shipment of telephone instruments which have been delayed for some time. They are being installed and the system will be placed in operation as soon as possible.

DELAWARE, OHIO.—A temporary injunction has been secured by the United States Telephone Company and the Sunbury & Galena Telephone Company against the Central Union Telephone Company restraining it from erecting poles and stringing wires in the town of Sunbury.

PORTSMOUTH, OHIO.—Mr. Thomas Numan, manager of the Portsmouth Telephone Company, has been appointed manager of the United States Telephone Company for seven counties, including Scioto, Jackson and Lawrence, in Ohio, and Ohio, Lewis and Greenup in Kentucky.

WARREN, OHIO.—A. B. Conklin, heretofore superintendent of construction of the Warren & Niles Telephone Company, of Warren, has been elected treasurer of the Interstate Independent Telephone & Telegraph Company, which has recently been organized to build and acquire exchanges in Illinois.

ST. CLAIRESVILLE, OHIO.—The Belmont Telephone Company, of Belmont County, is to be consolidated with the National Telephone Company of Wheeling, W. Va. The Belmont Company has been an independent company operating exchanges and toll lines at Bridgeport, Martin's Ferry, St. Clairesville, Barnesville and Bellaire.

MASSILLON, OHIO.—The United States Telephone Company has established in Massillon a division headquarters. Edward E. Ebersole, of Cleveland, has been appointed Superintendent of Maintenance of Way, and C. W. Sebern, assistant superintendent. Both will be located in Massillon. A fifty-wire test station will be located here.

CHAGRIN FALLS, OHIO.—To further complete the independent lines in Geauga and neighboring counties, the Newbury Telephone Company, of Newbury has been incorporated with $10,000 capital stock, by George W. Stafford, C. H. Hubbell, W. D. Brewster, F. P. Schumacher, J. M. Hutchinson and Leon S. Hubbell. The company will be affiliated with the Geauga County Telephone Association.

CANTON, OHIO.—George S. Walton, general manager of the Stark County Telephone Company, with headquarters at Canton, has resigned, and will be succeeded by A. A. Hillstock, formerly manager of the Central Union Company's exchange at Washington, C. H. Mr. Walton was formerly secretary of the Columbiana County Telephone Company, and later assistant counsel for the Federal Telephone Company.

CINCINNATI, OHIO.—Corporation Counsel Hunt of Cincinnati, has attacked the validity of the transfer by the Fitzimmons Telephone Manufacturing Company of the use of the streets to erect poles, string wires, etc. It is claimed that the franchise is not transferable. The Fitzimmons Company is an independent company which holds a franchise in Cincinnati and which has been endeavoring for some time to build an extensive system in that city.

CLEVELAND, OHIO.—The local telephone companies are making veiled threats that if the City Council passes the Beilstein ordinance which was introduced some time ago, extending the underground district to the outlaying parts of the city, that they will simply remove their lines from certain parts of the city and permit public indignation to settle the matter. It is claimed that in some parts of the city it would cost more to place the wires under ground than could be secured from rentals in a number of years. The ordinance is now before a committee. The companies have agreed to frame an ordinance showing what they are willing to do in the way of extending the underground district.

CLEVELAND, OHIO.—Cleveland people who are interested in the Springfield Home Telephone Company report that construction work is being pushed very rapidly, 150 men being employed at the present time. Solicitors have been at work sixty-five days, and thus far have secured 1112 contracts. It is expected that the plant will be in operation early next spring. The company will shortly be consolidated with plants at Xenia, Jamestown and Yellow Springs in Greene County. The consolidated company will be known as the Springfield-Xenia Telephone Company and will have a capital stock of $500,000. The officers of the new company will be as follows: N. J. Dreyfoos, president; J. M. Blatt, secretary, and L. M. Wolf, treasurer, all of Cleveland.

CANTON, OHIO.—The Business Men's Association, of Canton, a few evenings ago held a joint meeting with the Grocers' Association and the Butchers' Association and adopted resolutions agreeing to cancel their contracts with the Central Union Telephone Company rather than pay the advance in rate from $42 to $54 per year which the company has announced. George Holmes, manager of the Bell Company, claimed that no decision to increase the rates had been decided upon, but it was proven among those present at the meeting that the advance had been asked by solicitors. The advance is looked upon as a queer move in view of the fact that the exchange of the Stark County Telephone Company is shortly to be opened with low rates, improved apparatus and long distance service.

NEW CASTLE, PA.—A local telephone service is being established in New Wilmington.

CONNEAUTVILLE, PA.—Mr. Corry, secretary of the Conneautville Telephone Company, informs us of the steady growth and bright prospects of his company. It uses Stromberg-Carlson apparatus and has a 150-drop board, besides a long-distance board, having connection through the Union Telephone & Telegraph Company's lines. The company has over 300 miles of wire in use.

ORANGEBURG, S. C.—The Orangeburg & St. Matthews' Telephone Company, incorporated lately, has its system in operation and has long-distance connections.

CALDWELL, TEX.—The Trans-Texas Telephone Company has just started business. It has a 100-drop switchboard and 75 subscribers, with 75 miles of toll line. Another exchange at Somerville with 50 telephones is projected.

SALT LAKE CITY, UTAH.—The Salt Lake Home Telephone Company, through Attorney Elmer B. Jones, Samuel F. Fenton and P. T. Madsen, its promoters, intends to go before the City Council Committee in relation to its petition for a franchise to build and conduct an independent system in this city.

GRAND ISLE, VT.—A new telephone company has been organized at this place, to be called the Grand Isle Telephone Company; capital stock, $2,000. The directors are Albert Kinney, Juan Robinson, Joseph Angel, and Dr. F. W. Sears.

SUNNYSIDE, WASH.—The Christian Co-operative Telephone Association uses Eureka apparatus, has a 100-drop board and 32 subscribers.

ELECTRIC LIGHT AND POWER.

ARKADELPHIA, ARK.—Articles of incorporation of the Wilson Water & Electric Company, of Arkadelphia, have been filed. The capital stock is $75,000, all of which has been subscribed. The officers are: J. W. Wilson, president and treasurer; J. H. Crawford, vice-president; Josiah Hardage, secretary.

SAN FRANCISCO, CALIF.—An electric lighting plant is installed in Mendocino, Calif., and buildings are being wired for electric lights.

SAN FRANCISCO, CALIF.—The Richmond Light & Water Company has been incorporated, with San Francisco as the principal place of business. Directors: H. Disque, F. M. Ferguson, F. A. Edinger, W. P. Pringle and C. C. Juster. Capital stock, $25,000; subscribed, $410.

SAN FRANCISCO, CALIF.—An electric power plant will be installed by the Boston company, which controls the Trinity and Arcadia group of mines near Lovelock, Nev. The mining works will be operated and lighted by electricity transmitted from the new power station.

HAYWARDS, CALIF.—The Town Trustees of Haywards, have decided to call on election for the voting of $15,000 in bonds for the purpose of establishing a municipal electric lighting plant. The amount to be spent for the plant is $12,000 and the balance for the buildings.

LOS ANGELES, CALIF.—The Salinas Water, Light & Power Company was recently incorporated, with Los Angeles as the principal place of business. Directors: O. Z. Hubbell, J. H. Gardner, R. C. P. Smith, F. J. Whiffen and C. W. Allen. Capital stock, $200,000; subscribed in full.

SAN FRANCISCO, CALIF.—The Joint Supervisors Committee on Judiciary and Public Utilities, at a recent meeting in San Francisco, agreed upon plans for the proposed ordinances authorizing special elections for the purpose of issuing bonds for the acquisition of Public Utilities, including lighting.

SAN FRANCISCO, CALIF.—One of the latest California power transmission projects is that in which Chas. D. Lane, the steamship and mining capitalist, and A. B. Thompson, of Angels, are interested. The company controls water rights and purposes to construct a 35-mile water ditch from the headwaters of the middle fork of the Stanislaus River, which will convey the water to Murphys, Vallecito and Angels.

SAN FRANCISCO, CALIF.—The main electric generating plant of the Kern Power Company, recently incorporated will be located near Kernville, where the water rights have been acquired. It is proposed to transmit electric power over a large part of Southern and Central California and to Los Angeles. It is said it will take about two years to place the new system in complete operation. The Los Angeles Railway Company's officials are largely interested in the project.

SAN FRANCISCO, CALIF.—The Calaveras Mining, Power & Water Company, composed of San Francisco and Oakland capitalists, has completed a large amount of hydraulic engineering work in connection with its mining and power projects. Water is taken from the headwaters of San Antonio Creek, near the Big Trees. The company proposes to build two dams next summer, which will give a capacity of 500 miner's inches of water day and night for two years. It is asserted that electric power can be profitably transmitted to San Francisco from the proposed generating plant.

RIDGE FARM, ILL.—The Ridge Farm Electric Light, Heat & Power Company, Ridge Farm, Ill., has certified to an increase of capital stock from $5,000 to $10,000.

LINCOLN, ILL.—The Lincoln Heat, Light & Water Company, of Lincoln, Ill., has been incorporated, with a capital stock of $50,000. The incorporators are W. A. Thomas, James W. Collins and David H. Harts.

BLUE MOUND, MO.—An election will be held on the question of purchasing the electric light plant.

OTTAWA, OHIO.—Citizens of Ottawa are agitating a proposition to build a municipal electric lighting plant in connection with the water works.

STEUBENVILLE, OHIO.—The Steubenville Council is considering a proposition to bond the town for $40,000 for the purpose of building a municipal lighting plant.

KENTON, OHIO.—Contracts are being let for the equipment of a large brewery to be erected here by Peter Waldeck. Electrical and refrigerating machinery will be required.

CANTON, OHIO.—The Central Heat & Power Company has been granted a franchise to erect a steam heating and electric power plant in Canton. Ed. L. Smith is at the head of the project.

UPPER SANDUSKY, OHIO.—H. E. Hill and J. M. Barber, of Marion, have applied for a franchise in Upper Sandusky to build a steam heating and electric power plant. The franchise will be granted.

OTTAWA, ONT.—The plans of the proposed works of the the Ontario Power Company at Niagara, for the development of 150,000 electric horsepower will be filed here. The company will commence operations shortly, and will at first install machinery for the development of 50,000 horse-power. It will develop power at Chippewa, close to the point where the Welland River enters the Niagara River, and the works will give a head of 270 feet. The company expects to find in Canada a market for the power it proposes to develop.

SALT LAKE CITY, UTAH.—Negotiations are pending between the Utah Light & Power Company and the Consolidated Railway & Power Company with the view to avoiding the expenditure by the latter of $300,000 for a new steam power plant. If they are carried through additional power will have to be provided for in planning the proposed new dam and reservoir in Ogden Canon of the Utah Light & Power Company for the use of the railway company.

SALT LAKE CITY, UTAH.—Col. Altman and A. B. Lewis will build a large power plant on the banks of the Beaver River, using its waters for power. It is the intention of the company to furnish light and power to the surrounding country; also power to the various mining companies operating in and around Milford and Frisco. In addition to this these gentlemen propose to build an electric railway between Beaver City and Milford, connected by a stage line.

The Electric Railway.

FT. WAYNE, IND.—The Ohio & Indiana Air Line Railway Company, a recent consolidation of the Ohio & Indiana and the Toledo-Bryan companies, announces having secured right of way for the entire 157 miles between Toledo, Ohio, and Marion, Ind. It will use the Bonner rail wagon for the transportation of farm products to the market terminals without reloading.

LEXINGTON, KY.—The Bluegrass Traction Company, a $7,000,000 interurban electric railway syndicate, has opened temporary offices in Lexington, with Harold C. Beatty, of Detroit, in charge, representing New York, Chicago and Detroit interests.

CHARLOTTE N. C.—W. H. Moore, president of the National Good Roads Association, has made a proposition to the citizens of Greenville and Tusculum, Tenn., to build an electric railway between the two points, four miles apart. The proposition, it is said, has virtually been accepted.

CHARLOTTE, N. C.—The Cumming & Buford Electric Railway Company has been chartered to construct a sixteen-mile line between the above two points in Georgia. The capital stock is $500,000. The incorporators are J. G. Puett, R. W. Shadburn, H. L. Patterson and John H. Hockehull, of Cumming, Ga., and H. D. Jaquish, W. Thompson, Chas. H. Smith, Jr., R. J. Owens and J. O. H. Brown of Buford, Ga.

ALBANY, N. Y.—The Hudson Valley Railway Company has filed a certificate of a change in its route so as to take in Round Lake. This is the trolley line running between Albany and Lake George.

ALBANY, N. Y.—The Interurban Street Railway Company, as a reorganization of the North Mount Vernon Railway Company, has been incorporated with a capital of $500,000. The directors are Andrew A. Halsey, Fred. C. Cocheu, Joseph F. Coffey, Charles M. Sweeney, Joseph F. McClean, Michael J. Kennedy, Louis H. Meht, George W. Seixas and William J. Studwell, of Brooklyn.

MADISONVILLE, OHIO.—The Cincinnati & Columbus Traction Company has applied for a franchise through Madisonville.

FREMONT, OHIO.—Kerlin Brothers, owners of the Fremont & Ballville Street Railway, are building a temporary water power plant at Ballville.

GARRETTSVILLE, OHIO.—Citizens of Garrettsville are endeavoring to induce the Northern Ohio Traction Company to extend its Ravenna line to Garrettsville.

DAYTON, OHIO.—An ordinance has been passed by the City Council of Dayton granting franchises to the People's Railway Company to build extensions to several of its lines.

TOLEDO, OHIO.—The passenger earnings of the Toledo Railways & Light Company for November were $77,514.14, a gain of $6,968.66. The receipts from lighting will amount to about $25,000.

CLEVELAND, OHIO.—The Springfield & Xenia Traction Company has authorized an issue of $500,000 in bonds. The road is being built between Springfield and Xenia and is nearly completed.

MANSFIELD, OHIO.—The Vermillion, Mansfield & Southern Railway Company has been incorporated with $10,000 capital by E. J. Coen, George Fisher, R. F. Quigley, C. C. Baumhart and Charles McGraw.

TOLEDO, OHIO.—The Toledo Railways & Light Company is considering a number of extensions and improvements. Specifications will be furnished by C. W. Wason, purchasing agent for the Everett-Moore syndicate at Cleveland.

COLUMBUS, OHIO.—The Central Ohio Traction Company, which proposes to build a line from Columbus to Wheeling, W. Va., has increased its capital stock from $100,000 to $600,000. R. S. Vivian is president and James D. McDowell, secretary.

CLEVELAND, OHIO.—The passenger earnings of the Cleveland Electric Railway Company for the month of November were $188,642.71, a gain of $16,108.34. Eleven months, $2,094,556.91, a gain of $220,705.97 over the same period last year.

UPPER SANDUSKY, OHIO.—O. C. Stutz, promoter of the line which is to be built from Tiffin to Upper Sandusky, has applied to the citizens of Upper Sandusky for a site for power-house and car barns. The company is to be incorporated within a few days.

DAYTON, OHIO.—The Ft. Wayne, Dayton & Cincinnati Traction Company will shortly increase its capital stock from $1,000,000 to $5,000,000. The company is incorporated under the laws of South Dakota and proposes to build 350 miles of road in Indiana and Ohio.

TOLEDO, OHIO.—President Lang, of the Toledo Railways & Light Company, states that from $400,000 to $500,000 will be spent on the Toledo lines during the next few months. A large addition will be built to the power house, extensions will be made and new cars purchased.

AKRON, OHIO.—The power house at Akron will be enlarged to take care of the Canton-Akron extension of the Northern Ohio Traction Company, and the original plan of building a power-house at New Berlin will not be carried out. A sub-station will probably be established at Canton to take care of that portion of the line.

SPRINGFIELD, OHIO.—Officials of the American Railways Company, Philadelphia, held a conference recently with the manager of the Springfield Railway Company relative to improvements to be made to the Springfield lines. The power houses of the railway company and the Springfield Light & Power Company are to be consolidated. New cars are to be purchased and new rails laid.

AKRON, OHIO.—Plans are being prepared for extensive additions to the power house of the Northern Ohio Traction Company. It is the intention to abandon the present stations at Bedford, Cuyahoga Falls, and Barberton and operate the entire system from one station. Early next spring the company will commence work on an extension from Barberton to Wadsworth by way of Western Star.

TOLEDO, OHIO.—The Toledo & Western Railway has completed a temporary bridge over the Lake Shore Railway at Adrian, Mich., and cars will be operated through from Toledo to Adrian within a few days. A new 1000-hp generating unit has just been placed in operation at the Sylvania power house and another is being installed. When completed the power-house will have a capacity of 3000 horse-power, sufficient to operate both the Ohio and Michigan divisions of the road.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has acquired and consolidated the Tuscarawas Electric Company and the Tuscarawas Railroad Company. The new company will be known as the Tuscarawas Traction Company, and will have a capital stock of $350,000 and will issue bonds for the same amount. Officers have been elected as follows: F. T. Pomeroy, president; J. A. Reutherford, Canal Dover, vice-president; J. O. Wilson, Cleveland, secretary, and W. A. Akins, New Philadelphia, treasurer and general manager. Lines are in operation from Canal Dover to New Philadelphia and from New Philadelphia to Uhrichsville. The former line will be extended from Canal Dover to Strasburg, giving the system 20 miles of road.

NASHVILLE, TENN.—It is said that prospects are good for the building of an electric railway from Adamsville, Ky., via Springfield, Tenn., to Nashville. People along the route are enthusiastic over the matter.

YORKTOWN, VA.—The charter members of the Yorktown, Pequosin & Hampton Electric Railway at a meeting at Yorktown have disposed of their rights to a new company headed by O. D. Jackson, of Norfolk, Va. Fifteen thousand dollars has been subscribed towards building the line. The same company has secured the charter of a proposed line between Jamestown and Yorktown, Va. The big 500-hp electric plant at Ivy, N. C., has been started up and power will be transmitted to Asheville, 15 miles distant.

New Industrial Companies.

THE UNIVERSAL STEAM POWER COMPANY, of New York City, has been incorporated; capital, $100,000. Directors: W. J. Foster, Melvin Seabury, and W. B. Overton, of New York City.

THE STRATTON MOTOR COMPANY, of New York City, has been incorporated; capital, $150,000. Directors: E. F. Stratton and David Wood, of New York City, and G. H. Murray, Jr., of Hollis, L. I.

THE NEWFANE ELECTRIC COMPANY, of Newfane, Niagara County, N. Y., has been incorporated; capital, $1,000. Directors: C. T. Raymond and J. H. Eilers, of Lockport, and Joseph Robinson, of Newfane.

THE PROMETHEUS ELECTRIC COMPANY, of New York City, has been incorporated, with a capital of $500,000. The directors are B. T. Lynch, of Brooklyn, and S. G. Stewart and George Russell, of New York City.

THE UNION ELECTRICAL SUPPLY COMPANY, of New York City, has been incorporated; capital, $10,000. Directors: E. E. Westervelt and A. F. Westervelt, of Hackensack, and G. M. Johnson, of New York City.

THE EL RENO PLUMBING AND ELECTRICAL SUPPLY COMPANY, of El Reno, Okla., has been incorporated, with a capital stock of $3,000. The incorporators are: M. F. Pettie, S. B. Pettie, H. B. Hazelton, F. D. Johnson and J. B. Royalty, all of El Reno, Okla.

THE AMERICAN DIESEL ENGINE COMPANY, of New York City, has been incorporated; capital, $2,500,000. Directors: Alfred L. Curtiss, Mark Hyman, D. W. Morrow, Nathan A. Smyth, Graham Sumner, Harold Walker, of New York City, and J. Clinton Walker of Brooklyn.

Legal.

CONSOLIDATED REFRIGERATING.—The New York Law Journal says that in the action brought by H. W. Rosenbaum on behalf of the minority stockholders of the Consolidated Equipment Company against Isaac L. Rice, the Consolidated Refrigerating Company and others, Justice Leventritt has just handed down a decision in favor of Mr. Rosenbaum and denying Mr. Rice's and the other defendants' motion to vacate an order obtained for their examination before trial and production of books, etc., for the purpose of obtaining a full disclosure as to all of the details and facts surrounding the deal put through last spring. Justice Leventritt in his decision states that if Mr. Rosenbaum can establish the allegations set forth in his pleadings he will be clearly entitled to success upon the trial.

TELEPHONE SWITCHBOARD SUIT.—The case of the Western Electric Company against the Kinloch Telephone Company, St. Louis, came before the Federal Court of Appeals in St. Louis last week. The suit was an appeal from a decision of the Circuit Court, in which an injunction was granted last summer restraining the Kinloch people from using a certain switchboard. The Western Electric Company claims that this switchboard is an infringement of a patent which it owns. The Kinloch Company denies the validity of the patent. After the injunction by the Circuit Court a stay was granted until after the Court of Appeals shall have decided the question. The arguments were concluded and the question submitted. Another suit in which the same companies are concerned came up the day following. This relates to a lightning arrester, on which the Western Electric Company claims that the Kinloch Company has also infringed.

A TELEPHONE SUIT.—At Birmingham, N. Y., recently, the Consolidated Telephone Company, of Cleveland, won an important point in a suit which was brought against it some time ago by the Bell Company. The suit was originally brought in the Supreme Court at Elmira. The Bell Company sought to restrain the independent company from building a pole line up through its lines, where, because of the character of the highway, it was shown to be necessary. Both companies held a franchise over the highway, but the Bell Company claimed that by right of priority it held the exclusive right along the line where its poles had been erected. The first court granted a temporary restraining

order, but the Consolidated Company secured a reversal of this decision because the suit had been brought without notice. The Bell Company then gave notice and filed another suit. This hearing was held in Birmingham recently and the court declined to grant a temporary injunction, so that the case will be heard later on its merits.

OBITUARY.

E. J. MATHEWS, president of the American District Telegraph Company, of Philadelphia, was killed last week by a fall from his horse. He was born in Philadelphia in 1836. For many years he was in the brokerage business there, but some time ago came to New York, where he was associated at 40 Wall Street with his son, Wilbur, under the title of E. J. Mathews & Company. Mr. Mathews had been prominent in street railway affairs in Philadelphia, and at one time was heavily interested in Metropolitan Street Railway. He was also the prime factor in the New York & Queens County Railway, a director of the Postal Telegraph Company, and had been recently appointed a Commissioner of the State Reservation at Valley Forge. He leaves a widow, a daughter and three sons.

THOMAS DICKENSON BOYLES died in Schenectady, N. Y., on Saturday, Nov. 30, after a brief but severe and painful illness. Born in 1870, his entire education was directed towards the engineering profession. Graduating from the Rose Polytechnic School at Terre Haute in the class of '92, he took up the profession of electrical engineering immediately. A natural leader, Mr. Boyles was prominent in his alma mater, and there are few Rose men of the last decade to whom his name is not familiar as synonomous of all that a college man should be. Mr. Boyles entered the employ of the General Electric Company in 1892. His early work was chiefly devoted in the street railway department, and more particularly in connection with controller design. Early in his professional career he began to give much attention to the art of switchboard design. This class of engineering proved to be particularly attractive to him, and with switchboard design and construction, and the design of devices for switchboard use Mr. Boyles speedily identified himself as a specialist. Entering this branch of the electrical art at a period when it first demanded close and detailed study, and at a time when the character of electric service and transmission was rapidly changing to higher potentials and to larger units, Mr. Boyles' work speedily brought him into prominence, and to all who have made a study of switchboard engineering during the past five years his name is familiar. In 1899 Mr. Boyles abandoned pure engineering to enter the commercial department of the General Electric Company in connection with the switchboard office, and to his zealous efforts are quite largely due the present character of that organization. Mr. Boyles was associated with substantially all of the great switchboard problems of the last five years; notably, the Metropolitan and Manhattan projects, important portions of the Niagara Falls equipment, and the large and important boards of the New York Gas & Electric Company and of the Boston Edison Company. Indelible as is the mark which Mr. Boyles' personality and ability has left upon the profession of electrical engineering, he will be remembered yet longer and more tenderly for the splendid qualities of gentle manhood which endeared him to all of those with whom he came in contact. Amongst those to whom he had given friendship—and he gave it freely wherever it was deserved—the loss of his cheerful presence and helpful counsel must always be beyond remedy and beyond replacement.

PERSONAL.

MR. W. F. D. CRANE has joined the engineering force of Sanderson & Porter, 31 Nassau Street, New York City, the well known consulting and contracting engineers.

SIR C. FURNESS, the English shipbuilder and ironmaster, who is largely interested in London underground roads, has just returned to England, after a long visit on this side.

PROF. W. L. PUFFER, of the Massachusetts Institute of Technology, has recently returned from a trip to Europe, where he has been studying more particularly the nature of the education given there in electricity.

MR. JOHN JACOB ASTOR, who has long been interested in electric launches, has applied for United States and foreign patents on a new type of marine turbine engine, which has the shaft and the casing revolving in opposite directions.

MR. J. G. WHITE, head of the London and New York engineering firm that bears his name, has, we regret to say, been quite ill lately. His early and complete restoration to health is looked for, much to the delight of a host of friends on both sides of the Atlantic.

COL. R. C. CLOWRY, general superintendent of the Western Union Telegraph Company, was lucky in escaping without injury last week from a train wreck near The Dalles on Dec. 6 in Oregon. His special car stayed on the track while several others left it. The "accident" is attributed to train wreckers.

MR. CLARENCE P. DAY announces in a circular his retirement from the vice-presidency of the Industrial Press and his entry into the advertising field as an advertising counsellor. The capacity in which he proposes to act is that of counsellor to the advertiser in regard to mediums of a mechanical or technical character. Mr. Day's long experience in the field should make him of value to any one needing his services.

MR. DAVID YOUNG has decided to resign as president of the Elizabeth, Plainfield & Central New Jersey Street Railway Company, in order to give all his time to the presidency of the Jersey City, Hoboken & Paterson Street Railway Company, and vice-presidency of the North Jersey Street Railway Company For a year he has looked after three separate trolley systems, but the work is too much, and Mr. Alfred Barr will take charge of the Elizabeth and Plainfield system. Mr. Barr was until recently connected with the Worcester, Mass., traction lines.

MR. LOUIS R. ALBERGER, recently with the Henry R. Worthington Company, has formed the Alberger Condenser Company, of which he is president, the other officers being George Q. Palmer, of the Quintard Iron Works, and Messrs. B. W. Pierson, D. H. Chester and George P. Symonds, recently with the Worthington Company. The company will manufacture and sell condensing apparatus, vacuum pumping machinery and cooling towers, embodying important improvements, and will make a specialty of steam pumping and condensing apparatus for electric lighting and railway power stations.

MR. E. R. KNOWLES, of New York City, has been retained by the United States Government as consulting engineer for the electrical equipment of the gantry crane at Sandy Hook proving grounds. He has also been retained as consulting engineer by Mr. E. W. Bliss for the new ten-story factory building and the remodeling and equipping with electric power of five other factory buildings, all situated on 22d and 23d streets and Second Avenue, New York. A power plant of sufficient capacity will be installed in the new building, and from this point it and all the other buildings will be operated.

COL. JOHN PARTRIDGE, the present New York State Commissioner of Public Works, and now selected by Mayor Low as the next Police Commissioner for Greater New York, is well known to electrical people. He served for ten years or more as President of the Brooklyn & Newtown Railroad Company, since consolidated with the Coney Island & Brooklyn Railway Company. During the trolley strike of 1895, when every line in Brooklyn was tied up, Col. Partridge spent three days and nights conferring with the men employed on the cars of his company, and made concessions which enabled him to open his lines to the public at the end of that time. All of the other companies operating in the city held out against their employes, and in consequence most of the people of Brooklyn had to walk for three weeks of the winter.

MR. JOSEF HOFMANN, the famous young pianist, who is now in New York, is very fond of mechanics and quite an inventor in gasoline automobiles, etc. He would also appear to be working on storage batteries, although we do not follow easily this account from the *New York Herald:* "One of the methods of regenerating or recharging, chemically, such electrodes heretofore attempted to be used, has been by the employment of the hypochlorites, such as chloride of lime. That was disadvantageous, because during the oxidation of the electrode a deposit was formed, which had a bad effect, increasing the internal resistance of the battery, so that the electro-motive force would rapidly diminish. Mr. Hofmann has overcome these difficulties, and has demonstrated that the accumulator electrodes can be regenerated by chemical means, and in a practically feasible way, by the use of free hypochlorous acid in solution, instead of the troublesome hypochlorites. This invention may seem simple, but the simplest inventions are generally the most important and valuable."

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to its special five magnet generator type, No. 36 telephone, for heavily loaded or poorly constructed farmers' lines. It claims that they will ring through anything.

LINOTYPE MOTOR.—Bulletin No. 163 of the Jenney Electric Manufacturing Company, Indianapolis, Ind., describes and illustrates the Jenney linotype motor. The advantages of these machines are pointed out, and their construction is clearly illustrated.

REMOVAL.—The Gordon Battery Company announces that it has secured larger quarters at 439-445 East 144th Street, New York, which it will occupy on and after Jan. 1 next. This will enable the company to handle its increasing business with greater dispatch.

CROSS OIL FILTERS.—Two very large Cross oil filters were recently shipped to Smyrna, Asia Minor, by the Burt Manufacturing Company, of Akron, Ohio. The sale of this filter has extended to twenty-eight different countries, which is good evidence of its merits.

VOLTMETERS AND AMMETERS.—The Federal Instrument Company, 82 State Street, Albany N. Y., has issued a price list of its voltmeters and ammeters for direct and alternating current circuits. The instruments are illustrated and briefly described. They are claimed to be of the highest grade.

ELECTRIC LIGHT SUPPLIES.—The Central Electric Company's stock of sleet-proof pulleys, iron brackets, windlasses, street hoods, arc lamp cordage, etc., is very large and complete. The season for installing this material is now at hand, and this company will quote prices by return mail, and make prompt shipments in order that customers may be supplied before the severe winter sets in.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out a small pamphlet illustrating some very new and novel ideas in electric heating apparatus. It illustrates an electric heater which is entirely new, for use in houses or cold corners of offices, etc. It states that the current consumption of these heaters is very small and they can be operated at nominal cost. They are rapidly superseding gas stoves, grate fires, etc., in various places, are much more cleanly, and can be easily regulated.

THE ELECTROGRAPH.—The Electrograph Company of America, which was recently organized to exploit the electrograph (a machine for transmitting pictures by wire) has just issued its prospectus. The Electrograph and its operation are described, and illustrations show the machine and reproductions of its work. This machine was described and illustrated in ELECTRICAL WORLD AND ENGINEER of April 13 last, and was exhibited at the conversazione of the American Institute of Electrical Engineers at Columbia University in the same month.

THE LIBERTY MANUFACTURING COMPANY, 5988 Centre Avenue, Pittsburg, is the successor to the Chicago Boiler Cleaner Company, which formerly did business at the same address. The new company will continue to manufacture the Chicago boiler cleaner and the famous oil filter and purifier. Some very marked improvements are being made in the cleaner in the consumption of water, increase of power, and durability. Mr. G. W. Atterbury, the

president of the new company, is now in Europe establishing agencies made necessary by the rapidly increasing foreign business of the company.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has recently been surprising its friends with a second issue of its famous "Infernal" circular. The startling feature of this literature is a "buzzer" which "goes off" with considerable noise when the recipient opens up the paper. This centers attention on the contents of the circular, which describes and handsomely illustrates the company's fine line of dynamos and motors and the application of some of the latter to the running of machine tools, etc.; the man who gets the "shock" from the "buzzer" in this new circular is pleased to find that the make-up of the thing includes a key ring which he may detach and use.

"THE LIVING AGE" has printed as usual Prince Krapotkin's excellent review of current science. Two travel papers, quite different in their subjects, but suggesting comparison by the brilliancy of their style, are Arnold Haultain's description of "A Winter's Walk in Canada" in *The Living Age* for Nov. 23, and Harold Spender's "Ravenna" in the same magazine for Nov. 30. They are both of a quality too seldom seen in American magazines. The *National Review's* important article on the Foreign Policy of England, which has set both the English and the Continental press to talking of the possibility of an understanding between England and Russia, will be reprinted without abridgment in the *Age* for Dec. 14.

MR. W. DRUMMOND MARROW, formerly of Richmond, Va., who was general manager for the Standard Electric Company, of Danville, Va., from its organization in March last, has severed his connection with it to enter for himself the consulting electrical engineering, construction and repair business at 233 South Tryon Street, Charlotte, N. C. This was the former office of the Standard Electric Company, which Mr. Marrow fitted up while in the company's employ, and purchased from it, when he severed his connection with that concern. Mr. Marrow has had about sixteen years' experience in the different electric branches, having been in business for himself until March last, for the past ten years. He proposes to represent manufacturers of every description in that part of the country.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Cleveland, is making additions to its floor space and factory equipment which will give it largely increased facilities for turning out telephone switchboards and other apparatus. At present the company's factory is crowded with work. Among other boards under construction are three 1000 central energy boards for the exchanges in New York, of the Consolidated Telephone Company, with which the Century Company is affiliated. The company is working on a new long distance transmitter and will soon have an important announcement to make relative to a number of new varieties of central energy apparatus now being experimented with. The company has just issued Bulletin No. 10 illustrating and describing several new lines of apparatus.

CABLE TESTING APPARATUS.—Mr. James G. Biddle, Stephen Girard Building, Philadelphia, has received orders for cable testing equipments from such prominent companies as the Bell Telephone Company of Philadelphia, Keystone Telephone Company, Philadelphia, Interstate Telephone Company, Trenton, N. J.; Reserve Construction Company, Cleveland, Ohio, and the Pittsburgh & Allegheny Telephone Company, Pittsburgh, Pa. All of these outfits included one or more of the Fisher cable testing sets, which have practically come to be considered as standard apparatus for this class of work. The Fisher sets are made by Leeds & Company, for whom Mr. Biddle is sole selling agent. By addressing him, interested parties can secure a copy of catalogue 360 without charge. It describes the Fisher sets in detail, as well as accessory apparatus.

THE HENRY ELECTRIC EQUIPMENT COMPANY, of Denver, Colo., recently noted in our Commercial Intelligence, has started business and opened offices at 417 Boston Building, that city, to exploit some of the later work of the inventor, Mr. J. C. Henry, who died this year. The first thing taken up is a train lighting system just tested. The Henry Electric Equipment Company, which is to manufacture these new appliances in Denver, is as follows: President, C. F. Elliott; secretary, D. Carl Henry; directors, William Barber, mining broker of Colorado Springs; James H. Peabody, president of the First National Bank of Canon City, and State Senator N. F. Handy, also of Canon City. Among the others who witnessed the test were O. H. Shoup, of the Reed Investment Company, Colorado Springs; A. A. Burnand, of the Small Hope Mining Company, Leadville; Asa Fisher, of the La Belle Water & Power Company, Goldfield, Colo.; N. H. Fraser, C. A. Kuck and Thomas E. Smith, all of Denver.

FIRE DETECTING WIRE.—At the convention of the Pennsylvania State Firemen, held Oct. 2 last, the committee on exhibits made a very flattering report on the exhibit of the Montauk Fire Detecting Wire Company, of New York, which report was ordered printed in the proceedings. As is well known, the Montauk fire detecting wire is a wire which is affected by dangerous heat as well as by the smallest flame (even that of a match) and gives an alarm in from ten to fifteen seconds; it is a continuous thermostat. It has the approval of the Fire Underwriters of the City of New York, and is being rapidly introduced, some of the recent installations covering millions of dollars' worth of property. It is as efficient as a burglar alarm and is of such a nature that it can be spliced to other wires where there is danger of fire. The wire does not reduce the fire hazard, but it does give a warning very quickly, and is a valuable adjunct to protection of life and property.

INCANDESCENT LAMPS.—Among the many incandescent lamp manufacturers who have recently come into prominence is the firm of Goodchild & Welsh, 275 and 277 Broome Street, Newark, N. J. This firm started in a very modest way about two years ago and has steadily increased until it is to-day one of the largest firms in the East in this line. Its new and well equipped factory, with the best up-to-date machinery that can be procured, enables it to produce an output of 1500 lamps per day. These lamps, it is stated, have given perfect satisfaction wherever used and duplicate orders are the result. The firm's customers include many of the largest lamp users in the country, and the Hahne department store in Newark, N. J., described and illustrated elsewhere in this issue, is fitted out exclusively with these lamps. This firm claims to use the best material, and skilled labor, and the testing is carefully done under the supervision of M. H. Welsh, who was for seven years with the General Electric Company.

THE HAINES & NOYES COMPANY, manufacturer of guaranteed telephone apparatus for every possible use, Chicago, announces the appointment of the following agencies: Gilson & Hatch, Lynn, Mass.; Geo. R. Mathieu, 6000 Hoeveler Street, E. E. Pittsburg, Pa.; C. K. Hill, 201 Seventh Street, Pittsburg, Pa.; Roak & Rittenhouse, 723 Walnut Street, Philadelphia, Pa.; Federal Electric Company, export agents, New York City; Risley & Boniface, 109 S. New York Avenue, Atlantic City, N. J.; J. E. Henry & Company, Baltimore, Md.; H. I. Sackett, Builders' Exchange, Buffalo, N. Y.; J. A. Exner & Company, Permanent Building, Cleveland, Ohio; Porter Bros., Louisville, Ky.; W. T. Osborn & Company, Kansas City, Mo.; Overton Manufacturing & Engineering Company, Topeka, Kan.; Portland General Electric Company, Portland, Ore.; Woodill & Hulse Electric Company, Los Angeles, Calif.; the John M. Klein's Electrical Works, San Francisco, Calif.; Mr. Chas. W. Geib, Spokane, Wash.; Mr. T. W. Tuggle, Beaumont, Tex.; Mr. T. W. Rachford, Springfield, Ill.; Erickson Electrical Equipment Company, Boston, Mass.; H. P. Wood, Louisville, Ky.; James Clark, Jr., & Company, Louisville, Ky. It has made Messrs. E. M. Van Duzee, Jr., & Company, its agents for the Northwestern States, with headquarters in St. Paul, Minn., for all exchange business.

A CHRISTMAS GIFT.—A new departure in Christmas gifts along educational lines emanates from Boston. The plan affords an opportunity for an employer to present—at a nominal cost—to any deserving young ware-earner a scholarship in one or more of the following courses: mechanical, electrical, stationary, locomotive, textile or marine engineering; mechanical drawing; heating, ventilation and plumbing. An employer's good-will, expressed in the adoption of the above suggestion, would be of an exceedingly practical and valuable nature. The young man is thereby afforded an opportunity to further his education along technical lines, and so fit himself for a better paying position, and this is accomplished without loss of time from his present occupation. A more opportune time than Christmas, while the very atmosphere is filled with the gift idea, could not possibly be chosen. A unique feature of this scholarship plan lies in the fact that a reference library of engineering practice, comprising over 2800 quarto pages, bound in five handsome leather volumes, will be given outright to all December recipients of these scholarships. The books will be sent so as to reach their destination at Christmas time. Full information as to these scholarships, their cost, etc., may be obtained by addressing the American School of Correspondence (chartered by the Commonwealth of Massachusetts), Boston, Mass., U. S. A.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DEC. 3, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

687,709. PRODUCTION OF CAUSTIC ALKALI AND HALOGEN GAS; C. E. Acker, Niagara Falls, N. Y. App. filed July 18, 1899. (See Current News and Notes.)

687,723. ELECTRIC MOTOR; D. P. Burdon, Jacksonville, Fla. App. filed July 26, 1901. The motor employs a number of alternately energized magnets acted upon by separate sources of electrical energy whereby one source is at rest while the other is in action, thus providing a machine especially applicable for use in connection with batteries.

687,727. MACHINE FOR STRINGING WIRES; F. B. Collins, Vasser, Mich. App. filed April 29, 1901. A traveler adapted to travel on one or two wires and readily pass over insulators on cross-arms and at the same time deliver a wire either upon the cross-arm over which it is traveling or to one beneath.

687,729. OSCILATING DEVICE FOR BRUSH HOLDERS FOR ELECTRICAL MACHINES; W. Cooper, Cincinnati, Ohio. App. filed April 9, 1900. The brushes are caused to travel slowly backward and forward over the surface of the commutator, so as to wear the surface uniformly.

687,766. TROLLEY FOR ELECTRIC RAILWAYS EMPLOYING OVERHEAD CONDUCTORS; W. F. Mack, South Bethlehem, Pa. App. filed Sept. 26, 1901. A fork is pivoted to the harp and controlled by a weight and the trolley wheel in such a manner as to rise into position when the wheel leaves the wire to return it thereto, after which the fork returns to its normal lowered position.

687,800. PLANT FOR THE ELECTRODEPOSITION OF METAL; A. L. Walker, Perth Amboy, N. J. App. filed March 28, 1900. (See Current News and Notes.)

687,812. CAPPING FOR ELECTRIC CONDUITS; W. F. Bossert, Utica, N. Y. App. filed Dec. 28, 1900. A cylinder having a protecting ring and adapted to be screwed on to the end of the conduit.

687,829. ELECTRIC CONTROLLER; C. H. Keeney, Milwaukee, Wis. App. filed Sept. 14, 1901. In an electric controller system, a single solenoid and its reciprocable core, means actuated by the movement of the solenoid core in one direction for successively cutting out resistance, and mechanical means for putting in the resistance.

687,833. BATTERY; P. E. Francken, Brussels, Belgium. App filed July 25, 1900. Details.

687,861. TROLLEY GUARD; A. W. Smith, Pine River, N. H. App. filed Jan. 16, 1901. The guard is held in normal position by spiral springs surrounding the axle.

687,881. APPARATUS AND CIRCUIT FOR OPERATING ELECTRIC LAMPS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1900. (See page 993.)

687,882. VAPOR LAMP; P. C. Hewitt, New York, N. Y. App. filed April 5, 1900. (See page 993.)

687,883. TERMINAL FOR ELECTRIC VAPOR OR GAS LAMPS; P. C. Hewitt, New York, N. Y. App. filed April 18, 1900. (See page 993.)

687,885. ELECTRIC BATTERY; G. D'Infreville, New York, N. Y. App. filed Jan. 3, 1901. A battery adapted for use either as a primary or secondary and on either an open or closed circuit. It contains a solution of sulphuric acid with an upper electrode of amalgamated zinc, a lower electrode carrying peroxide of lead and with a clear horizontal stratum of the solution between them.

687,893. CARBON APPARATUS AND MACHINERY; W. H. Marshall, Cleveland, Ohio. App. filed April 12, 1901. A method of preserving arc light carbons from impurities in the course of their manufacture, which consists in providing all inner exposed surfaces of the apparatus through which the carbon stock passes with a carbon cover.

687,895. VACUUM BREAKING DEVICE; T. D. Millea, Springfield, Mass. App. filed Jan. 20, 1900. An electro-magnetic valve operating device.

687,903. ELECTRICAL HEAT REGULATING APPARATUS; H. Schultz, Berlin, Germany. App. filed July 29, 1898. A clockwork is used to move a contact of a circuit closer relatively to the expanding medium of a thermometer whereby the temperature at which the circuit closer acts is progressively varied.

687,916. ELECTRIC SWITCH; E. S. Cook and W. H. Chipperhead, London, England. App. filed March 22, 1901. Details.

687,943. ELECTRIC LAMP; T. A. Smith, Azusa, Calif. App. filed Jan. 18, 1900. The globe is formed with an internal tubular pillar around which the filament leads in spiral form the interior of the tube being covered with reflecting material.

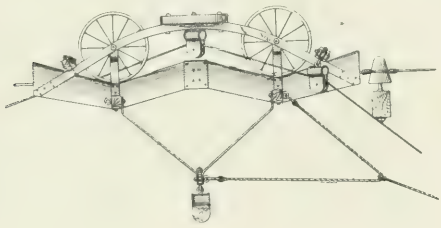
687,948. ELECTRIC SIGNALING AND INDICATING APPARATUS; F. W. Wood, Newport News, Va. App. filed May 13, 1901. The indicator comprises two magnets and an armature carrying the index. The transmitter consists of a rheostat, the terminals of which are respectively connected with the two magnets and its contact arm being so connected as to simultaneously increase the current through one magnet and decrease it through the other.

687,950. TROLLEY; J. Zumbrunnen, Elliott, Pa. App. filed April 4, 1900. Details.

687,982. IMPLEMENT FOR SINKING ELECTRICAL GROUND PLUGS; W. E. Fischer, Bloomsburg, Pa. App. filed April 22, 1901. A grounding plug having a wire attached to it and a driving bar for the plug having a receptacle for the reception of the wire during the driving of the plug, the free end of the wire remaining above the surface of the ground during the driving of the plug.

687,991. DYNAMO FRAME; A. Churchward, Chicago, Ill. App. filed June 12, 1899. Modification of the following.

687,992. DYNAMO ELECTRIC MACHINERY; A. Churchward, Chicago, Ill.



687,727.—Machine for Stringing Wires.

App. filed Dec. 18, 1899. Wrought iron or steel plates are secured to the field frame and wrought iron or steel pole pieces are seated against the plate, the pole pieces being removably secured to the plate.

687,996. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich App. filed Nov. 30, 1900. (See page 987.)

687,997. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

687,998. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

687,999. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

688,009. AUTOMATIC MEANS FOR CONSERVING ENERGY OF ELECTRIC BATTERIES; P. Siegel and M. H. Abrahams, New York, N. Y. App. filed April 25, 1901. A clock is arranged to throw the different cells of a battery into circuit successively.

688,025. CONTROLLER FOR ELECTRIC AUTOMOBILES; F. F. Loomis, Akron, Ohio. App. filed May 24, 1900. Details.

688,031. FUSE PLUG FOR CUTOUT BLOCKS; J. Sachs, Hartford, Conn. App. filed Dec. 8, 1900. A fuse case and fuse inclosed therein, a conducting body extending around the fuse-case and appreciably distant therefrom, an engaging electrical connection between the said body and one end of the fuse-case, and an insulating member between the other end of the fuse-case and said conducting body.

688,045. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; A. J. Wilson, Westfield, N. J. App. filed May 23, 1900. A home signal and a distant signal both located at the entrance of a block; a circuit for the home signal; a circuit for the distant signal; a rail-circuit; means in the rail circuit operated by the home signal for controlling the circuit of the distant signal, whereby the distant signal cannot go to safety unless the home signal is at safety.

688,046. ELECTRIC SIGNALING SYSTEM; A. J. Wilson, Westfield, N. J. App. filed Oct. 23, 1900. Two signals located at a substantial distance from each other; a signal circuit containing two magnets for controlling respectively said signals, one of said magnets being responsive and the other unresponsive to a given current; a resistance coil and means for connecting the resistance coil in multiple with said signal circuit and disconnecting it therefrom for making responsive one or both magnets, whereby one or both signals may be operated.

688,058. INSTRUMENT FOR MEASURING THE RESISTANCE OF ELECTRIC CIRCUITS; E. K. Brown, Springfield, Mass. App. filed April 1, 1901. Details.

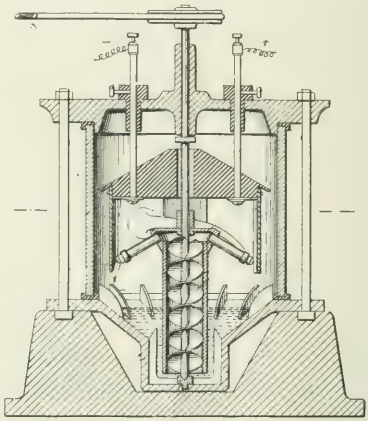
688,068. INTERRUPTER; R. H. Cunningham, New York, N. Y. App. filed July 10, 1901. An interrupter, comprising positive and negative electrodes, and a mercury container having movement relative to the said electrodes and arranged to discharge streams of mercury upon the electrodes to form a periodical conductor between the electrodes.

688,077. POROUS DIAPHRAGM FOR BATTERIES; G. T. Eyanson, Philadelphia, Pa. App. filed May 17, 1901. Glazed porcelain or other earthenware plates are provided with grooves at the edges and across the flat faces, with holes at the points of intersection of vertical and horizontal grooves. A lead frame surrounds the plate and parts of the same extend into the grooves and into the holes at intersections. In making up a complete plate the edges of several plate sections are burned together, thus forming a partition or diaphragm, which diaphragms may be burned together to form a vessel.

688,118. SELECTIVE SYSTEM; S. A. Reed, Middletown, N. J. App. filed Feb. 27, 1901. (See Current News and Notes.)

688,124. TELEPHONE ATTACHMENT; J. A. Rice, Bland, New Mexico. App. filed March 29, 1901. (See page 987.)

688,125. ELECTRIC LAMP SOCKET; J. T. Robb, Flatbush, N. Y. App. filed Sept. 27, 1901. Details.



688,068.—Interrupter.

688,130. CONTROLLER FOR ELECTRIC CARS; B. W. Scott, San Jose, Calif. App. filed April 30, 1901. The lever which moves the brake mechanism at the same time moves a gear segment and rotates a pinion on the shaft of the electric controller.

688,150. ELECTRIC MOTOR; J. Darling, Chicora, Pa. App. filed June 5, 1901. General improvement in construction designed to simplify the motor and to facilitate putting the parts together.

688,170. ELECTRIC FURNACE; J. F. Hammond, New York, N. Y. App. filed Feb. 21, 1901. (See Current News and Notes.)

688,176. REGULATING SOCKET FOR MULTIFILAMENT INCANDESCENT LAMPS; C. A. Hussey, New York, N. Y. App. filed March 16, 1901. Details of a socket for throwing the filaments into circuit singly or together and either in series or parallel.

688,184. AUTOMATIC MONITOR FOR TELEPHONE EXCHANGES; J. B. Lee, Charleston, S. C. App. filed Sept. 1, 1900. (See page 989.)

688,213. THERMOSTATIC FIRE ALARM; H. C. Vierkant, Tarrytown, N. Y. App. filed March 18, 1901. Details.

688,268. PROCESS OF PRODUCING MINE EXPLODERS; N. Schmidt, Kupperstig, Germany. App. filed Dec. 30, 1897. A process for producing mine exploders which consists in forming longitudinal creases in a strip of suitable material, impregnating the same material and feeding conductors into the said creases in such manner as to keep the same insulated from each other, closing the said strip to a cord, drying the same and applying the fuse to the end thereof.

THE ELECTRICAL WORLD AND ENGINEER'S

MOONLIGHT TABLES FOR 1902

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

JANUARY, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	1.45 A.M.
2	5.15 "	3	2.40 "
3	5.15 "	4	3.40 "
4	5.15 "	5	4.35 "
5	5.15 "	6	5.30 "
6	5.15 "	7	6.20 "
7	5.20 "	8	6.20 "
8	5.20 "	9	6.20 "
9	5.20 "	10	6.20 "
10	5.20 "	11	6.20 "
11	5.20 "	12	6.20 "
12	5.20 "	13	6.20 "
13	5.25 "	14	6.20 "
14	5.25 "	15	6.20 "
15	5.25 "	16	6.20 "
16	5.25 "	17	6.20 "
17	5.30 "	17	12.00 M.
18	12.35 A.M.	18	6.20 A.M.
18	5.30 P.M.	18	12.00 M.
19	1.40 A.M.	19	6.20 A.M.
19	5.30 P.M.	19	12.00 M.
20	5.30 "	20	12.00 "
21	5.35 "	21	12.00 "
22	5.35 "	22	12.00 "
23	5.35 "	23	12.00 "
24	5.35 "	24	12.00 "
25	5.35 "	25	12.00 "
26	5.40 "	26	12.00 "
27	5.40 "	27	12.00 "
28	5.40 "	28	12.00 "
29	5.40 "	30	12.30 A.M.
30	5.45 "	31	1.30 "
31	5.45 "	01	2.25 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	1.45 A.M.
2	5.15 "	3	2.40 "
3	5.15 "	4	3.40 "
4	5.15 "	5	4.35 "
5	5.15 "	6	5.30 "
6	5.15 "	7	6.20 "
7	5.20 "	8	6.20 "
8	5.20 "	9	6.20 "
9	5.20 "	10	6.20 "
10	5.20 "	11	6.20 "
11	5.20 "	12	6.20 "
12	5.20 "	13	6.20 "
13	5.25 "	14	6.20 "
14	9.15 "	15	6.20 "
15	10.20 "	16	6.20 "
16	11.30 "	17	6.20 "
17	....	..	...
18	12.35 A.M.	18	6.20 "
19	1.40 "	19	6.20 "
20	2.50 "	20	6.20 "
21	3.50 "	21	6.20 "
22	No Light.	22	No Light.
23	"	23	"
24	"	24	
25	5.35 P.M.	25	8.25 P.M.
26	5.40 "	26	9.30 "
27	5.40 "	27	10.30 "
28	5.40 "	28	11.35 "
29	5.40 "	30	12.30 A.M.
30	5.45 "	31	1.30 "
31	5.45 "	01	2.25 "

FEBRUARY, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	3.15 A.M.
2	5.50 "	3	4.10 "
3	5.50 "	4	5.00 "
4	5.50 "	5	5.45 "
5	5.50 "	6	6.00 "
6	5.50 "	7	6.00 "
7	5.55 "	8	6.00 "
8	5.55 "	9	6.00 "
9	5.55 "	10	6.00 "
10	5.55 "	11	6.00 "
11	6.00 "	12	6.00 "
12	6.00 "	13	6.00 "
13	6.00 "	14	6.00 "
14	6.00 "	15	6.00 "
15	6.05 "	16	6.00 "
16	6.05 "	16	12.00 M.
17	12.40 A.M.	17	6.00 A.M.
17	6.05 P.M.	17	12.00 M.
18	1.40 A.M.	18	5.50 A.M.
18	6.05 P.M.	18	12.00 M.
19	6.10 "	19	12.00 "
20	6.10 "	20	12.00 "
21	6.10 "	21	12.00 "
22	6.10 "	22	12.00 "
23	6.10 "	23	12.00 "
24	6.15 "	24	12.00 "
25	6.15 "	25	12.00 "
26	6.15 "	26	12.00 "
27	6.15 "	28	12.10 A.M.
28	6.20 P.M.	01	1.05 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	3.15 A.M.
2	5.50 "	3	4.10 "
3	5.50 "	4	5.00 "
4	5.50 "	5	5.45 "
5	5.50 "	6	6.00 "
6	5.50 "	7	6.00 "
7	5.55 "	8	6.00 "
8	5.55 "	9	6.00 "
9	5.55 "	10	6.00 "
10	5.55 "	11	6.00 "
11	6.00 "	12	6.00 "
12	6.00 "	13	6.00 "
13	9.20 "	14	6.00 "
14	10.30 "	15	6.00 "
15	11.30 "	16	6.00 "
16	...	..	...
17	12.40 A.M.	17	6.00 "
18	1.40 "	18	5.50 A.M.
19	2.40 "	19	5.50 "
20	3.30 "	20	5.50 "
21	No Light.	21	No Light.
22	"	22	"
23	"	23	"
24	6.15 P.M.	24	9.15 P.M.
25	6.15 "	25	10.15 "
26	6.15 "	26	11.15 "
27	6.15 "	28	12.10 A.M.
28	6.20 P.M.	01	1.05 "

MARCH, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	2.00 A.M.
2	6.20 "	3	2.50 "
3	6.20 "	4	3.35 "
4	6.20 "	5	4.20 "
5	6.25 "	6	5.00 "
6	6.25 "	7	5.25 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.15 "
13	6.30 "	14	5.15 "
14	6.35 "	15	5.15 "
15	6.35 "	16	5.10 "
16	6.35 "	17	5.10 "
17	6.35 P.M.	17	12.00 M.
18	1.25 A.M.	18	5.10 A.M.
18	6.35 P.M.	18	12.00 M.
19	2.10 A.M.	19	5.05 A.M.
19	6.40 P.M.	19	12.00 M.
20	6.40 "	20	12.00 "
21	6.40 "	21	12.00 "
22	6.40 "	22	12.00 "
23	6.40 "	23	12.00 "
24	6.45 "	24	12.00 "
25	6.45 "	25	12.00 "
26	6.45 "	26	12.00 "
27	6.45 "	27	12.00 "
28	6.45 "	28	12.00 "
29	6.50 "	30	12.40 A.M.
30	6.50 "	31	1.30 "
31	6.50 "	01	2.10 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	2.00 A.M.
2	6.20 "	3	2.50 "
3	6.20 "	4	3.35 "
4	6.20 "	5	4.20 "
5	6.25 "	6	5.00 "
6	6.25 "	7	5.25 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.15 "
13	6.30 "	14	5.15 "
14	10.30 "	15	5.15 "
15	11.30 "	16	5.10 "
16	...	..	...
17	12.30 A.M.	17	5.10 "
18	1.25 "	18	5.10 "
19	2.10 "	19	5.05 "
20	2.50 "	20	5.05 "
21	3.25 "	21	5.00 "
22	No Light.	22	No Light.
23	"	23	"
24	"	24	
25	6.45 P.M.	25	9.00 P.M.
26	6.45 "	26	10.00 "
27	6.45 "	27	11.00 "
28	6.45 "	28	11.50 "
29	6.50 "	30	12.40 A.M.
30	6.50 "	31	1.30 "
31	6.50 "	01	2.10 "

APRIL, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	2.50 A.M.
2	6.50 "	3	3.30 "
3	6.55 "	4	4.05 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.35 "
6	6.55 "	7	4.35 "
7	6.55 "	8	4.35 "
8	7.00 "	9	4.30 "
9	7.00 "	10	4.30 "
11	7.00 "	12	4.30 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	2.50 A.M.
2	6.50 "	3	3.30 "
3	6.55 "	4	4.05 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.35 "
6	6.55 "	7	4.35 "
7	6.55 "	8	4.35 "
8	7.00 "	9	4.30 "
9	7.00 "	10	4.30 "
11	7.00 "	12	4.30 "

MAY, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	2.40 A.M.
2	7.20 "	3	3.10 "
3	7.25 "	4	3.45 "
4	7.25 "	5	3.55 "
5	7.25 "	6	3.55 "
6	7.25 "	7	3.50 "
7	7.25 "	8	3.50 "
8	7.30 "	9	3.50 "
9	7.30 "	10	3.50 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	2.40 A.M.
2	7.20 "	3	3.10 "
3	7.25 "	4	3.45 "
4	7.25 "	5	3.55 "
5	7.25 "	6	3.55 "
6	7.25 "	7	3.50 "
7	7.25 "	8	3.50 "
8	7.30 "	9	3.50 "
9	7.30 "	10	3.50 "

JUNE, 1902

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	2.50 A.M.
2	7.50 "	3	3.30 "
3	7.50 "	4	3.30 "
4	7.50 "	5	3.30 "
5	7.50 "	6	3.30 "
6	7.55 "	7	3.30 "
7	7.55 "	8	3.30 "
8	7.55 "	9	3.30 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	2.50 A.M.
2	7.50 "	3	3.30 "
3	7.50 "	4	3.30 "
4	7.50 "	5	3.30 "
5	7.50 "	6	3.30 "
6	7.55 "	7	3.30 "
7	7.55 "	8	3.30 "
8	7.55 "	9	3.30 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "

23	7.15 "	23	12.00 "	27	7.15 "	28	12.10 A.M.	25	7.45 "	25	12.00 "	27	7.45 "	28	12.05 A.M.	26	8.00 "	26	12.00 "	27	8.00 "	28	12.15 A.M.
24	7.15 "	24	12.00 "	28	7.20 "	29	12.50 "	26	7.45 "	26	12.00 "	28	7.45 "	29	12.40 "	27	8.00 "	28	12.15 A.M.	28	8.00 "	29	12.50 "
25	7.15 "	25	12.00 "	29	7.20 "	30	1.30 "	27	7.45 "	27	12.00 "	29	7.45 "	30	1.10 "	28	8.00 "	29	12.50 "	29	8.00 "	30	1.25 "
26	7.15 "	26	12.00 "	30	7.20 "	01	2.00 "	28	7.45 "	28	12.40 A.M.	30	7.45 "	31	1.40 "	29	8.00 "	30	1.25 "	30	8.00 "	01	2.05 "
27	7.15 "	28	12.10 A.M.					29	7.45 "	30	1.10 "	31	7.50 "	01	2.15 "	30	8.00 "	01	2.05 "				
28	7.20 "	29	12.50 "					30	7.45 "	31	1.40 "												
29	7.20 "	30	1.30 "					31	7.50 P.M.	01	2.15 "												
30	7.20 "	01	2.00 "																				

JULY, 1902

Table No. 1. Frund's Moonlight System.

Date.	Exting.	Date.	Light.
1	8.00 P.M.	2	2.50 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	8.00 "	8	3.35 "
8	8.00 "	9	3.35 "
9	8.00 "	10	3.35 "
10	8.00 "	11	3.35 "
11	8.00 "	12	3.40 "
12	8.00 "	13	3.40 "
13	8.00 "	14	3.40 "
14	8.00 "	15	3.40 "
15	8.00 "	16	3.40 "
16	8.00 "	16	12.00 M.
17	8.00 "	17	12.00 "
18	8.00 "	18	12.00 "
19	8.00 "	19	12.00 "
20	7.55 "	20	12.00 "
21	7.55 "	21	12.00 "
22	7.55 "	22	12.00 "
23	7.55 "	23	12.00 "
24	7.55 "	24	12.00 "
25	7.55 "	25	12.00 "
26	7.50 "	26	12.00 "
27	7.50 "	27	12.00 "
28	7.50 "	29	12.45 A.M.
29	7.50 "	30	1.30 "
30	7.50 "	31	2.25 "
31	7.50 "	01	3.30 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 P.M.	2	2.50 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	8.00 "	8	3.35 "
8	8.00 "	9	3.35 "
9	8.00 "	10	3.35 "
10	9.40 "	11	3.35 "
11	10.10 "	12	3.40 "
12	10.40 "	13	3.40 "
13	11.15 "	14	3.40 "
14	11.50 "	15	3.40 "
15	...	..	...
16	12.30 A.M.	16	3.40 "
17	1.15 "	17	3.45 "
18	2.00 "	18	3.45 "
19	No Light.	19	No Light.
20	"	20	"
21	"	21	"
22	7.55 P.M.	22	9.15 P.M.
23	7.55 "	23	9.50 "
24	7.55 "	24	10.20 "
25	7.55 "	25	10.50 "
26	7.50 "	26	11.25 "
27	7.50 "	27	12.00 M.
28	7.50 "	29	12.45 A.M.
29	7.50 "	30	1.30 "
30	7.50 "	31	2.25 "
31	7.50 "	01	3.30 "

AUGUST, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	4.00 A.M.
2	7.45 "	3	4.00 "
3	7.45 "	4	4.00 "
4	7.40 "	5	4.00 "
5	7.40 "	6	4.00 "
6	7.40 "	7	4.00 "
7	7.40 "	8	4.00 "
8	7.40 "	9	4.05 "
9	7.35 "	10	4.05 "
10	7.35 "	11	4.05 "
11	7.35 "	12	4.05 "
12	7.35 "	13	4.05 "
13	7.30 "	14	4.10 "
14	7.30 "	14	12.00 M.
15	12.50 A.M.	15	4.10 A.M.
15	7.30 P.M.	15	12.00 M.
16	1.40 A.M.	16	4.10 A.M.
16	7.30 P.M.	16	12.00 M.
17	7.25 "	17	12.00 "
18	7.25 "	18	12.00 "
19	7.25 "	19	12.00 "
20	7.25 "	20	12.00 "
21	7.20 "	21	12.00 "
22	7.20 "	22	12.00 "
23	7.20 "	23	12.00 "
24	7.20 "	24	12.00 "
25	7.15 "	25	12.00 "
26	7.15 "	27	12.20 A.M.
27	7.15 "	28	1.20 "
28	7.10 "	29	2.20 "
29	7.10 "	30	3.30 "
30	7.10 "	31	4.25 "
31	7.05 "	01	4.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	4.00 A.M.
2	7.45 "	3	4.00 "
3	7.45 "	4	4.00 "
4	7.45 "	5	4.00 "
5	7.40 "	6	4.00 "
6	7.40 "	7	4.00 "
7	7.40 "	8	4.00 "
8	8.40 "	9	4.05 "
9	9.15 "	10	4.05 "
10	9.55 "	11	4.05 "
11	10.30 "	12	4.05 "
12	11.15 "	13	4.05 "
13	12.00 M.	14	4.10 "
14	...	..	...
15	12.50 A.M.	15	4.10 "
16	1.40 "	16	4.10 "
17	2.40 "	17	4.10 "
18	No Light.	18	No Light.
19	"	19	"
20	"	20	"
21	7.20 P.M.	21	8.55 P.M.
22	7.20 "	22	9.30 "
23	7.20 "	23	10.05 "
24	7.20 P.M.	24	10.45 "
25	7.15 "	25	11.30 "
26	7.15 "	27	12.20 A.M.
27	7.15 "	28	1.20 "
28	7.10 "	29	2.20 "
29	7.10 "	30	3.30 "
30	7.10 "	31	4.25 "
31	7.05 "	01	4.25 "

SEPTEMBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 "
2	7.05 "	3	4.25 "
3	7.00 "	4	4.25 "
4	7.00 "	5	4.30 "
5	7.00 "	6	4.30 "
6	6.55 "	7	4.30 "
7	6.55 "	8	4.30 "
8	6.55 "	9	4.30 "
9	6.50 "	10	4.30 "
10	6.50 "	11	4.30 "
11	6.50 "	12	4.35 "
12	6.50 "	13	4.35 "
13	6.45 "	13	12.00 M.
14	6.45 "	14	12.00 "
15	6.45 "	15	12.00 "
16	6.40 "	16	12.00 "
17	6.40 "	17	12.00 "
18	6.40 "	18	12.00 "
19	6.35 "	19	12.00 "
20	6.35 "	20	12.00 "
21	6.35 "	21	12.00 "
22	6.30 "	22	12.00 "
23	6.30 "	23	12.00 "
24	6.30 "	25	12.15 A.M.
25	6.25 "	26	1.15 "
26	6.25 "	27	2.25 "
27	6.25 "	28	3.30 "
28	6.20 "	29	4.40 "
29	6.20 "	30	4.55 "
30	6.20 "	01	4.55 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 A.M.
2	7.05 "	3	4.25 "
3	7.00 "	4	4.25 "
4	7.00 "	5	4.30 "
5	7.00 "	6	4.30 "
6	6.55 "	7	4.30 "
7	8.25 "	8	4.30 "
8	9.10 "	9	4.30 "
9	9.50 "	10	4.30 "
10	10.40 "	11	4.30 "
11	11.35 "	12	4.35 "
12	...	..	...
13	12.30 A.M.	13	4.35 "
14	1.25 "	14	4.35 "
15	2.25 "	15	4.40 "
16	No Light.	16	No Light.
17	"	17	"
18	"	18	"
19	6.35 P.M.	19	8.10 P.M.
20	6.35 "	20	8.45 "
21	6.35 "	21	9.30 "
22	6.30 "	22	10.20 "
23	6.30 "	23	11.15 "
24	6.30 "	25	12.15 A.M.
25	6.25 "	26	1.15 "
26	6.25 "	27	2.25 "
27	6.25 "	28	3.30 "
28	6.20 "	29	4.40 "
29	6.20 "	30	4.55 "
30	6.20 "	01	4.55 "

OCTOBER, 1902

Table No. 1. Frund's Moonlight System

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	4	4.55 "
4	6.10 "	5	5.00 "
5	6.10 "	6	5.00 "
6	6.10 "	7	5.00 "
7	6.05 "	8	5.00 "
8	6.05 "	9	5.00 "
9	6.05 "	10	5.00 "
10	6.00 "	11	5.05 "
11	6.00 "	12	5.05 "
12	6.00 "	13	5.05 "
13	5.55 "	13	12.00 M.
14	5.55 "	14	12.00 M.
15	5.55 "	15	12.00 "
16	5.55 "	16	12.00 "
17	5.50 "	17	12.00 "
18	5.50 "	18	12.00 "
19	5.50 "	19	12.00 "
20	5.45 "	20	12.00 "
21	5.45 "	21	12.00 "
22	5.45 "	22	12.00 "
23	5.45 "	24	12.15 A.M.
24	5.40 "	25	1.20 "
25	5.40 "	26	2.30 "
26	5.40 "	27	3.30 "
27	5.35 "	28	4.35 "
28	5.35 "	29	5.25 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	01	5.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	4	4.55 "
4	6.10 "	5	5.00 "
5	6.10 "	6	5.00 "
6	6.10 "	7	5.00 "
7	8.35 "	8	5.00 "
8	9.25 "	9	5.00 "
9	10.15 "	10	5.00 "
10	11.10 "	11	5.05 "
11	...	..	...
12	12.10 A.M.	12	5.05 "
13	1.10 "	13	5.05 "
14	2.10 "	14	5.05 "
15	3.15 "	15	5.10 "
16	No Light.	16	No Light.
17	"	17	"
18	"	18	"
19	5.50 P.M.	19	8.10 P.M.
20	5.45 "	20	9.10 "
21	5.45 "	21	10.10 "
22	5.45 "	22	11.10 "
23	5.45 "	24	12.15 A.M.
24	5.40 "	25	1.20 "
25	5.40 "	26	2.30 "
26	5.40 "	27	3.30 "
27	5.35 "	28	4.35 "
28	5.35 "	29	5.25 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	01	5.25 "

NOVEMBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.30 A.M.
2	5.30 "	3	5.30 "
3	5.30 "	4	5.30 "
4	5.30 "	5	5.30 "
5	5.25 "	6	5.35 "
6	5.25 "	7	5.35 "
7	5.25 "	8	5.35 "
8	5.25 "	9	5.35 "
9	5.20 "	10	5.35 "
10	5.20 "	10	12.00 M.
11	1.00 A.M.	11	5.40 A.M.
11	5.20 P.M.	11	12.00 M.
12	5.20 "	12	12.00 "
13	5.20 "	13	12.00 "
14	5.20 "	14	12.00 "
15	5.15 "	15	12.00 "
16	5.15 "	16	12.00 "
17	5.15 "	17	12.00 "
18	5.15 "	18	12.00 "
19	5.15 "	19	12.00 "
20	5.15 "	20	12.00 "
21	5.10 "	22	12.20 A.M.
22	5.10 "	23	1.25 "
23	5.10 "	24	2.30 "
24	5.10 "	25	3.30 "
25	5.10 "	26	4.30 "
26	5.10 "	27	5.30 "
27	5.10 "	28	6.00 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.10 "	01	6.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.30 A.M.
2	5.30 "	3	5.30 "
3	5.30 "	4	5.30 "
4	5.30 "	5	5.30 "
5	8.10 "	6	5.35 "
6	9.00 "	7	5.35 "
7	10.00 "	8	5.35 "
8	11.00 "	9	5.35 "
9	12.00 M.	10	5.35 "
10	...	..	...
11	1.00 A.M.	11	5.40 "
12	2.00 "	12	5.40 "
13	3.10 "	13	5.40 "
14	4.10 "	14	5.45 "
15	No Light.	15	No Light.
16	"	16	"
17	5.15 P.M.	17	7.55 P.M.
18	5.15 "	18	9.00 "
19	5.15 "	19	10.10 "
20	5.15 "	20	11.15
21	5.10 "	22	12.20 A.M.
22	5.10 "	23	1.25 "
23	5.10 "	24	2.30 "
24	5.10 "	25	3.30 "
25	5.10 "	26	4.30 "
26	5.10 "	27	5.30 "
27	5.10 "	28	6.00 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.10 "	01	6.00 "

DECEMBER, 1902

Table No. 1. Frund's Moonlight System

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	6.00 A.M.
2	5.05 "	3	6.00 "
3	5.05 "	4	6.05 "
4	5.05 "	5	6.05 "
5	5.05 "	6	6.05 "
6	5.05 "	7	6.05 "
7	5.05 "	8	6.10 "
8	5.05 "	9	6.10 "
9	5.05 "	10	6.10 "
10	5.05 "	10	12.00 M.
11	5.05 "	11	12.00 "
12	5.05 "	12	12.00 "
13	5.05 "	13	12.00 "
14	5.05 "	14	12.00 "
15	5.05 "	15	12.00 "
16	5.05 "	16	12.00 "
17	5.05 "	17	12.00 "
18	5.05 "	18	12.00 "
19	5.05 "	19	12.00 "
20	5.05 "	21	12.20 A.M.
21	5.05 "	22	1.25 "
22	5.05 "	23	2.25 "
23	5.05 "	24	3.35 "
24	5.05 "	25	4.20 "
25	5.05 "	26	5.20 "
26	5.10 "	27	6.10 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	01	6.20 "

Table No. 2. Standard Moonlight System

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	6.00 A.M.
2	5.05 "	3	6.00 "
3	5.05 "	4	6.05 "
4	7.50 "	5	6.05 "
5	8.45 "	6	6.05 "
6	9.45 "	7	6.05 "
7	10.40 "	8	6.10 "
8	11.40 "	9	6.10 "
9	...	..	...
10	12.45 A.M.	10	6.10 "
11	1.50 "	11	6.10 "
12	3.00 "	12	6.10 "
13	4.10 "	13	6.15 "
14	No Light.	14	No Light.
15	"	15	"
16	5.05 P.M.	16	7.45 P.M.
17	5.05 "	17	9.00 "
18	5.05 "	18	10.10 "
19	5.05 "	19	11.15
20	5.05 "	21	12.20 A.M.
21	5.05 "	22	1.25 "
22	5.05 "	23	2.25 "
23	5.05 "	24	3.25 "
24	5.05 "	25	4.20 "
25	5.05 "	26	5.20 "
26	5.10 "	27	6.10 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	01	6.20 "

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, DECEMBER 21, 1901. 38 No. 25.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - - 6.00
Single Copies, - .10
In requesting your address changed give OLD as well as new address.

Copyright, 1901, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 21, 1901.

CONTENTS.

	PAGE
Editorial	1011
Manhattan and Electric Traction	1014
Electrical Engineers of the Day—XXV. W. B. Potter	1014
The Debt of Electrical Engineering to C. E. L. Brown—V. By B. A. Behrend	1015
The Manufacture of Deep Sea Cable in America	1018
The Economic Design and Management of Telephone Exchanges—III. By Arthur V. Abbott, C. E.	1020
Development of the Indiana Telephone Field. By R. D. Fisher	1022
Telephone Activity in Pittsburg and Western Pennsylvania	1022
Marconi Signals Across the Atlantic	1023
Electricity for a Pennsylvania Railroad New York Tunnel	1025
New Telephone Patents	1026
Long Distance Transmission Into Chicago	1027
Carbon Bisulphide in the Electric Furnace	1028
A Third-Rail Road Across New Jersey	1029
Current News and Notes	1029
LETTERS TO THE EDITORS:	
Alternating Current Terminology. By Wm. Hand Browne, Jr., and Louis Bell	1031
Long-Distance Transmission in Canada. By J. A. Kammerer	1031
United States Signal Corps Telephones. By Thomas J. Stewart	1032
Digest of Current Electrical Literature	1032
New Books	1036
Electrical Trade Society of New York	1037
Electric Power in a New Jersey Brewery	1037
A New Milling Machine	1038
Leitch Selective Telephone Signal System	1039
Novelties in Pliers	1039
DEPARTMENTS:	
Financial Intelligence	1040
Commercial Intelligence	1041
General News	1043
Trade Notes	1046
Record of Electrical Patents	1047

GIFTS TO EDUCATION.

That Mrs. Stanford would some day add to the endowment of the Stanford University in California was understood, but it comes as a surprise to see her quietly turning over $30,000,000 to the authorities there in a single day. This great benefaction is, however, accompanied by another announced at the same time, Mr. Carnegie's gift of $10,000,000 for a National University at Washington. The generosity that can range from a grant in aid of the new library of the American Institute of Electrical Engineers up to this contribution to the cause of education on so colossal a scale compels unbounded admiration, especially when it is directed with care and wisdom to specific results. It is stated that Mr. Carnegie's offer to President Roosevelt does not involve the establishment of university buildings in Washington, but rather the placing in the hands of Government trustees of a fund from which the expenses of deserving students in the line of original investigation may be paid at home or abroad.

It is indeed along the lines of original investigation that money can be best spent, for while we would be slow to say that education is overdone, it does seem as though there were getting to be too many educational establishments, whereas laboratories are all too few. If some of the seats of learning already existing were consolidated, men like Rowland, Pupin, Trowbridge and others could be relieved of much of their teaching work and encouraged to prosecute the original research in which they prove themselves so competent. Indeed, such an endowment might well go to men not in educational work and institutions—we mean such inventors and investigators as Brush, Thomson, Tesla and Edison, though these fortunately have been able to profit sufficiently by their inventions to provide themselves with the means and appliances for further probing into the secrets of nature.

WIRELESS TELEGRAPHY.

Recent announcements have appeared in the daily press from St. Johns, Newfoundland, to the effect that signals have been received by Mr. Marconi there from Cornwall, England. Details of this very interesting and important event appear elsewhere in our current pages. The distance between these positions is in the neighborhood of 1830 nautical miles, or 2100 statute miles. The details reported up to the present time are altogether too meagre to enable any reliable conclusions to be drawn as to this alleged transmission across the Atlantic Ocean. It would seem that only triple successions of dots corresponding to the letter S in the Morse alphabet have been reproduced at the receiving instrument. In view of the well-known possibilities of disturbance from purely local atmospheric phenomena, it is only reasonable to look for the actual exclusive transmission of words by wireless transatlantic signaling before reliance can be fully placed on all the statements thus far made.

The maximum distance over which readable wireless signals have been hitherto transmitted seems to have been between St. Catharines, on the Isle of Wight, and the Lizard, Cornwall, a distance of 186 miles. The sudden increase in distance to 2100 miles represents more than a ten-fold increase of radius, which we should expect to be overstepped more gradually. Sooner or later, however, it is reasonable to expect that wireless messages will be transmitted over transatlantic distances. As to whether such distances can be bridged by Hertzian waves in a sufficiently definite and reliable way to enable

commercial messages to be exchanged is a much more difficult question to answer. If such signaling could be carried on in a positive manner, the question might next arise as to how far the wireless system would depreciate the value of the large amount of capital now lying at the bottom of the seas in the form of ocean telegraph cables. All that can be said at the present time is that enormous improvements have yet to be made, both in the range and in the selectivity of of wireless signaling before the Atlantic cables can suffer by wireless competition. The mere increase in range or effective radius of signaling is useless for this purpose, unless accompanied by a corresponding increase in the selectiveness of the signals, since to introduce a receiving instrument which shall be capable of responding to impulses within 2000 miles, instead of 100, merely means that a correspondingly greater field exists for other transmitting stations to interfere with its reception, unless the selective tuning of the receiver has been correspondingly improved.

But whatever may be the future as regards ocean cable telegraphy, there can be no doubt that short lengths of ocean can be, and, in fact, already have been, bridged by wireless telegraphy to the exclusion of cables, and that with even existing methods, the advantages of wireless telegraphs in the future to sailors and to shipping, must be enormous. Although our Navy is still ponderously investigating wireless telegraphy, sufficient light has appeared to British naval authorities to seemingly justify the serious adoption of the system, about 50 vessels of the British Navy having been already equipped with wireless telegraph apparatus. The system appears to be in the course of rapid adoption in the mercantile marine, and a number of wireless stations for communication with vessels at sea have been installed on the coast of England, besides at Gibraltar, Malta and various European ports. At this rate it will not be long before all important stations along the routes of trade will be equipped with Hertzian signaling apparatus.

If signals have actually, as Mr. Marconi intimates, thus been sent across the Atlantic, it is reasonably certain that an increase in power in the sending apparatus can ensure their being sent regularly. We expressed long ago the opinion that most experiments in wireless telegraphy labored under the disadvantage of inadequate input of energy. But if signals can be so sent we are inclined to think that the ordinary conception of the mechanism of transmission must be materially modified. Of course, the whole theory of the matter is in a tentative condition, but such a result should shake it up not a little, and lead to some very interesting developments. To return again to the commercial possibilities opened by wireless telegraphy across the Atlantic, it must be remembered that while a great deal has been heard about tuning the sending and receiving apparatus, very little seems really to have been accomplished, although some of Slaby's results look promising. Even if tuning can be carried out successfully on a small scale, it is by no means certain that equal success would attend it when large amounts of energy were involved. We are unpleasantly familiar with harmonic complications even in ordinary apparatus and the reduction of the impulses used in wireless telegraphy to an uncomplicated form is a rather formidable problem.

To look at another aspect of the matter, what would be the effect on wireless telegraphy in France and Germany of transmitters pounding away on the ether in hurling messages at America? What would the hypersensitive German Government say if the staff messages during its sacred army manœuvres were broken in upon by John Bull vociferously ordering pork in Chicago? The idea certainly involves the possibility of international complications of a highly interesting sort. Meanwhile, even the short-range land work is not having an altogether easy time of it. We have not heard that the portable sets sent to South Africa have materially helped in locating the elusive DeWet. The best results yet attained have been reached in communication with incoming steamers, and during naval manœuvres. The whole matter is obviously in an early stage of its development, and one must not expect too much at first. But the commercial possibilities are even vaguer than the scientific ones, and he would be rash who would hazard a guess at their magnitude. Meantime, Mr. Marconi is entitled to very warm and hearty congratulations on his great achievement, for the confirmation of which in various ways all now await with profound interest.

Zossen and Other Traction Matters.

A little more of detail has come to light regarding the recent experiments on the Berlin-Zossen line. As usual, the reports in the daily press—with no blame to them, however—proved to be somewhat inexact as well as incoherent, but the truth is sufficiently interesting and encouraging. It now appears that the maximum speed attained was almost exactly 100 miles per hour, the initial runs having been gradually worked up toward this point, after the cars had preliminarily been pulled rapidly over the line by a locomotive to make sure that the running gear was in first-class operative shape. The speed finally attained, while it has several times been surpassed in this country by locomotives, was great enough to give the motor cars a thorough test, and so far as present information goes, they behaved in an eminently satisfactory manner. The current collectors, motors, controlling apparatus and brakes seemed up to their work, and were evidently capable of developing a far higher speed than was actually attained. The limiting factor proved to be the roadbed, and the trials have been temporarily suspended pending its being put in proper condition for increased speeds.

This state of affairs is substantially what we predicted in speaking editorially of the Zossen work some time before the experiments began. There has not of late years been any serious reason to doubt the ability of electric motors to carry the running speed of cars above a hundred miles per hour, nor has the task of current collection at such speeds seemed forbidding, provided that the voltage of the working conductors were carried high enough to keep the volume of current within reasonable bounds. The controlling mechanism for the motors employed for this work must be a little unusual, but should not frighten competent engineers like those engaged, and likely to be engaged, on this important work. The track, however, is quite another matter, and to say that it is the whole battle would come pretty near the truth. In dealing with the high speed problem, electrical engineers have been far too prone to forget about the track, or, mindful of it, to pin their faith to lightening the motor car enough to counteract defects beneath it. Now, no possible lightening of the cars can make a bad track into a good one or a safe track out of a dangerous one. The Chicago-St. Louis high-speed road projected a decade since could have been pulled through to success so far as motive power went with the means even then at hand, but the track laid as planned with 70-lb. rails would have almost infallibly lead to disaster.

The roadbed for this sort of work must be exceptionally smooth and well ballasted, the curves and grades easy and the rails the stiffest that skill can design. Probably 90 lbs. per yard would suffice if the material were put where it would do the most good, but even with all these precautions the line should be pounded into shape at moderate speeds through at least one season before it is sufficiently solid for the purpose intended. When the Berlin-Zossen track is worked into shape, the rest will be comparatively easy, but we would earnestly advise the persistent use of a testing car, if such a thing is

available on the Imperial German Railways. To the best of our recollection, however, they are longer on red tape than on speed over there, and it would probably be simpler and quicker to import an American car for this purpose.

From this important work, we turn to note with pleasure some on this side of the water, of equal interest and encouragement to the electrical engineering community. Full account is given in our columns of the new plans for bringing the Pennsylvania Railroad and the Long Island into the heart of New York City by tunnels under the rivers, the trains all to be hauled by electricity. In view of what is being done on the elevated, and the plans of the New York Central, it is evident that so far as Manhattan Island is concerned, the electric locomotive and the electric car will soon reign supreme. With high-speed electric traction, a la Zossen, for the open country, and low-speed for the terminals, it would look as though the steam regime, magnificent and laudable as it has been, approximates to a definite consummation.

Distribution and Meter Losses.

Those who point to the low cost of generating electrical energy in large central stations and use it for a text from which to preach a sermon on municipal ownership and the enormous profits being realized by all private companies would do well, if only on the grounds of fairness, to look into the matter of distribution losses, the *bete noir* of the central station man, who labors incessantly to reduce these losses. For the difference between the current generated and current sold is so great as sometimes to be startling even to those familiar with the subject.

For example, in an Edison direct-current three-wire network, fed direct from the power house, with which we happen to be familiar, and whcih represents fair average practice in that class of central station distribution, only 68 per cent of the energy metered at the central station switchboard is accounted for by the customer's meters. In other words, the central station is paid for only 68 per cent of the energy generated. The loss in the feeders and mains is considered by the manager of the station in question to be 15 per cent, leaving 17 per cent to be charged to consumers' meters running slow and failing to register the total amount of energy passing through them. The percentage of loss by slow consumers' meters is probably less in the plant referred to than in the majority of central station distributing systems, because there special attention has been given to meters. In another plant where the distribution is all by alternating currents at 2000 volts, supplying 100-volt secondary networks through transformers, the consumers' meters register only 60 per cent of the energy generated. In this case the loss in lines and transformers is probably not over 15 per cent, so that 25 per cent is chargeable to slow consumers' meters. As said before, these cases are by no means exceptions unless, perhaps, that they represent better than average conditions. These facts, however well known to the few central station men that follow them up and determine them, are but little talked of, and might well be given greater general publicity than they have been to counteract false ideas as to the delivery cost of electrical energy supplied on the consumer's premises.

From an engineering standpoint the main question is how to reduce distribution and meter losses. The mere question of loss in feeders and other lines is dependent either on considerations of good regulation or on how large an investment in copper it will be profitable to pay interest on. The matter of meter loss, however, is dependent on management, testing and inspection, and is one which by no means is as thoroughly thrashed out by central station men as it should be. It may be argued that the loss of revenue through consumers' meters failing to register all the energy passing is equivalent to a discount equal to the amount of such loss, and when considered as such by the company is of no financial detriment. If the loss by slow meters were distributed pro rata among the customers according to the amounts they used, or deducted from the meter readings of the class of consumers using the largest amount of current in proportion to the maximum, it would be all right to consider the loss by slow meters as a discount from the regular schedule. But meters are not accommodating enough to work that way in practice. The very classes to which they give the most liberal discounts are the ones which it costs the central station the most to supply, namely, residences which have a large number of lights and consequently a large meter installed, but which usually burn but few lights. The large meter with few lights on is very apt to run slow. If nearly the full number of lights are on there is not the same likelihood that the meter will run slow then as when it is lightly loaded. Then, too, meters are not accommodating enough to run slow at the same rates, and injustice and dissatisfaction result. Customers must have confidence in the accuracy of the meters if the service is to be made satisfactory to them. The discount argument will not hold in defence of allowing meters to get into bad condition.

How to keep meters in better condition is a matter to which much attention has been given in the past by a few of the more progressive central stations, but to which matter the majority are only recently directing serious thought. Practice is at present divided between two general methods. One is to test meters or check their accuracy from time to time in place on the consumer's premises, without removing or altering them in any way from their actual working conditions. The other plan is to do all meter testing in the shop and take a meter down whenever it is to be tested, substituting in its place a newly tested meter. Former practice checked or tested meters only on complaint of the customer or suspicion by the company. Modern practice is to check meters at regular intervals of from two years to six months—the latter interval becoming the more common. There is more chance to overhaul and test a meter thoroughly in the shop than on the consumer's premises, but the advocates of the other method point to the fact that a meter tested in the shop may be altered by the treatment it receives before it is put up; and, furthermore, that in view of the slight attention usually necessary to put a meter right, the expense and trouble of removing the meter to the shop is not justified. Indeed, the usual operations that must be gone through with to correct a meter (cleaning the commutator, renewing the jewel or adjusting the drag magnets) can be done in less time than it would take to replace and remove the meter alone.

Where meters are tested *in situ*, practice is again divided as to the method of checking, some sending two men with a stop-watch and standard indicating wattmeter, others keeping on hand in the testing laboratory an assortment of carefully calibrated recording wattmeters of all sizes and sending these out with one meter inspector who simply compares the revolutions of each consumer's meter for a short time at different loads, with that of a standard recording meter of the same size temporarily connected in the same circuit; a place being provided to hang the test meter below the regular consumer's meter. It is thus seen that there are plenty of methods to choose from, any of which is good if conscientiously carried out by good men, but any of which may be marred by carelessness.

Manhattan and Electric Traction.

The work of preparing the Manhattan Elevated power plant has continued very actively during the present week, and an early operation of part of this system is looked for confidently. This being the case, inquiry naturally arises as to the benefit to the public and the company. By far the best analysis is that made by the *Street Railway Journal* in a recent issue as follows:

Probably the closest parallel in this country to the electrical equipment of Manhattan is afforded by the Lake Street and South Side Elevated roads in Chicago. Both of these lines are paralleled by surface roads, and the latter also by the unsurpassed steam suburban service of the Illinois Central. The percentage of operating expenses to gross on Lake Shore, while equipped with steam, varied between 67.67 per cent and 61.78 per cent, while with electricity it has been between 51 and 47 per cent. The percentage in 1899 and 1900 for South Side was 57.2 and 58.2, respectively, as against 65.5, 69.1 and 78.9 under steam in 1897 and the two preceding years. The Manhattan Company's percentage for the year ending Sept. 30, 1901, was only 50.97 per cent. The operating expenses of the company during the year ending June 30, 1900, are divided as follows:

Maintenance of way and structure	$421,628
Maintenance of equipment	583,376
Conducting transportation	3,877,123
General expenses	350,491
Total	$5,232,618

The motive power at present by steam costs $949,893, or 8.8 cents per train-mile, while electricity should not cost more than 7.2 cents, or a saving of 1.6 cents per train-mile. This would result in the saving of $171,843. The total saving, therefore, would be, assuming same mileage and speed:

Power	$171,800
Saving on firemen	330,000
Saving on motormen	110,000
Total saving per trains	$611,800

The same number of cars that in 1900 made 10,740,183 train-miles could, with electrical equipment, have made probably between 12,000,000 and 13,000,000 train-miles with but little additional cost for power and maintenance, and practically no additional cost for conducting transportation. If 13,000,000 train-mile could be made, figures for conducting transportation would be as follows, present train mileage being 10,740,183:

	Car Mileage.	Total Cost.	Car Mile Cost.
Steam 5-car train	44,878,000	$3,877,123	.086c.
Electric 5.18 cars	67,340,000	3,577,814	.053c.

A saving of .033 cent per car on a total of 67,340,000 car-miles does not seem unreasonable and would amount to $2,222,220, or more than enough to pay 3 per cent additional on the old capitalization of the company and 7 per cent on the later issue, putting the stock on a 7 per cent basis.

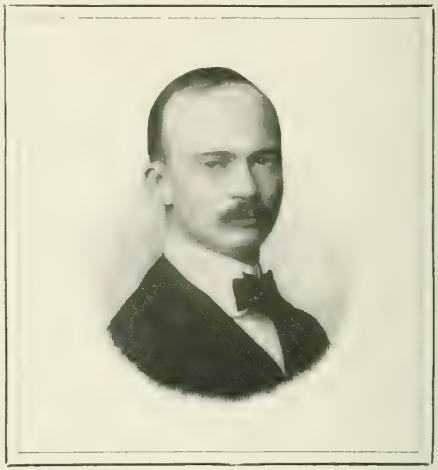
Electrical Engineers of the Day—XXV.

W. B. Potter.

Few engineers in the electrical profession have done more to advance the electric railway art to its present place than has William Bancroft Potter, the engineer of the railway department of the General Electric Company. Mr. Potter was born at Thomaston, Conn., in 1863, and received his first training in engineering in a large machine repair shop at Hartford. Here all classes of repair work was done on stationary engines, steamboats, steam fitting and mill work. The variety of work was of great assistance in giving an experience of value to Mr. Potter in mechanical and machine design.

During this period the Hartford Electric Light Company was started and commenced operations with a number of arc machines, which were among the first of their type. In connection with repairs on the engines of this plant, Mr. Potter became acquainted with the chief engineer, who advised him strongly to take up the new branch of engineering. Mr. Potter at first strongly objected to leaving his mechanical work, but finally in 1887 applied to the Thomson-Houston Company for a position, and was told to report at Lynn. His first duties were in connection with arc lighting apparatus, and after several weeks at the factory he was sent to Greensboro, N. C., starting the system of arc lighting in that place. He shortly afterward went to Raleigh, N. C., to overhaul the lighting plant there, which meant putting everything in order from the engines to the pole line, and although this was Mr. Potter's first large contract, he completed the work in such shape that he was retained by the company as superintendent until 1889. Being impressed with the possibilities in the electric railway field, he gave up this position and returned to the Thomson-Houston Company at Lynn, and applied for a position in the railway department. After a year's experience on railway construction work he entered the Lynn factory, first as engineering assistant to Mr. J. B. Cahoon and afterward to Mr. W. H. Knight, engineer of railway work.

The Thomson-Houston Company was experimenting about this time with its first magnetic blowout series parallel controllers, and the other applications of the magnetic blowout, such as circuit breakers, etc. In this work Mr. Potter's originality and ability to apply theory to successful practical operation was of great value, and the development of many of the railway devices which are to-day standard owe their origin and design to him. While interested in the power station side, Mr. Potter's attention was principally turned towards



railway equipments, and his practical mind saw at an early date the advantage of standardization for apparatus of this class.

Mr. Potter's attention was given largely up to the time of the consolidation with the Edison General Electric Company to the design and operation of railway motors, controllers and switchboards and the many smaller parts of a railway equipment. After the consolidation of the two companies to form the General Electric Company, Mr. Potter removed to Schenectady and was made engineer of the railway department of the entire company in 1895, which position he has held up to the present time.

In the past few years he has paid special attention to heavy and high-speed railway work, and has invented many devices used in this class of service, starting with the Intramural Railway at the Chicago Fair in 1893. The equipment of the Chicago elevated roads with electricity, and later the N. Y., N. H. & H. R. R. and Manhattan Elevated in New York have all been done under his personal supervision from the manufacturing company's standpoint. The tremendous development of interurban and suburban railways during the past few years has also received Mr. Potter's close attention, and his practical knowledge and skill as an inventor has been turned towards this branch of the art. Already alternating-current apparatus is becoming as standardized and as common as direct-current machinery was five years ago.

Mr. Potter has made several trips abroad in connection with great railway undertakings on the Continent and in England, notably the Paris-Orleans Railroad in France and the Central London Underground in England. His name appears from time to time among those to whom patents have been granted, and no less than 75 now stand in his name.

The Debt of Electrical Engineering to C. E. L. Brown—V.

By B. A. Behrend.

THE FRANKFORT STATION.

IN Fig. 21 is given a drawing of the Frankfort generators. They were designed in 1893 and put into operation in 1894. Before entering upon details of this machine we will shortly relate some of the conditions pertaining to the history of the Frankfort station. The City of Frankfort had long been considering the building of a large municipal station for the distribution of light and power over a wide area. The electrical exposition at Frankfort in 1891 was inaugurated with a view to giving the various German electrical manufacturers an opportunity for displaying their work. When it came to the working out of a proposition for the City of Frankfort, the German factories, not experienced in alternating-current work, advocated the use of direct current, while Mr. Brown, having just developed some very good single-phase motors, stood up energetically for a single-phase alternating-current plant. There was very little inclination among the members of the City Council to award the contract to the "foreigner," since when reason fails prejudice must step in; but Mr. W. H. Lindley, the city engineer, a man of great ability and talent, seeing the advantages connected with the alternating-current system and having unlimited confidence in the ability of Mr. Brown to carry out this large plant, and doubtless alive to the poorness of the designs of the German firms in alternating currents at that time, consistently advocated Brown's proposition. In Lindley's address to the City Council reviewing the various propositions, the following passage occurs: "In the place of a conglomeration of engineers whose ignorance must be acknowledged, we have before us one of the most talented engineers in the field of electrical engineering, whose constructions show the able hand of an ingenious designer." Mr. Lindley's words were very strong, but those who know intimately the state of affairs at that time, cannot refuse to admit their truth.

We will now turn our attention to the details of the 525-kw single-phase generators for Frankfort.

As is seen from Fig. 21, the generator is of the flywheel construction, which has been so successfully built by Mr. Brown for the past ten years. The rated output of each generator—there are four 525-kw and four 1050-kw generators in the station—is 3000 volts and 175 amperes at 85 revolutions and 45.3 cycles. Each generator has 64 poles, the bore of the armature being 550 cm., and its length 32 cm. There are altogether 256 slots, of which 128 are empty. There are 64 coils of copper strip, each coil having 8 turns of 54 mm.² section. The resistance of the armature winding is .21 ohm.

The field winding consists of 64 coils of 50 turns each. It is made of copper strip of 100 sq. mm. section, wound on edge, the resistance of the 64 coils in series being .44 ohm. The copper loss in the armature is only 1¼ per cent, while the exciting energy does not exceed 1.8 per cent.

FIG. 22.—CHARACTERISTIC CURVES OF 750-HP FRANKFORT GENERATORS.

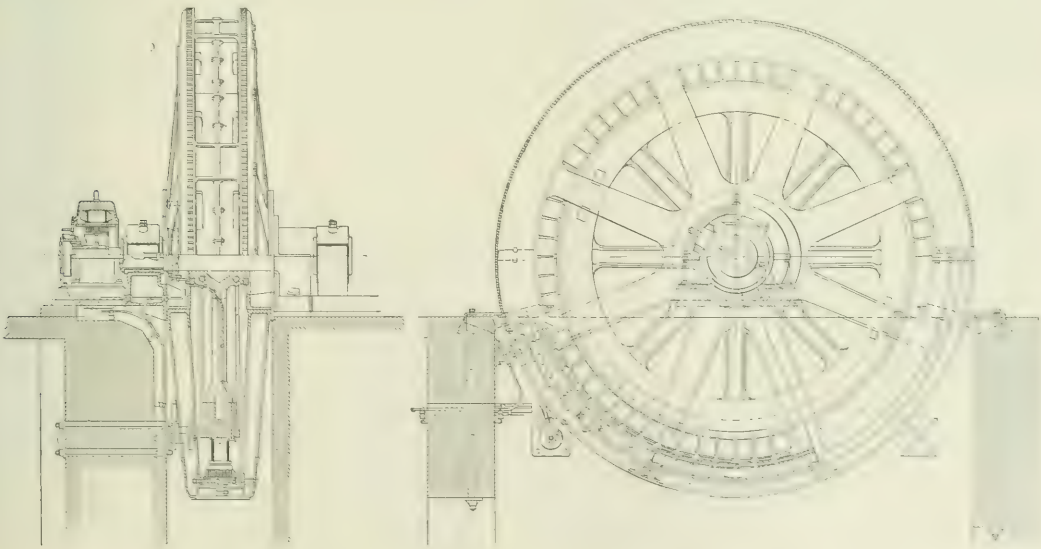


FIG. 21.—750-HP, SINGLE-PHASE FLYWHEEL GENERATOR. CITY OF FRANKFORT, GERMANY, 1894.

From the characteristic curves given in Fig. 22, we see the good regulation of this machine, the short-circuit current at full excitation being almost four times as large as the normal current. The rise

in voltage, if the full current of 175 amperes is thrown off, is 180 volts on a non-inductive load, or 6 per cent.

The great advantage of the field coil made of strip on edge consists, besides being a very mechanical and almost indestructible construction, in the better radiation of such a coil, as the heat is conducted to the surface through the copper and as it has not, as in ordinary field coils, to pass through the poorly conducting insulation. Such field coils, therefore, take less space and heat less than ordinary field coils.

There are some interesting features of design that deserve some comment. The solid cylindrical steel poles are used by Mr. Brown wherever applicable, as they permit the use of round field coils which are easier to make and embrace the largest flux with the shortest perimeter. Only in a few instances Mr. Brown laminates the pole tips as, for instance, in his Paderno generators, which have rather large holes in the armature.

With the closed slot as shown in Fig. 21, the eddy currents in the pole pieces are negligible. The objection to the closed slot that no form-wound coils made outside of the machine can be used, does apply in this country where the price of labor is high, but it is of much less weight in Europe. The windings of all of Mr. Brown's machines are made very carefully and look strikingly neat and well-arranged. If a coil burns out, it is taken out and a new one is wound in by hand. The extremely careful workmanship of these hand-wound coils makes the occurrence of a breakdown much less frequent.

The armatures of the Frankfort generators are built up of 16 segments, each containing 4 coils. The segments can be taken out and repaired, as is clearly shown in the drawing. In these generators Mr. Brown also used for the first time the peculiarly rigid and stiff construction of end-housings which support the armature, center it in regard to the field, and permit of the armature being turned into any position for purposes of repair. Fig. 21 shows this construction clearly. In such large generators it is extremely difficult to make the frame rigid, and even if much weight is put into the frame, the latter is yet almost plastic, and it becomes a very wearisome process to adjust the air-gap all around the periphery. With comparatively little weight Mr. Brown obtains an amount of stiffness and rigidity that could never be obtained in the usual way, and his construction must be considered superior to the ordinary frame for very large diameters.

It may not be amiss to call the attention of designing engineers to the particulars of this machine. They will find that after almost ten years, its design need not shun comparison with any work done of late. The weight of the armature is about 57,000 lbs., the weight of the revolving field with flywheel being 60,000 lbs.

The larger units are represented in Fig. 23. They give 3000 volts and 435 amperes at 85 revolutions on a circuit of a power factor of 80 per ecnt. They are constructed like the smaller units, and their armatures weigh 150,000 lbs., the revolving field with flywheel weighing 100,000 lbs. In 1897, when they were built, they were as to size the largest machines then running, and they are only now surpassed in size by the 5000-kw Manhattan generators of the Westinghouse Company. The normal rating of the Frankfort generators would be 2000 kw at 85 revolutions and 45.3 cycles if they were wound for three-phase currents. Their outside diameter is 25½ ft., their bore being 22½ ft. A performance curve of these machines is given in Fig. 24. Fig. 25 shows a photographic reproduction.

Fig. 26 shows the Frankfort station with the small generators in front, and two of the large units in the back. They are driven by tandem engines, and a novel feature that has been greatly followed on the European Continent is that the cranks of the engines are synchronized so that variations in the angular velocity of the engines appear simultaneously in the same direction in all machines. The Frankfort station has been in successful operation since 1894, and it is one of the finest and simplest stations in Europe.

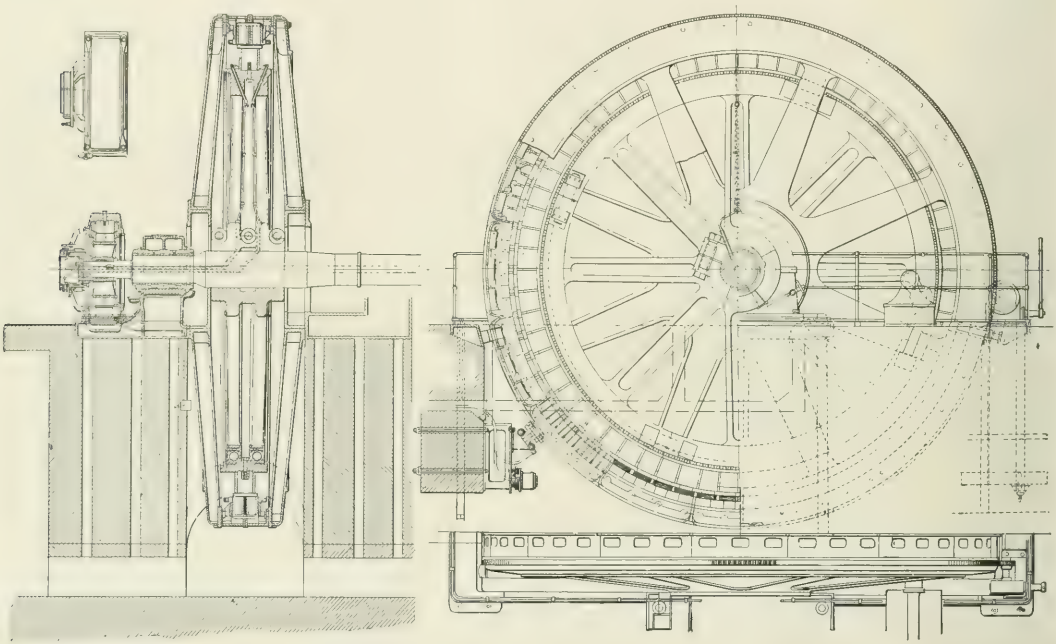


FIG. 23.—1500-HP SINGLE-PHASE GENERATORS, CITY OF FRANKFORT, GERMANY.

On the Frankfort mains there are running now single-phase induction motors whose output amounts to over 5000 hp. The testimonials of their owners are evidence that these motors are reliable in service and require little or next to no repair.

From the standpoint of the American designer it would be argued that Mr. Brown's Frankfort generators are very large, or even too large, in diameter. A good deal might be said for and against such a criticism. Aside from mechanical reasons there should be no doubt that the diameters are well chosen by their designer, for the weight of the active material is small, and so are the losses—the core loss, the loss in the armature copper and the energy for excitation. The latter is remarkably small in all of Mr. Brown's designs, owing to the use of cylindrical poles and to a careful choice of the number of ampere-turns on the armature per pole. It will thus be clear that electrically these machines must be considered excellent in all respects,

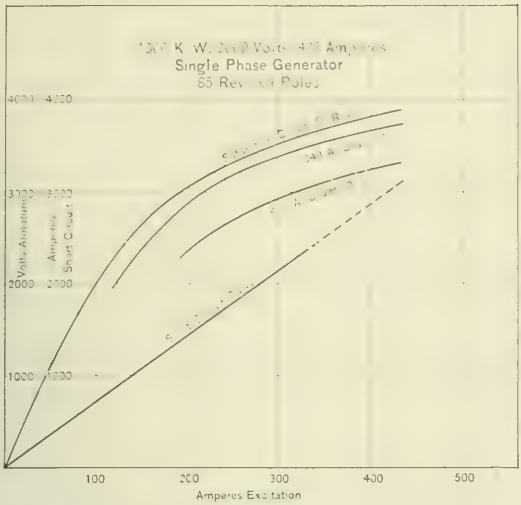


FIG. 24.—CHARACTERISTIC CURVES OF 1500-HP SINGLE-PHASE GENERATORS. CITY OF FRANKFORT.

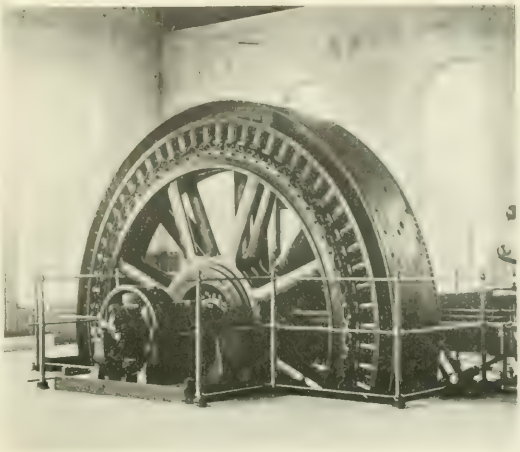


FIG. 28.—EXTERNAL FIELD FLYWHEEL GENERATOR.

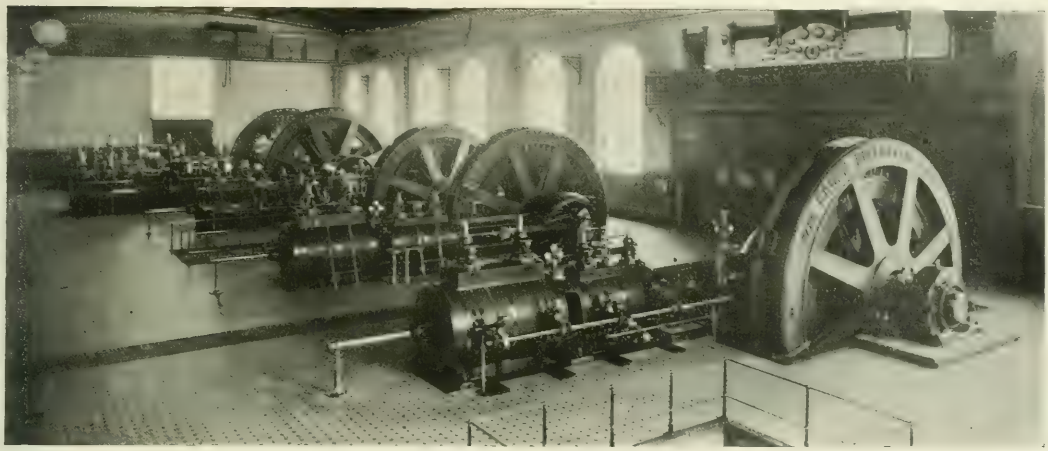


FIG. 26.—SINGLE-PHASE GENERATORS IN THE CITY OF FRANKFORT.

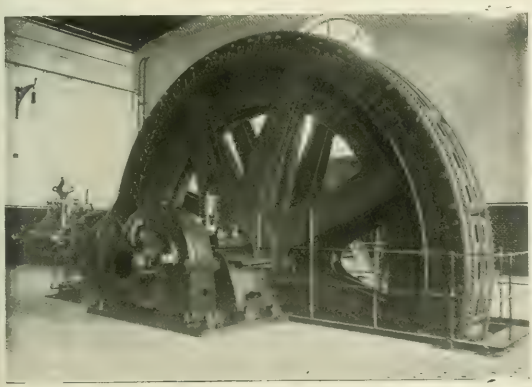


FIG. 25.—1500-HP SINGLE-PHASE FRANKFORT GENERATOR.

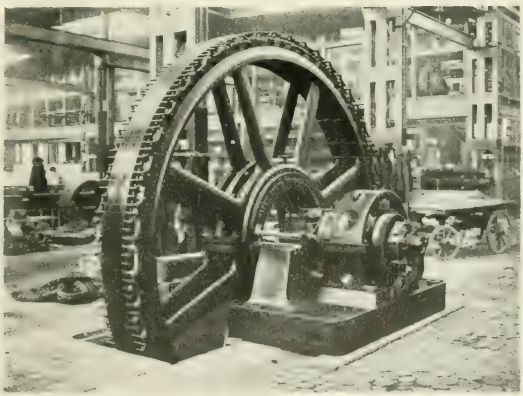


FIG. 29.—ARMATURE OF EXTERNAL FIELD FLYWHEEL GENERATOR

SINGLE-PHASE GENERATORS IN THE FRANKFORT, GERMANY, STATION.

and the large diameter was decidedly a step in advance, especially considering the fact that such large diameters were at the time of the design of the Frankfort station entirely unheard of.

In short, the Frankfort generators presented a new departure. The large pole pitch diminished the leakage from pole to pole. The width of the pole was small in comparison with the pole pitch, while the armature was made wide, which construction increases the e. m. f. slightly. All objections to the large diameter thus fall to the ground excepting the greater difficulty of handling the large parts in the shop and of making the armature frame stiff enough not to collapse. In regard to the former objection, Mr. Brown knew difficulties only to overcome them, and in regard to the latter objection, Mr. Brown devised a construction, shown in Fig. 27, which permitted the easy entering of armature and field, and stiffened at the same time the armature frame.

There was an article in the papers not very long ago about the advantage of working an alternator slightly beyond the bend of the saturation curve in order to diminish the drop, and the author claimed novelty for his design. But almost ten years ago Mr. Brown had clearly grasped the idea and put it into practice, as is borne out by the saturation curves published in this memoir. It is a curious psychological fact that we seem to think that when an idea has at last been understood by us, that it has never before been understood by anybody else.

To make machines of small output as flywheel generators, Mr. Brown devised in 1894 the type illustrated in Figs. 28 and 29. The poles are bolted to the flywheel and project toward the shaft. The

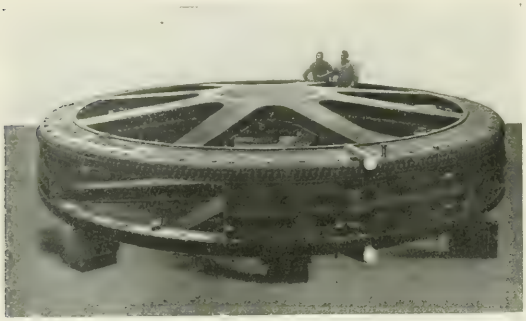


FIG. 27.—ARMATURE OF 1560-HP GENERATOR, CITY OF FRANKFORT.

armature is stationary and mounted on a bracket projecting from the bearing housing. The three-phase armature winding consists of round copper bars, as is clearly seen in the illustration. The construction of the armature mounted on the bearing housing leads of necessity to a perfect centering of armature and field. The core loss of the armature is diminished, as the volume of the latter is smaller than in the ordinary type for the same surface speed, and the moment of inertia of the flywheel is greatly increased. This type of machine, which they term at Baden the Cairo type, must be considered as a very happy combination for steam-driven generators of comparatively small output.

Arbitration Proceedings Favor Mr. Yerkes.

Note was made in these pages last week of the decision in Mr. C. T. Yerkes' favor, in connection with the arbitration proceedings relative to the London Underground. The report is also confirmed that Mr. Yerkes has awarded his contract for the London underground electrical generators and steam plant to the British Westinghouse Electric & Manufacturing Company, whose new works at Manchester, England, will be in operation within a few weeks. The electrical generators will be as large as those for the Manhattan Elevated Railway in New York. The Westinghouse generators at Niagara are 5000 hp each; their Manhattan machines are 6650 hp each, and those for Mr. Yerkes' London enterprise will be 6660 hp each, driven by turbine engines, by far the largest of their kind.

The work will begin immediately, and within two years from Jan. 1 the stifling old steam tunnels which penerate London in all directions, will be whitened and ventilated, and served by an up-to-date system of electric trains. So far as is known, no part of the motor contract has yet been given out.

The Manufacture of Deep Sea Cable in America.

NOW that Congress has assembled and President Roosevelt has insisted in his message to Congress upon the pressing importance of an American Pacific cable, great interest in the question of such a cable and in the further question of its manufacture in the United States, is being shown among electrical men. The action taken by the Commercial Cable Company is already familiar to our readers, and note has been made of the introduction of two bills into Congress affecting the work in connection with such an enterprise. But the main point, namely, the ability and readiness of the American manufacturer to make such cable, or the extent to which he should be afforded protection in establishing that branch of industry, has not been discussed, and we are now glad to submit a little data in regard to those vital matters, resulting from our inquiries among those most deeply concerned. There are features of the situation that are by no means clearly understood, but upon which light may be thrown to advantage at the present juncture.

Under paragraph 450, in the Dingley Tariff Act of July 24, 1897, telegraph cables would pay a duty of 35 per cent ad valorem in so far as they are imported into this country; but as an Atlantic cable, for example, 2500 knots in length, only has three miles of its length brought within our jurisdiction, the actual protection to American manufacturers is only 3-2500 of 35 per cent, or 1-25 of 1 per cent—practically nothing. If the Dingley tariff of 35 per cent could be made effective upon the whole length of such cables, the percentage would be satisfactory, though not excessive, as will appear from later statements. The contention is that it should be enforced until American manufacturers have firmly established themselves in that line of business, and until the American manufacturer can get his materials for cable manufacture at as low a price as the foreigner, and until, by improvements in machinery, etc., the difference in wages can be offset. It might require ten years, or it might not be more than five years—time alone can determine definitely.

It should be applied, it is contended, as a tax on imports, with the proviso that every foot of a foreign made cable landed on our shores shall be held, for purpose of assessing the tariff duty, as imported, because otherwise there is no protection to American manufacturers on such cables, and because, furthermore, that part of the cable within one marine league cannot be severed from the whole, and accomplish any useful commercial purpose. It might be so held, under the present tariff laws, but nothing short of a United States Supreme Court decision would settle the question, and, therefore, the tariff laws should be amended, if practicable, so as to leave no room for other interpretation. If that be not practicable, then a law should be passed absolutely prohibiting the landing of foreign made cables on on our shores, and lastly (but this is least desirable, and perhaps least likely to meet approval) a bonus or subsidy of 35 per cent might be authorized on submarine cables exceeding a certain length, say 100 miles, when installed.

Moreover, the extent to which capital must be risked in the development of a deep-sea cable industry has perhaps not yet been fully realized by those who have not looked into the subject. Some of our American cable manufacturers have of late removed from inland factories to establishments planted upon fairly deep tide water, but so far as we can ascertain none of them have yet felt warranted in making the heavy full investment that would be required until they can virtually be guaranteed that the contracts shall be placed on this side of the water. Otherwise, it would be foolish even to make a start. The amount of cable made in this country for rivers, lakes and even arms of the sea is enormous, but the deep sea work, with all that it involves, is quite another matter from the manufacturing point of view.

Let us look then into the cost of a deep sea cable factory. Twenty nautical miles per day is the minimum capacity that an American manufacturer should provide for. A large proportion of the machinery would have to be bought abroad in order that the plant might be put in operation at the earliest possible moment; or if built at home the designing of it, the making of the patterns, and the making of the machinery for a first plant, and a first-class plant, of this kind, would cost as much as the foreign price of such machinery, plus the American duty, which is 45 per cent, and then the package, freight and insurance will add approximately 10 per cent more, so that the American factory will cost approximately 55 per cent more than the foreign factory. Very extensive and substantial buildings

are necessary to house the machinery and conduct the manufacture, costly excavations and walls for the necessarily large number of steel cable tanks, and extensive real estate and docks near large centers of population and with deep-water frontage, must be provided. Altogether, it is estimated that such a plant will represent an investment of approximately $750,000.

The amount of working capital which an American company must provide in order to carry out a cable contract with a private company, or with the government, as is proposed, amounting to about $12,000,000 to $15,000,000, will depend upon the terms of payment that the buyer may be willing to adopt; but if the production and installation of the cable be spread over three years' time, giving $4,000,000 to $5,000,000 per annum, any manufacturer undertaking the contract would need to have a ready working capital of somewhere between $2,000,000 and $5,000,000, depending upon the frequency and the stages of manufacture at which the buyer would make partial payments. This is apart from the cost of the plant, and of the ship or ships.

So much for the investment in the plant and the working capital. The next point in order is that of labor, one that President Roosevelt has just insisted must be first in mind in all changes of the tariff and all efforts towards reciprocity. The data given below is based upon the best information that can be had from American and foreign manufacturers and workmen. The foreign submarine cable factories work two turns of 12 hours each, or one of from 12 to 14 hours, according to conditions. Laborers in England are paid 5 pence per hour (10 cents), while we pay $1.50 to $1.75 per 10-hour day. Skilled employes applying gutta percha to the wire get 7 to 8 pence per hour, while we pay for corresponding work (covering wire with rubber) from $2 to $2.50 per 10-hour day. Skilled employes running the closing machines (armoring) get 8½ pence per hour, while we pay $2.50 per 10-hour day. Machinists get 10 pence per hour, while we pay from $2.50 to $3.50 (the latter being specially skilled machinists) for a nine-hour day. It will be seen from the above that the American labor cost is from 50 to 75 per cent greater than the foreign cost for similar service. Add to this the fact that the government cable must be made upon the basis of an eight-hour day, and that under the circumstances the manufacturer will almost certainly have to pay the same for an eight-hour day as he now pays for ten hours, or else fail to get the necessary skilled hands for three shifts per day (the running of such a factory should be continuous), and it becomes apparent that the labor cost will be at least twice as great here as it is in foreign lands.

The next handicap to come up for consideration is that of the cost of materials, although here the facts, or the implications they carry, are rather more complex, and might perhaps be changed somewhat by the present confused status of copper, but in the main, what is stated below is true of the conditions.

Copper Wire.—Copper is exported from this country in large quantities. Nevertheless, although there is no duty on copper bars, the commanding position of the copper mining companies enables them to exact about 1 cent per pound (and sometimes more) from American consumers above what the foreigner has to pay. Furthermore, there is the same disparity in wages in the wire drawing industry of the two countries, so that the cost of the copper wire to the American cablemaker is from 10 to 15 per cent greater than the cost to the English manufacturer. There is a tariff duty of 2½ cents per pound on copper wire, so that it is out of the question to import it for the purpose, even if American manufacturers were disposed to do so.

Gutta Percha.—There is, we believe, no tariff duty on this article in the crude state. Nevertheless, since it all comes from the East Indies, and is handled by English factors or importers, practically all at London, the cost to the American manufacturer (including additional commissions, and additional freight and insurance) may fairly be put at 5 to 10 per cent above the cost to the English manufacturers. If the American manufacturer should import this material in a partially manufactured state, the tariff duty would be 35 per cent ad valorem; and a portion of it would probably have to be so imported until the American factories were running absolutely uniform and perfect material from the crude state to a certain degree of refinement.

Jute Yarn.—Immense quantities of this material would be required in making the cable, and the yarn can be procured from American manufacturers. The American prices, however, range from 25 to 35 per cent above the Dundee, Scotland, prices, the American tariff duty being from 1 cent per pound plus 10 per cent ad valorem, up to 35 per cent ad valorem.

Iron Armor Wire.—An enormous quantity of this article will be required for the Pacific cable—somewhat more than half the total weight (the total weight from 1¾ to 2¼ tons per knot). Americans cannot buy the wire abroad and import it, because the duty on such material is 1¼ cents per pound, and American cable producers pay a higher price than do foreigners. On many occasions the difference has been the full tariff of 1¼ cents per pound, which would be from 33⅓ per cent upwards.

Cable Ships.—This question, which has not so far been touched upon, is important. There are no such ships in America, while England has a splendid fleet of them, and other countries also excel us in this respect. It is true our Government has dabbled a bit in converting merchant steamers into cable ships, but the operation has been attended with all the drawbacks that might be expected from such an operation. It is stated by one well-known American manufacturer of insulated wires and cables that an American steamship builder with whom he talked on the matter said that he would charge not less than $750,000 for such a cable ship complete. At least two cable steamers would be required on the Pacific cable enterprise. The Government here might possibly lend a hand with some of our newer transports, but as noted already, they were not built primarily for cable tank capacity or the heavy deck hamper involved in equipping with cable machinery.

As to operation and ownership, the alternative is practically that of private enterprise and Government control. Our own platform of opposition to any extension of municipal or State management to commercial enterprises is too well known to our readers to need restatement here, although we are willing to concede that a modification of our views is inevitable in times of national peril, such as war, when cables, like everything else, are at once subject to the higher considerations. There may also be validity in the contention that a cable is something in the nature of lighthouses and kindred work for the common welfare and protection. In the main, however, fortified by English experience, we prefer cables under private management. We are glad as an offset to present the points as to government control suggested by a well informed student of the matter, it being true that many American manufacturers would prefer government installation and operation.

First.—It seems evident that the Republican majority in both branches of Congress is in favor of Government construction and ownership of the Nicaragua Canal, wherefore Government ownership of the American trans-Pacific cable is not a departure from the principles of the party now in control of national affairs, nor from those of the Nation.

Second.—The means of communication between the people of the several States, and between the United States and foreign countries by mail are provided and operated by the Government, for the benefit of the Nation, and the Pacific cable is merely another means of communication between the United States and its recently acquired outlying possessions, which can otherwise only be reached by the slow process of the mails, or by telegraphing at very great expense, over foreign-owned lines, and through foreign countries.

Third.—Private capital will not undertake the laying and operation of a trans-Pacific cable without freedom to fix its own rates, or a large subsidy from the United States Government every year for a long period of time, and representing altogether about one-half the total cost of the system. If the Government is going to contribute so largely to the establishment and maintenance of this service, it might as well go a little farther and secure to itself and its people the benefits of Government ownership of this means of communication with its outlying Pacific possessions.

Fourth.—In times of war, either between ourselves and other nations, or between several other nations, the cutting of the cable and thus breaking our lines of communication, would be very much less likely to take place if the cable were owned by the Government than if it were a private corporation, and for obvious reasons.

Fifth.—The private corporation would never reduce the rate below the maximum provided for in a subsidy bill, nor would it voluntarily make low rates, whereas the Government would naturally keep on reducing the rate as traffic and earnings increased, to simply make the enterprise pay its operating and maintenance expenses, to the great

advantage of American intercourse and commerce with our Pacific possessions, and the uncounted people of Asia.

Sixth.—The Government can borrow the money to pay for the cable system, at a very much lower rate than any private corporation, besides avoiding the necessity of earning dividends on stock whether "watered" or not, and, therefore, it could unquestionably give the American people the great benefit of much lower rates than a private corporation could possibly give, be it ever so willing.

The Economic Design and Management of Telephone Exchanges—III.

By Arthur V. Abbott, C. E.

2. DISTRIBUTING BOARD, OR CROSS-CONNECTING BOARD.

THE distributing boards are frames, usually of iron, so arranged that all the wires of the wire plant may end on connectors (see Connector), on one side, and the cables from the switchboard on the other side, then by means of flexible pieces of wire called jumpers (see Jumper) it is possible at any time to change the connection of any wire plant wire, to any switchboard wire without disturbing either the wire plant or the switchboard. There are usually two distributing boards, one called the Main Distributing Board, at which all the wire plant wires end, and to which extend all the switchboard cables. If a subscriber moves from one location to another, and must be connected to the office by an entirely different wire route, his switchboard number may be retained by changing the jumper connecting his former switchboard wire to the new wire plant wire. The main distributing board often carries the protection. The other distributing board, called the Intermediate Board, has no protection, and is frequently smaller, about two-thirds the size of the main board. From the main board the switchboard cables pass to one side of the intermediate board, and each wire is then exposed on a connector, then the same cables pass to the multiple in the switchboard. From the *answering jacks and signals* cables go to the other side of the intermediate board, thus by a jumper on the intermediate board any answering jack may be associated with any multiple jack. By this means busy subscribers may be distributed among different operators without changing their numbers or disturbing the multiple cables.

Running Board.—An inferior form of distributing board usually made by placing connectors on wooden strips often located at the bottom of and inside the switchboard frame.

3. POWER PLANT.

The entire apparatus installed in a central office to manufacture, or transform electricity, and deliver it to the telephone switchboard Power plants are of two types. (a) Those that take electricity from some commercial source and transform the same into the desired electrical supply for telephone service, and (b) those that include a prime mover of some kind, and a dynamo driven therefrom. The first type comprises either a direct or alternating-current rotary transformer, usually installed in duplicate, for converting the electricity supplied by the commercial mains into the desired voltage and current for charging a storage battery. A ringing generator, also in duplicate, consisting of a dynamotor operated from the commercial mains and delivering alternating current for ringing at from 100 to 125 volts and about 16 cycles per second, of a size proportioned to the office, usually ¼, ½ or 1 kw. A storage battery, usually of 10 to 12 cells in series (20 to 24 volts), sometimes of 20 cells (40 volts), of such capacity as to be able to carry the office for at least 36 hours without charging, on the basis of 10 ampere-hours per hundred originating calls. A switchboard equipped with the necessary switches to receive the commercial supply, and handle the transforming machinery and battery, together with all necessary instruments for measuring electricity, and the protection for the power circuits. In the second type, a gas engine, small water motor, or other prime mover is installed to supply power, a low voltage dynamo replaces the rotary transformers, and the ringing generators are operated from the battery. Both these forms of power plant include a fuse board that distributes and carries the necessary protection to guard the leads that supply electricity to the telephone swichboard, and a wire chief's desk supplied with all apparatus necessary to test for, discover and clear, any trouble that may arise in any part of the telephone plant.

4. OPERATORS' FURNITURE.

At every central office proper quarters must be provided for the comfort of the operators. These include necessary toilet facilities and bathroom, a dining room equipped with gas stoves for heating tea and coffee, tables and full set of table utensils and fittings for operators' lunch, a locker room and lockers for the clothing of each operator on duty at once, a parlor reasonably furnished for the comfort of operators when resting, and a hospital in which cases of illness may receive attention. This may be a small ante-room provided with a sofa or cot, or even a portion of the parlor partitioned off with a folding screen. At the switchboard each operator must be provided with an adjustable chair. The manager must be provided with an office properly furnished where he can transact business with the public separate from the operating room.

The chief operator and monitors must be supplied with chairs and desks equipped with telephone sets, signals and call wires to reach any of the operators at the board, the wire chief and each other, and exchange lines for public business. A card catalogue of subscribers, and a card trouble record complete the list.

Branch Terminal or Bridging Board.—In the early multiple switchboards each of the multiple jacks contained a spring contact, and the jacks were arranged in series, so that there were as many contacts as there were jacks, any one of which could be opened by an infinitisimal particle of dirt. By setting the jack springs one on each side of the line, or in parallel, all the spring contacts were avoided, and the troubles due to open lines vanished. Boards with jacks so arranged are called *branch terminals,* or *bridging* boards.

Busy Test.—Such an arrangement of a subscriber's circuit as will inform any operator at any position of the switchboard whether the line is being used. Usually the busy test is accomplished by putting a battery on the sleeve of the plugs; then when a plug is placed in any jack, the rings of all other jacks of the same line are electrified, and any operator touching a charged ring with the tip of a connecting plug will hear a sharp "click" in her telephone.

Cable Forms.—Pieces of multiple wire cable that are to be attached to spring jacks, connectors and the like, must have the ends of the various wires arranged in definite positions to match the apparatus to which attachment is to be made. When the wire ends are thus arranged, lashed, varnished, tested out and marked, the cable is said to be *formed.*

Cable Run.—(a) Supports, preferably of iron, that carry and enclose the various aggregations of cables that connect the different pieces of apparatus in a central office. (b) The passage way or entrance or space including necessary supports provided to allow the cables of the wire plant access to the main distributing board.

Chief Operator.—The attendant who has general charge of a central office.

Circuit.—That combination of electrical apparatus which permits of two parties to be placed within talking relations with each other. In the switchboard, circuits are known as "one-wire," "two-wire" or "three-wire" circuits, depending on the number of main conductors that are required for each subscriber's circuit through the jacks. Circuits are divided into (a) *Subscribers'* circuits, extending from the subscriber's premises and terminating in the switchboard at the exchange, including the answering jack and calling signal. (b) *Operators' Circuits or Cord Circuits,* or those which are used by the operator in the prosecution of the business of the exchange. (c) *Trunk* circuits, or those which are used to extend between two switchboards in different offices.

Cord.—A flexible electrical conductor attached to a plug.

Pair of Cords.—Each plug is supplied with a cord. When the two cords are united by connecting clips a flexible conductor is formed capable of instantly electrically uniting any two jacks. Cords are, therefore, always used in pairs. Cords and plugs are further known as one, two and three-way, depending on the number of conductors they carry.

Cord Shelf.—A projection on the switchboard on which are placed the plugs and keys of the cord circuits, and from which the cords are suspended.

Color Scheme.—Switchboard cables are made up of single wires, wires in pairs, triples, or quadruple, depending on the nature of the circuit for which the cable is to be used. By dying the insulating material covering the various wires with different colors, according to a predetermined code, it is possible to identify at each end of a piece of cable the several wires without resorting to the laborious

process of testing. Such a method of colored insulation is called a *"color scheme."*

Connector.—Sometimes called "terminal," "line terminal," "clip" or "punching"; a U-shaped piece of thin metal having two ears, to which wires may be soldered, used to connect different wires or cables together. For distributing boards connectors are made up on maple blocks, each carrying 10 to 20 pairs.

Jack or Spring Jack.—A contrivance consisting of one or more springs and a ring held in an insulating frame, so designed that when a properly formed metal plug with a corresponding number of conductors is inserted into the ring it may make contact with the various conductors formed by the ring and springs, and extend the circuits, of which they form a part, to corresponding conductors in a flexible cord attached to the plug. Jacks are divided according to their construction, into *one, two, three, four, five* or *six-point* jacks, depending on the number of contacts, or conductors they contain, and according to the use to which they are put into answering jacks, multiple jacks and trunk jacks.

Answering Jack.—The jack which is associated with the subscribers' calling signal, and which in multiple and divided boards is exclusively used by the operator in answering subscribers' calls.

Multiple Jacks.—Those which have no signal, and of which several are attached to each line, so distributed along the switchboard that each operator can reach every line. In multiple boards, multiple jacks are divided in subscribers' multiple jacks and out-trunk multiple jacks, depending on whether they are attached to subscribers' lines or to outgoing trunk lines. The subscribers' multiple is further divided into the "A" multiple, or those jacks which appear before "A" operators, and the "B" multiple those which are placed in front of "B" operators.

Trunk Jacks.—Jacks which form the termni of trunk lines.

Jumper.—A piece of flexible wire, or metal strip, used as a usually more or less temporary connection between two parts of a circuit.

Key.—A switching device whereby different circuits may be connected or disconnected at pleasure.

Ringing Keys.—Keys used for placing ringing current upon lines.

Listening Keys.—Keys to enable the operator to listen to subscribers' orders.

Combination Keys.—Keys which unite both above functions in a single piece of apparatus.

Order Wire or Call Circuit Keys.—Keys used by the operator to connect herself with a call wire.

"Listening" in or Supervising.—The act of an operator in connecting her telephone with the circuit of two subscribers presumably talking together for the purpose of ascertaining whether the subscribers are conversing.

Operator's Load.—The amount of work, or number of messages, an operator can handle in a day's work. On modern switchboards an "A" position should handle from 1600 to 2000 messages per day. A "B" position from 2400 to 3000 messages. On a magneto board a fair "A" position load is from 1100 to 1300 messages, and for a "B" position from 1900 to 2100.

Manager.—The person in charge of a central office.

Peg Count.—The operation of counting the number of originating calls received in a central office during any consecutive 24 hours, for the purpose of ascertaining the load on the office. The result of a peg count when plotted with hours as abscissæ and number of originating messages as ordinates gives the "load" line of the office.

"Position."—The space at a switchboard occupied by one operator, is also used to designate the entire collection of apparatus provided for an operator. Positions are divided in "A" and "B" positions.

Protection.—The apparatus provided to avert injury by abnormal currents to either (a) central office equipment, (b) sub-stations, or (c) wire plant wires.

(a) CENTRAL STATION PROTECTION.

Central station protection usually consists of a spark-gap and heat coil. The spark-gap is composed of two plates, preferably of carbon, one of which is grounded while the other is connected to the line wire, and separated about 1-200 of an inch, usually by a disk of perforated mica or silk. In a recess in one of the carbon plates a small lump of fusible metal (160 degs. solder) is often placed. This lump melts under the heat of the discharge, and flowing across the gap dead grounds the line. The heat coil consists of a small spool of resistance wire (5 to 50 ohms), in the center of which a movable pin is arranged to impinge on a ground plate. Normally, by means of fusible solder, the pin is held off the ground, but in case of an abnormal current of too low-potential to leap the spark-gap, the solder melts and drops the pin to the ground. Common battery boards must have the protection arranged to *open* the switchboard side of the line while *grounding* the wire plant side. Sometimes a light fuse (maxstat 1 ampere) replaces the heat coil, but is not so reliable. The entire protection for each line is placed on the line side of the main distributing board, the carbons and heat coils being mounted in springs to be readily replacable after performing their functions.

(b) SUB-STATION PROTECTION.

The sub-station protection includes the same features as that for the central office, to which a fuse (7 amperes) is frequently added, the whole apparatus placed on a porcelain block located near the sub-station set (see Sub-station Set), or preferably on the wall of the building near the point where the line enters.

(c) CABLE PROTECTION.

At the point where a cable runs into an open wire line it is usual to place a fuse (3 to 7 amperes) between each cable wire and the open wire. When a cross takes place between a telephone wire and a wire carrying electricity at relatively high potential, the protection at the sub-station or central office operates and grounds the line, a rush of current then blows the fuse at the sub-station or at the junction of the cable or both, isolating the open wire from both the cable and the sub-station. Much difference of expert opinion exists as to the extent to which protection should be employed. There are many advocates of the entire omission of protection from underground lines and wide disagreement as to how far aerial lines should be guarded. Saving in expense is the only argument against the complete system as outlined. While protection devices are not infallible, to omit any of them is courting a risk that a conservative policy would shun.

Plug.—A small rod of brass shaped to fit a jack and used to connect the jack to a flexible cord. Plugs are divided into (a) answering plugs, or those which are only inserted in the jacks of subscribers making calls, placed next to the face of the switchboard on the cord shelf. (b) Connecting plugs, or those which are only inserted in the jacks of subscribers that are to be called, placed nearest the operator on the cord shelf.

Relay.—An electromagnetic device consisting of an electromagnet that when excited attracts a movable armature, thus completing a circuit. Relays are divided into (a) *Line relays,* or those which are used by subscribers for signaling the exchange; (b) *Cut-off* or *Controlling relays,* or those which are used to isolate a subscriber's line from its answering jack and signal; (c) *Supervisory relays,* or those which control the supervisory signals. (d) *Pilot Relays,* or those common to a number of signals acting as a general guard in case of failure of any individual relay.

Signals.—A device for calling the attention of an operator. Signals are divided into *Line* or *Calling* signals, or those attached to subscribers' lines for the purpose of notifying an "A" operator that a subscriber desires a connection. *Clearing out* or *Supervisory* signals that are attached to the cord circuits of both "A" and "B" operators, chiefly used to notify operators that conversation is completed; and *Pilot Signals,* or those which are common to or are in parallel with a group of other signals and serve to call attention to the fact that some other signal is displayed. Example: A night bell connected to all the signals of a magneto board. Signals may also be classed by their operation into *Manual* signals, or those that after being displayed must be restored by hand to their normal position, and *Automatic* or *Self-restoring* signals that take care of themselves. The ordinary annunciator, an electromagnet that when exicted attracts its armature, and allows a shutter to fall by gravity, displaying a number, is an example of the first class. Such a signal is usually called a *"Drop."* Of the second class the miniature electric lamps of the modern switchboards form the best example.

Supervisor.—An operator who has charge of a division of the switchboards, supervising a group of operators, and reporting to the chief operator.

Terminals.—Telephone circuits usually contain many different pieces of apparatus, and frequently several kinds of cable or wire. When one piece of apparatus or kind of wire is to be joined to another, a great variety of connecting devices are used, all of which pass under the generic name of *terminal.*

Wire Chief.—The attendant who has charge of the power plant, and supervision of the switchboard. In many cases the wire chief has also more or less charge of the maintenance of the aerial wire plant, and sometimes is expected to run lines for new subscribers.

Development of the Indiana Telephone Field.

By R. D. Fisher.

THE development of the Indiana telephone field is not only remarkable for its rapid progress, permanency and convenience, but stands as a monument to skill, science, modern improvements, wise business sagacity and management. The results of the expenditure of millions of dollars is a network of lines radiating from the centers of population into every part of the State. According to the recent valuable report of the Auditor of State there were on the first day of April 110 incorporated telephone companies owning and operating telephone plants and lines in the State. There were also a number of voluntary associations and private lines not included in the above estimate. The assessed valuation of their lines alone was $4,436,663. The valuation per mile, as fixed by the State Tax Commissioners, shows the surprising and apparently inequitable variation of $5 to $500. Real estate, machinery, switchboards, instruments, office fixtures, etc., are valued by local assessors and are not included in the above estimate. There are 152,702.03 miles of telephone wire in operation in the State on the first day of April.

The past season (eight months) has been one fraught with important events, and the Indiana field has been among the most active in telephone development. A score or more new companies have been incorporated, and an equal number of plants installed. There were in April 22,000 Central Union telephones and 52,469 independent telephones in use, whereas, during the past eight months the number has increased at least 30 per cent. Indiana has a population of nearly 3,000,000 people. There are 92 counties in the State. On April 1 there were several counties without telephones, and no toll stations were maintained within their borders. To-day there is telephone service in every country of the State, and nearly one-half of the people can communicate with each other and with the outside world.

Doubtless among the companies constituting the independent chain, the most aggressive is the Hon. S. P. Sheerin's New Telephone Company, of Indianapolis, including that company's long-distance lines. It had on April 1, 4,486.50 miles of wire in operation, but the company's development during the past eight months has increased the capacity of the long-distance and local plants at least 50 per cent, and the encouraging fact remains that the demand for telephones is greater than ever before. Lines are now being built to Logansport, Peru, Jeffersonville and Louisville, and preliminary arrangements have been completed for the building of projected lines to Vincennes, Washington, Evansville and Muncie. "The outlook is better than ever," said General Manager Sale, of the New Long Distance Company. "We have been granted within the past month franchises on conservative terms at Washington, Vincennes, Logansport and South Bend, and have a petition pending at Muncie. Our new plants at New Castle and Peru are nearing completion and will shortly be in operation." Great activity in telephone development is also manifest in northeastern Indiana, where Mr. George W. Beers and business associates have labored for several years with great success and profit. The Home Telephone Company, of Ft. Wayne, of which Mr. Beers is president, has 350 miles of wire in Allen County; the National, 219 miles, and the Citizens' Company, 51 miles. Mr. Beers' operations are not confined to Allen County. Indeed, he has control of a number of companies operaitng in adjacent counties, and has recently secured the control of the Anderson Telephone Company. The lines are being extended, the plants in general are being improved, and the latest appliances adopted. One notable and beneficial improvement is the increasing number of exchanges, and the fact that long, heavily taxed party lines are growing in disfavor. The work of connecting the numerous farmers' lines with the village exchanges and the village exchanges with the county seat exchanges, and these in turn with the long-distance lines has been going on among the independent companies all summer until it is now the boast of the managers of this combination of interests that the Indiana farmer, sitting in his home, can communicate by telephone all over the State. The equipments of country lines and of country and village exchanges have been greatly improved. Opposition by abutting landowners has faded away, and the telephone is now accorded its proper and legal use in the highway. Telephones are being placed in some of the country school houses, and in one instance an exchange is operated in a public school building.

While the development of the Indiana field is largely due to the independent movement, the Bell companies, all over the State, under the energetic new Sabin regime, have become strong competitors, both in extensions and in improvements. This company has nearly 40,000 miles of wire in operation in the State, making many improvements and extensions during the year. But the Independents maintain that the people—the business interests and the farmers—still remain partial to the independent companies. At present Indiana is deficient on toll lines, but this is being remedied as fast as possible. In a short time the entire State will be connected up ready to jump over into bordering States, reach across the Alleghenies to the east and the Mississippi to the west.

Telephone Activity in Pittsburg and Western Pennsylvania.

The telephone business has never enjoyed a period of activity to equal the last year. All existing lines have been greatly extended and improved, while our new company has gone into actual operation and, by its great push and energetic action, is to-day a thoroughly established and well equipped competitor of the older companies. The situation in Pittsburg and the surrounding territory is an interesting one. The Central District & Printing Telegraph Company, which was organized in Pittsburg in 1874 as a telegraph company, is the oldest telephone company in this part of Pennsylvania. It is the licensee of the Bell company. The company next in importance is the Pittsburg & Allegheny Telephone Company, which came into the city a little over two years ago. It is now doing a remarkable business, and its subscribers already number several thousand. The third company is the Federal Telephone Company. It has no franchise nor connections in the city proper, and it confines its operations to the boroughs, villages and towns outside of Pittsburg, which are scattered throughout Western Pennsylvania, and it must be admitted that it also has done a great deal of work. It is also adding new exchanges as rapidly as franchises and ordinances are passed in its favor.

To get an adequate idea of the wonderful amount of work, which has been done by the different companies, it is interesting to get their reports, which in actual facts and figures speak for themselves.

Beginning with the C. D. & P. T. Company, the oldest one, here are some of the items:

MILES OF POLES, JAN. 1, 1901.	
Exchange	1211
Toll line	2752
	3963
MILES OF POLES, NOV. 1, 1901.	
Exchange	1349
Toll line	3200
	4549

Showing an increase of almost 20 per cent in eleven months.

MILEAGE OF WIRE, JAN. 1, 1901.	
Exchange	61,265
Toll line	16,150
	77,415
MILEAGE OF WIRE, NOV. 1, 1901.	
Exchange	78,480
Toll line	17,485
	95,965

This shows an increase of almost 25 per cent.

The cost of additions made to the system in buildings and real estate during the first ten months of this year ending October, 1901, not including switchboards, wire and other apparatus:

Plants	$743,539.43
Real estate	50,190.26
	$793,729.69
Number of telephones in use by the company, Jan. 1, 1901	35,509
Those in use Nov, 1, 1901	39,031
Increase	3,522

The improvements, which the company has made throughout its system during the last year, are really remarkable, and their magnitude cannot be appreciated unless they are mentioned in detail.

At the Grant exchange it put into operation the relay board and the common battery system. The South Side exchange has been transferred to a new building erected for telephone purposes. A relay board was also installed there. The Fisk or Lawrenceville exchange has been equipped with the common battery system and the exchange building has been remodeled. The Park exchange building was completed during the year, and new apparatus was installed. The East exchange was also remodeled, and a relay switchboard is now being installed. The Hill exchange has been transferred into a building purchased for that purpose, and a common battery and switchboard has been put into operation. At Wilkinsburg, a suburb of the city of Pittsburg, a new exchange building is in course of construction, and orders for a new switchboard have already been issued. The work on the new building of the Court exchange in this city is also being pushed as rapidly as possible. This work has been delayed because in digging the foundation the contractors struck a quarry of very hard stone. The company is also completing new buildings for exchanges at Marietta, Ohio, and at Parkersburg, W. Va. The switchboard at Marietta has already been delivered at the building. The principal part of the city has been provided with underground conduits. The company has reconstructed its exchange and plant at Franklin, Pa., underground conduit has been put in and a new switchboard has been installed. At East Liverpool, Ohio, another exchange plant of the local company, an underground system is being put in. The architects have prepared other plans for a new building, which will be erected as soon as the bids are in, and a new relay switchboard will be installed. At Wheeling, W. Va., the C. D. & P. T. has extended its underground system so as to take in South Wheeling. The old exchange at this last place will be abandoned, and, in order to improve the service, all connections will be formed from the main exchange in Wheeling. During the past year the company has also rebuilt the branch exchanges in the Beaver Valley at Beaver, Beaver Falls, New Brighton, Rochester and Monaca.

The Pittsburg & Allegheny Telephone Company, the local competitor of the C. D. & P. T., has been in operation about two years. During that time it has succeeded in connecting up between 7500 and 8000 telephones distributed over Pittsburg, Allegheny, Coraopolis, McKees Rocks, Carnegie, Braddock, Homestead, Swissvale, Wilkinsburg, Verona and New Kensington. At Bellevue, Pa., and Sewickley, Pa., new exchanges are being established at present. This company does most of its circuit work underground. It has practically two subways completed between the city proper and Wilkinsburg, a distance of nine miles. The company is adding from 20 to 30 new telephones a day. It has now completed arrangements for long-distance connections with Cleveland, Ohio; Erie, Pa., and all intermediate points. The company prides itself upon the phenomenal success it has met with in this territory, and it claims that this success was made possible by low rates and good service.

By Nov. 26, 1901, Federal Telephone lines had been extended into all of the following named places in Western Pennsylvania. In addition thereto it has secured franchises in several towns not mentioned hereon, and will extend its lines to many other points during 1902.

Allegheny County.—Bellevue, Avalon, Ben Avon, Emsworth, Clifton, Dixmont, Glenfield, Haysville, Osborne, Sewickley, Edgeworth, Shields, Leetsdale, Fair Oaks, Coraopolis, Esplen, McKees Rocks, Carnegie, Woodville, Bower Hill, Bridgeville, Millvale, Etna, Verona, Oakmont, Wilkinsburg, Wilmerding, Wall, Pitcairn, East McKeesport, McKeesport, Versailles, Port Vue, Glassport, Duquesne, Dravosburg, Belle Bridge, Elizabeth, West Elizabeth, Lock No. 3, Bunola, Elkhorn.

Beaver County.—Economy, Baden, Remington, Conway, Freedom, Monaca, Aliquippa.

Washington County.—West Brownsville, California, Coal Centre, Elco (Wood Run), Roscoe (Lucyville), Stockdale, Allenport, Speers, Charleroi, Monongahela City, North Charleroi, Courtney, Finleyville, Washington, North Washington, South Washington, West Washington, East Washington, Canonsburg, South Canonsburg.

Westmoreland County.—Monessen, Irwin, Latrobe, Youngstown, New Kensington, North Belle Vernon, Manor, Baggaley, Hyde Park, Avonmore, Saltsburg.

Fayette County.—Brownsville, Fayette City, Bridgeport, Belle Vernon.

Armstrong County.—Freeport, Leechburg. This makes a total of 87.

Marconi Signals Across the Atlantic.

William Marconi.

The readers of Sunday newspapers were treated with a sensation of the first order by the announcement last Sunday morning that Marconi had received during the previous week several signals at St. Johns, Newfoundland, transmitted from Cornwall, England. It now appears that before leaving England Marconi had made plans for accomplishing this result, though it was given out that his object in coming to Newfoundland was to establish a station for communication with ships at sea. It is quite probable that the publication of the results achieved was unauthorized, the experiments being merely preliminary ones of a scientific rather than practical nature.

The distance between the Cornwall station at Poldhu, Cornwall, from which the signals were sent, and that on Signal Hill, Newfoundland, where they were received, is about 2100 land miles. The signals consisted in repetitions of three dots, corresponding to the letter "S" in the Morse code, and were audible in a delicate telephone connected with the receiving apparatus.

As previously stated before leaving England, Marconi had arranged with the electrician in charge of the Cornwall station, to begin sending signals daily after a certain date, which Marconi would cable him upon perfecting his arrangements at St. Johns, where he arrived several weeks ago. Signal Hill, at the entrance to the harbor, was selected as an experimenting station, and his equipment was installed there. On Dec. 9 he cabled the Poldhu station to begin sending signals at 3 P. M. daily, and to continue them until 6 P. M., these hours being, respectively, 11 30 A. M. to 2.30 P. M., St. Johns time. During these hours Wednesday Marconi elevated a kite with

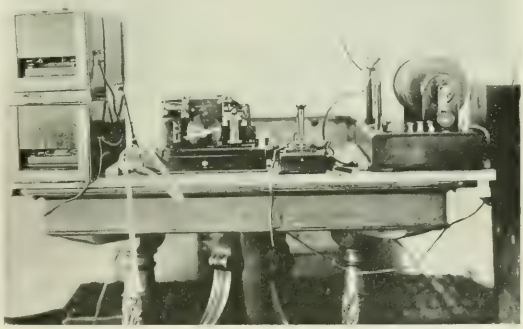


Fig. 1. Standard Marconi Apparatus.

an aerial wire. He remained at the recorder attached to the receiving apparatus, and, to his profound satisfaction, signals were received by him at intervals, according to the programme arranged previously with the operator at Poldhu. These signals, as stated before, consisted of repeating at intervals the letter "S," which is made by three dots, or quick strokes. This signal was repeated so frequently, and according to the detailed plan arranged to provide safeguards against possibility of a mistake, that Marconi was satisfied that it was a genuine transmission from England. Again on Thursday, during the same hours, the kite was elevated and the same signals were renewed.

Though satisfied of the genuineness of the signals and that he has succeeded in his attempts to establish communication across the Atlantic without the use of wires, Marconi wishes it understood that the system is yet only in an embryonic stage. The possibility of its ultimate development is, however, demonstrated by the success of the present experiments with incomplete and imperfect apparatus, as the

signals can only be received by the most sensitively adjusted apparatus, working under great difficulties, owing to the conditions prevailing at St. Johns.

In a letter in Tuesday's *New York Herald* Marconi gives the following account of the experiments:

"Before leaving England I arranged for our long-distance station near the Lizard to signal me the letter 'S' repeatedly for three hours when I had advised them that I was ready to receive the same. I cabled on Monday that all was in readiness, and asked the signal to be sent at short intervals between 3 o'clock and 6 o'clock, Greenwich time, and to be continued each day until ordered to stop. This time would correspond approximately with 11.30 to 2.30 here.

"I received on Thursday indications of the signals at 12.30, and with certainty and unmistakable clearness; at 10 minutes after 1 quite a succession of 'S's' were received with distinctness. A further number were received at 20 minutes after 2, the latter not so good. Signals were received Friday at 28 minutes after 1 o'clock, but not so distinct as on Thursday.

"I am of the opinion that the reason why I did not obtain continuous results were, first, the fluctuations in the height of the kite, which suspended the aerial wire, and, second, the extreme delicacy of my receiving instruments, which were very sensitive and had to be adjusted repeatedly during the course of the experiments.

"When a permanent station is installed here I will not be dependent upon fluctuations of the wind, and I am confident of making the signals strong and reliable—that is, not requiring such delicate and sensitive receiving instruments by employing much greater power at the sending station.

"I must go immediately to England to make arrangement for employing more power at the sending station, and I trust in a very short time to establish communication between the two continents in a thoroughly reliable and commercial manner."

An unexpected development following the announcement of Marconi's success was a warning from the Anglo-American Telegraph Company that if he persists in his work in Newfoundland an injunction will be served. In a letter served on Marconi on Sunday the solicitors of the cable company gave notice on behalf of the company that the sole and exclusive rights to operate or construct any system or means by which telegraphic communication is obtained from any places in the colony or within the jurisdiction of the government of the colony to places outside the colony are owned by it, consequently they notify him that the work in which he is engaged is in direct violation of the rights and privileges granted to the company by its charter from the government.

The solicitors add that unless they receive promptly an intimation that he will not proceed further with his present work and remove the appliances he has erected for the purpose of telegraphic communication, legal proceedings will be begun to restrain him from further prosecution of work and also for any damages which the company may sustain or has sustained. They further notify Mr. Marconi that the company will hold him responsible for any loss or damage sustained by reason of his trespass upon their rights.

To a *New York Herald* representative Marconi expressed himself as follows regarding this notification:

"I entirely disclaim any intention of infringing upon the rights of the Anglo-American Telegraph Company. I was aware that it had a monopoly here for another two years, but I thought it was simply an ordinary commercial monopoly, by which no other company could enter into competition, and I had no intention of competing in the ordinary business sense until the charter had expired. It seems incredible to me that this monopoly should extend so far as to prevent my making such scientific experiments as during the last week.

"It is too late to-night for me to consult my own solicitors, but I shall lay the matter before them in the morning. It appears to me that this letter practically admits the success of my experiments and should remove any doubt, if such can exist, in the minds of the public, as to the truth of my report that I have really had a communication 2000 miles without wires or cables. I intended giving an important exhibition of tests on Signal Hill to-morrow to Sir Cavendish Boyle and a number of gentlemen interested, but I fear I will not now be able to do so."

Mr. A. M. Mackay, general superintendent of the Anglo-American Telegraph Company, referred to the notification as follows:

"When Mr. Marconi came here he announced that his visit was in connection with proposed small stations on the southeast coast in connection with lighthouses and fog alarms, and a future extension of his system on Labrador. He mentioned that while here he would conduct a few experiments and try to communicate with passing ocean liners.

"Thinking this was the full extent of his operations here, our company did not object. It was never for one moment supposed he was going to try to obtain signals across the Atlantic, or we would, in self-defense, have been compelled to apply for an injunction against him as soon as he landed here. His doing this is a direct infringement of our rights under government charter, and my instructions are to notify him promptly and take necessary steps to restrain him from making any further experiments. These instructions were carried out."

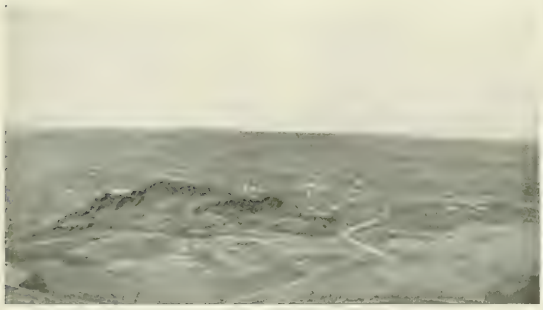


FIG. 2. VIEW LANDWARD FROM SIGNAL HILL.

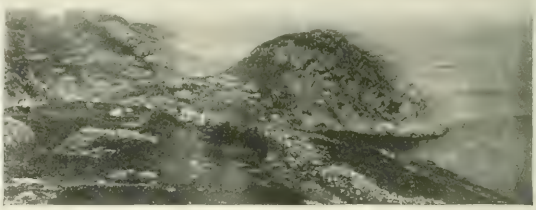


FIG. 3.—VIEW SEAWARD FROM SIGNAL HILL.

According to press dispatches Marconi will inaugurate the new year by sending a special message, if the steamship on which he will sail Thursday of this week, reaches England on time. He will go direct to Cornwall and take charge of matters there.

Dr. Pupin is quoted as saying that he fully believes that Marconi succeeded in signaling between the coasts of Newfoundland and Cornwall, England, by his system of wireless telegraphy. "According to the newspaper reports I have read the signals were very faint, but that has little to do with it. The distance, which is about 1800 sea miles between these two points, was overcome, and further development of the sending instruments is all that is required.

"Two years ago, in a discussion before the Institute of Electrical Engineers, I expressed an opinion that improvements to the system would overcome the distance. This new system, if it is adopted, will not affect the cables so far as I can see at the present time, for it must be understood that the cables are being perfected constantly. At the present time there are 14 cables between Europe and America, and each one of these cables works much faster than the Marconi system can work over short distances, and, besides, nobody doubts at the present time that the cable will soon be made from 40 to 50 times as fast as it is at the present day.

"One point which is of great value and interest to the scientific world is that Marconi has proved conclusively that the curvature of the earth is no obstacle to the system of wireless telegraphy. Some were inclined to think, and there were many heated discussion upon it, that the curvature limited the system.

"All Marconi's efforts of late have been directed toward perfecting and making his sending apparatus more powerful and giving a greater height to the sending end. It still remains to be proved, however, that heavy banks of fog, low hanging clouds and heavy showers along and in the path of the transmitted electric wave will not entirely obstruct its progress. The presumption generally is that they will, as experiments thus far have proved them so. Atmospheric conditions have also much to do with and strongly affect the electric wave.

"One great drawback of the system is that you cannot work more than one set of instruments at any one time between two continents on account of mutual interference. Marconi deserves great credit for pushing this great work so persistently and intelligently, and it is only to be regretted that there are so many so-called scientists and electricians who are trying to get around Marconi's patent and thus deprive him and his people of the credit and benefits of the work to which they are fully entitled."

Marconi's achievement in first detecting a wireless telegraphic signal from across the Atlantic naturally draws attention to the spot on which the feat was accomplished. This is not the first time that the island of Newfoundland has formed a center of interest from such a cause, for it was there, in 1858, that the earliest word came in over the transatlantic cable. The condition of distance ruled it thus in the one case as in the other, for this triangular island forms virtually the elbow of the continent, stretching out farthest of any point in the temperate zone toward the European shore. On the outer side of Newfoundland is a peninsula which juts from the island as that

FIG. 4.—ST. JOHN'S HARBOR. SIGNAL HILL ON THE LEFT.

does from the Canadian coast, and on the extreme eastern reach of this peninsula of Avalon rise the two tall rugged promentories which guard the harbor of St. Johns. It was from Signal Hill—520 ft. high—which stands as the northern post of the harbor gate, that Marconi flew his kite.

From the business district of the town it is a drive of only a mile or so to the top of the Signal Hill. The road winds up past the ruins of an old fort, which the driver points out as a French one, for during the seventeenth century St. Johns was in and out of French possession at intervals. The last time the town changed hands was in 1762, when, after a desperate fight, Signal Hill was stormed and taken by the British. But the islanders are not entirely done with the French even yet, for the Treaty Shore rights are a perennial trouble to the West Coast of the colony.

Once on top of the Signal Hill the view in all directions is magnificent, especially along the serrated line of headlands to the northward; in fact, it is as good a place for an outlook as you can find unless you come from the U. S. A. and have been so perverted by yarns about Newfoundland fogs that you will not admit your ability to see farther than the edge of the cliff. The stone castle on the summit is a monument founded in 1897 to the late John Cabot, discoverer of the island, which has been discovered a good many times since, and will have to be a good many times more before the public finds out what an interesting place it is. The utilitarian natives do not appreciate the sentiment of keeping it holy as a tombstone to a departed friend, so they have employed it as a signal tower. Perhaps their object is to warn off future discoverers. At any rate, their signal pole is a good likeness to the gallows on which John Cabot was hanged—if he was hanged. For every-day purposes the people of St. Johns built their gibbet on an inferior mound near the Signal Hill.

Newfoundland is a country undoubtedly destined to a great electrical future because of its countless lakes and mountain torrents available for power. St. Johns has now a trolley road with Westinghouse equipment. It is supplied with current from a 1600-hp plant situated about 8 miles out of town. Early last August the cars were all tied up, and nobody seemed to care. They said the water had given out, but it was also intimated that some of Mr. Reid's affairs with Parliament had occasioned the suspension. Moreover, the colony is a contributor to the electrical manufacturing industry, for a good deal of copper is taken out of the ground.

Electricity for a Pennsylvania Railroad New York Tunnel.

Great interest has naturally been aroused in New York City by the announcement of the Pennsylvania Railroad Company of its intention to establish a great terminal station in the heart of New York City, namely, in the vicinity of Herald Square and West Thirty-Fourth Street. The official statement of President Cassatt is in part as follows:

"The Pennsylvania Railroad Company is now prepared to carry out its policy, long since adopted, of extending its railroad into New York City, therein establishing a suitable passenger terminus for the accommodation of the public. To accomplish this on a comprehensive plan the Long Island Extension Railroad Company will withdraw its application for powers to construct its terminal railroad, and in lieu of such independent construction it is now proposed to build, under the charter of the Pennsylvania-New York Extension Railroad Company, just organized, and a New Jersey railroad company, about to be organized, a through underground connection between the Long Island Railroad and the Pennsylvania lines in New Jersey, and to construct a proper and commodious joint underground terminal station in New York City for the Pennsylvania and Long Island roads.

"After years of exhaustive study the conclusion has been reached that a tunnel line, operated by electricity, is in every way the most practical, economical, and the best both for the interests of the railroad company and of the city. The line as adopted will traverse the city of New York from the Hudson River to the East River, and be underground throughout, and at such depth as not to interfere with the future construction of subways by the city on all its avenues, similar to the one now building along Fourth Avenue.

"As the railroad will be wholly underground and operated electrically, in the same manner as the recently constructed Orleans Railway Extension in Paris, it will not be objectionable in any way. There will not be any smoke, dirt or noise, and as all the surface property may be built upon after being utilized underneath for railroad purposes, the neighborhood of the station will be improved instead of marred, as is so often the case when railroad lines are constructed on the surface or elevated."

Previous plans had contemplated the construction of a bridge, but according to the plans which were prepared by Charles M. Jacobs, of the firm of Jacobs & Davies, experts in tunnel building, the tunnel will be practically a submerged bridge. This bridge will be enclosed in a steel tube to keep out the water and the mud, and it will rest on piers built on piles, which will be driven down through the mud and sand until they reach bed rock. One of the main reasons for abandoning the scheme of building a bridge across the North River was the tremendous cost. The tunnel will, it is estimated, cost not more than $15,000,000 or $20,000,000, and it may be possible to construct it for less. It will be used exclusively by the Pennsylvania Railroad and its connection, the Long Island Railroad.

The Manhattan terminal for the North and East River tunnel will be on the newly acquired property between Thirty-second and Thirty-third streets, and Seventh and Tenth avenues. Here a large station will be erected. This is to be a magnificent structure architecturally, and for this reason alone it is believed that it will raise the character and value of the surrounding property. From the street level there will be a gradual decline to a platform 100 ft. long, where there will be electric elevators and stairways leading down to the tracks, of which there will be some 20 or more. The train platforms will aggregate several miles, and the dimensions of the station will be 1500

by 5 [illegible] in length and width, respectively. The tunnel proper will consist of between two and four steel tubes, the exact number not having been decided upon as yet. Each of these tubes will be 18½ ft. in diamter on the inside and 19½ ft. on the outside. Within these tubes will be the bridge construction on which the tracks will be laid. At present it is the intention to build the Hudson tunnel from a point just north of the present Pennsylvania station. The Island of Manhattan will be reached at Thirty-third Street and Thirteenth Avenue.

The grade through the tunnel will be about 1½ per cent, or about a foot and a half in every hundred. At Seventh Avenue the elevation will be about 100 ft. above the bed of the river and about 40 ft. below the street level. The tunnel will then gradually drop until at Tenth Avenue it will be only 40 ft. above the bed of the Hudson. At Eleventh Avenue it will have dipped 30 ft. more, and at Thirteenth Avenue it will be 10 ft. below the river bed. It will then continue gradually to decline until at midstream it will have reached a depth of nearly 100 ft. below the surface of the river bottom.

The trains which will run through the tunnel will be operated by electricity. This will obviate any special arrangements for ventilation, as each train running through it will carry with it a wave of fresh air. The tunnel will be electrically lighted and will practically be as light as day. The power for the motors and the light will be furnished by a large plant which will be built on the New Jersey shore, for the reason that coal is cheaper there than in New York. The motors will be used only in the tunnel, and will be switched on

ELECTRIC LOCOMOTIVE, PARIS-ORLEANS RAILROAD.

in place of a regular locomotive during the regular stop of the trains in Jersey City and in Long Island City.

To complete the entire work will take the continuous labor of three years, so that the tunnel will be ready for operation in the early part of 1905 if the permission to build the tunnel is not unduly delayed. When it is completed the Pennsylvania Railroad will not only have an entrance into New York, but will be able to send through trains without the use of ferries from all New England points to the South and West in connection with the New Haven Road and a bridge from Mott Haven to Long Island, which is to be built by a separate company.

Reference having been made by the Pennsylvania authorities to the work in the Paris-Orleans Railroad tunnel with electric locomotives of the type under consideration here, we show one of them. There are eight built by the General Electric Company at Schenectady, and supplied through the French Thomson-Houston Company. Each is equipped with four motors, and is capable of hauling a train of 300 tons, exclusive of the locomotive, a distance of 2½ miles in 7 minutes, with a grade of 1.1 per cent maximum, between the old depot where the tunnel begins and the handsome new one in the heart of the city, on the Seine, nearly opposite Notre Dame and the Tuilleries. Current is picked up from a third rail by six shoes, and by an overhead device for switching points. Direct current is used. The locomotives weigh only 45 tons, and it is said that only 150 trains per day, both ways, have to be handled. They are quite successful, but the Pennsylvania work would be much heavier in every respect.

New Telephone Patents.

To the U. S. Patent issues of Dec. 10 telephony yields five patents. Of these two relate to receivers, two to switchboard systems and one to the philosopher's stone of telephony, the telephonic relay. This relay is the invention of Mr. George A. Cardwell, of New York, and like most of its forerunners in the Patent Office records, is of the single-track variety. It consists (Fig. 1) of a D-shaped permanent magnet, with opposing polar extensions, each carrying two coils of equal resistance. Between the gap of these extensions is a tuning fork, the tines being in close proximity to the ends of extensions. Between the tines is a carbon microphone arrangement, the disks being secured, respectively, to the fork tines. The line current passes through one pair of the above-mentioned coils. The microphone is connected to a battery and the primary of an induction coil, the secondary of which is connected to the second pair of coils. In the microphone circuit is also another battery and induction coil, the secondary of which is in the relay or outgoing line, *S*.

The action of the relay is as follows: Pulsations of current from the main line in one pair of the magnet coils cause the vibration of the two arms of the fork in equal and opposite directions, thereby varying the pressure between the microphonic disks. The circuit from local battery passing through the disks is caused to pulsate in unison with the pulsations of the main line, thereby causing similar pulsations in the circuit which traverses the second pair of coils and producing a magnetic effect on the cores, which reinforces the magnetic effect of the pulsations of the main line. The local or outgoing

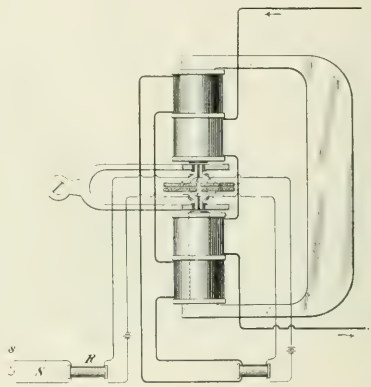


FIG. 1.—CARDWELL TELEPHONE RELAY.

circuit from the second battery passes through the microphone disks, and its current is caused to pulsate by the varying pressure between said disks and in unison with the pulsations in the main line. Through the induction coil *R* this current will cause similar pulsations in the outgoing line *S*, which line includes the receiver *s*.

One of the two patents on receivers is granted to Mr. William S. Paca, of Baltimore, and the invention is of delightful simplicity, as it consists of fitting a damper into a hole made in the center of the core of the electromagnet. The damper may be made of any suitable material—such as felt, leather, soft rubber, or an equivalent—and is provided with a flattened head against which the diaphragm will make contact lightly when the receiver is in use. In the words of the inventer, "the damper will extend beyond the face of the core of the magnet a sufficient distance to keep the diaphragm from contacting with the core proper of the magnet, but will not in any respect interfere with the proper attraction between the diaphragm and the core, the effect being merely to limit the vibration of the diaphragm, and thus prevent objectionably loud sounds being produced in the ear of the user caused by excessive currents in the electromagnet and overcome any buzzing or blurring in the receiver."

A receiver in which a considerable departure from the regular methods of assembling the standard elements of a receiver is patented by Mr. Francis J. Orr, of Holland, N. Y. In Mr. Orr's invention the cores of the electromagnet are mounted on a metal diaphragm, which is attached at its center to a block inserted between the prongs of the permanent magnet and at its periphery to the re-

ceiver case. The electromagnet cores pass through this diaphragm so as to impinge on the poles of the permanent magnet. The inner ends of the windings of the magnet coils are connected by means of a miniature microphone, formed of a small rod of metal or carbon with its ends resting loosely in sockets of the adjusting screws to which the wires of the coils are attached. Opposite the working ends of the electromagnet cores is the regulation diaphragm and clamped forward of this, spaced between the diaphragm and the earpiece is a second diaphragm, which has a circular opening in the center of substantially the same size as the opening in the earpiece.

Mr. Orr claims that with his receiver the sound produced will be very much increased and clearer as compared with receivers in ordinary use, and that "the usual buzzing and roaring" are obviated. The microphonic joint between the windings of the magnet coils causes the sound produced to be materially increased by the slight vibration of the microphone. Further, in the inventor's own words, "the inner plate, vibrating at every impulse or wave of the human voice, controls or causes a unison of the vibration of the two diaphragms with the plate, and this plate is somewhat heavier or thicker than the diaphragms. The result is that one is able to hear clearly when the vibrations in the ordinary type of receiver are utterly unintelligible." While there is certainly a distinct element of difference between this and the ordinary run of receiver inventions, it is difficult to see why the receiver should be more sensitive than the ordinary receiver to voice vibrations, and at the same time less sensitive to "the usual buzzing and roaring." The fundamental difficulty is that no receiver can reproduce what the line does not deliver to it, and troubles in hearing, or buzzing and roaring, are really in the line.

To Mr. Harry G. Webster, of Chicago, is granted a patent on a novel switchboard system, the patent being assigned to the Stromberg-Carlson Telephone Manufacturing Company. Mr. Webster's invention is designed to effect the automatic cut-out of the line signal,

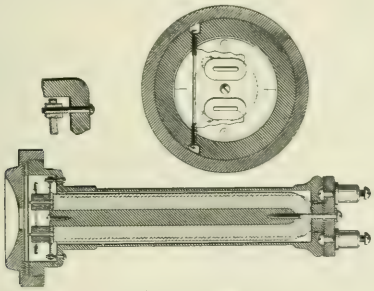


FIG. 2.—ORR'S TELEPHONE RECEIVER.

when the answering plug is inserted in the jack, without the use of the customary cut-off relay and its associated switching mechanism. The inventor, however, does not wish to be limited to a common battery system. The invention is shown in connection with a common battery, and the disclaimer is rather excess of caution, since cut-off relays are not used with the magneto system. The essence of Mr. Webster's invention consists in the use of a differentially wound relay whose armature controls a switch that throws the line from the line-signal to the answering jack. Under normal conditions current from the common battery flows through both coils of the relay, and the coils opposing each other the relay is inert. The insertion of the plug in the answering jack makes a circuit that shunts one coil of the relay which then becomes energized and attracts the armature, thereby switching the line from the line signal to the answering jack.

The application of the differentially-wound relay is an ingenious idea and certainly obviates the employment of the cut-off relay and switch. Whether this system gives a well-balanced talking circuit is not quite so clear, while a separable and normally open contact between the answering jack and the line is a feature of the system that might be objectionable in practice.

Mr. Charles H. North, assignor to the North Electric Company, of Cleveland, patents a switchboard system having for its object to cheapen and simplify telephone exchange systems and to render them more efficient in service. He obviates the necessity of using condensers or repeating coils in the subscribers' lines, placing a repeating coil simply in each operator's cord circuit, which are about one-tenth as numerous as subscribers' lines.

Referring to the diagram, Fig. 3 shows a complete installation with calling and supervisory signals, the operator's circuit being shown in detail. The line and supervisory signals are shown as gravity drops and are understood to illustrate any approved form of electrically-operated signal. In the diagram station A^1 has called station A^2, and the operator is ringing A^2. When the calling station removes the receiver, circuit is made through the battery H and line signal F^1, and the signal is displayed. The answering plug being inserted, circuit through F^1 is broken, the jacks being of the "five-point" variety, and F^1 is restored. Test current is put on to the bushing of the jack by the sleeve of the plug connected to test battery T by line K 9. With the plug inserted circuit is made through the metallic circuit line, the station and the half l of the repeating coil L. The other half of the repeating coil l^1 is connected to the combined ringing and listening key N, which normally connects l^1 with the tip and ring of plug J^1 connecting the called subscriber. The key N rings station A^2 by throwing in generator Q, the circuit being easily traced between grounds G^3 and G of station A^2. Until A^2 takes his receiver off the hook the supervisory signal F^3 is energized, line B^1 being grounded through the bell a, and making circuit through F^3 and the battery H to ground at G^1, by means of the connection at the neutral point of the winding l^1 of the repeating coil leading to F^3 by means of line m^1 and springs P^3 P^4 of key N.

When the receiver is off the hook connection with ground G is broken and the supervisory signal is de-energized. Supervisory signal F^2 acts in the same way for station A^1, being inert when the receiver is off the hook and active when it is on, circuit then being made

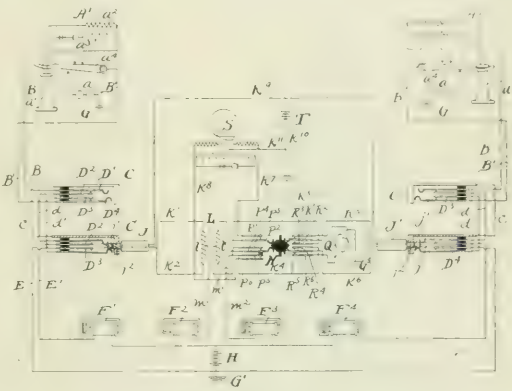


FIG. 3.—NORTH SWITCHBOARD SYSTEM.

from the ground G on bell a through line B^1 and one-half the coil l through F^2 and H to the ground G^1. It is to be noted that although battery H is referred to in the specifications as the "main" battery and station A^2 is shown without local battery, the system is not a common battery system; in fact, as described, battery H is cut off from the line as soon as a plug is inserted in a jack, and thereafter serves only to work the supervisory signals over one leg of the metallic circuit put to ground. The battery H, is in fact, a signaling battery, and does not obviate the necessity of a battery at the subscriber's station. The omission in the case of station A^2 is probably merely a draughtsman's error.

Long-Distance Transmission Into Chicago.

Contracts have recently been closed for apparatus to supply the centrifugal pumps at Bridgeport in Chicago (which pump water from the Chicago River into the Illinois-Michigan Canal), with electric power generated in the power house of the Economy Electric Light & Power Company, of Joliet, 35 miles distant. These pumps have always heretofore been operated by marine engines of high economy, and it is a significant fact that the Economy Electric Light & Power Company could afford to make a figure for supplying power for these pumps lower than steam power. The power house at Joliet is operated by water power. The Economy Electric Light & Power Company will build the transmission line on the banks of the canal from Joliet to Chicago. The Illinois and Michigan Canal Commissioners have contracted for two 300-hp, three-phase motors,

which will be belted to the centrifugal pumps. These motors will be wound for a pressure of 2080 volts. The transmission voltage will be either 30,000 or 40,000 volts, the transformers being arranged for either voltage.

Carbon Bisulphide in the Electric Furnace.

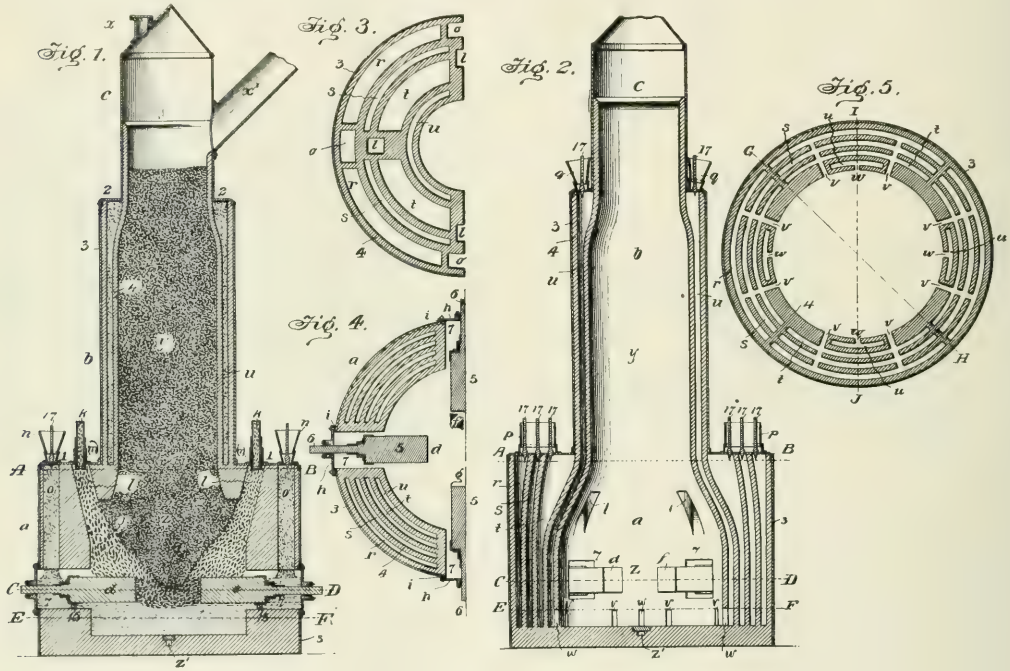
An electric furnace recently patented to Edward R. Taylor, of Penn Yan, N. Y., is of especial interest, not only as showing the details of a structure which has stood the test of prolonged commercial use, but as illustrating a fact, which is becoming yearly more and more apparent—that the field of the electric furnace is by no means to be restricted to the performance of reactions which require excessive temperatures, but that under well chosen conditions many chemical decompositions which lie within the temperature range of combustion funaces may be more effectively and economically brought to pass by heat electrically developed within the reacting mass. The furnace presents a decided novelty, and has been in operation near Penn Yan for two years, producing carbon bisulphide by direct reaction between vapors of sulphur and carbon. It is understood that the output has reached 100,000 lbs. per month, and that after two years of continuous operation the furnace remains in efficient working order.

Figs. 1 and 2 of the accompanying drawings show the structure in vertical section, upon planes 45 degs. apart, and indicated by the lines *GH* and *IJ* of Fig. 5. Figs. 3, 4 and 5 are horizontal sections on planes *AB*, *CD* and *EF*, respectively, of Fig. 1. The furnace is of the stack type, comprising a base, *a*, body, *b*, and dome, *c*. The carbon electrodes, *d*, *e*, *f*, *g*, supported by blocks 15, are arranged horizontally in pairs in the base of the structure, and above them are suitable ports for the introduction of the charge materials—in this case sulphur fed through hoppers *n* to passages *o*, and charcoal *z*, held in bulk in the main shaft *y*. The walls *b*, 4, are double in the intermediate or body portion, and into the interstitial space, *u*, sulphur is also fed by a hopper *q* to absorb and re-convey into the furnace heat which would otherwise be lost by radiation. The lower section *a* is provided with a series of concentric walls, shown as five in number, thus forming four concentric passages, *r*, *s*, *t*, *u*, the innermost of which is continuous with the annular passage, *u*, of the body portion of the stack. All of these passages open at the bottom by ducts, *v*, *w*, into the hearth of the furnace, and through all of them sulphur is fed by hoppers *p*. A sheet iron dome, *c*, continuous with the metal sheathing 3 of the furnace body, surmounts the structure, and is provided with a charging opening *x* and a pipe x^1 leading to a condenser for the bisulphide.

Upon the lower shoulder 1 of the furnace, and adjacent to the hoppers *n* for the introduction of sulphur, are four metal tubes, *k*, attached to but insulated from the sheathing 3. These conduits are situated respectively above the electrodes, and open into downwardly extending passages *l* within the masonry of the furnace base: through them conductive carbon *j* is fed upon and past the electrodes, and serves to protect them from excessive wear and also to close the circuit between them. It is in this bed of fragmentary carbon that the heat necessary for the reaction is developed.

The electrodes comprise a working end 5 and a metallic conductor 6: the electrode ports 7 are closed by removable plates, *h*, *i*, which also permit access to the interior of the furnace. At z^1 an outlet is shown through which the sulphur may be tapped. All hoppers are fitted with regulating plugs 17.

Complicated as the structure may appear, the operation is extremely simple. Sulphur is introduced into the base of the furnace to partially cover the electrode faces, and the several concentric passages between the walls are filled with the same material. Fragmentary coke or other conductive carbon is fed through the pipes *k* to cover and connect the electrodes, and the shaft is filled with the charge of charcoal. The circuit is now closed through the fragments *j*, whereupon the sulphur is vaporized and so reacts upon the charcoal, the resulting bisulphide escaping to the condensers. It will be seen that a double means of regulation is afforded, the current being governed either by the amount of conductive carbon introduced or by reducing the working surface of the electrodes by partially submerging them in the molten sulphur, and also that the waste heat of the furnace walls and of the electrode connections is utilized for liquifying the sulphur. In structure and function alike the furnace is distinctly novel, and its satisfactory operation during a long period bears witness to the care with which the details of construction have been worked out.



FIGS. 1, 2, 3, 4 AND 5.—SECTIONS AND PLANS OF ELECTRIC FURNACE.

A Third-Rail Road Across New Jersey.

The promoters of the Trenton & New Brunswick Traction Company, which was incorporated last week at Trenton, have announced that an electric third-rail system will be constructed between these two cities at once. The line will be built entirely over private land, the right of way having been bought for the entire distance. After the line is built to New Brunswick it will be continued straight across the State to near Carteret, and thence across the Kill Von Kull to Staten Island, ending at Stapleton. There a ferry will continue the journey to New York.

In addition to the passenger service, it is proposed to operate a full freight service, first by steam and later by electric locomotives. It is difficult to ascertain the exact backing of the enterprise. If the New Jersey Central Railroad Company is behind it, it could get a line across the State to Trenton by buying up the Raritan River Railroad, which it is now said to control.

It is reported also that the scheme is backed by a syndicate interested in the Newark and Philadelphia trolley lines. The fact that the route goes through few or no important villages or towns lends support to the belief that a new fast route between New York and Philadelphia is projected. It is impossible to get the greatest speed on the present lines because of the large towns which are intersected.

It is the intention of the promoters of the new line to use standard passenger coaches of 60 or 66 ft. in length, and weighing upward of 100,000 lbs. complete. The cars will have four motors and will be run at a speed of 75 to 80 miles per hour. It is expected that from New Brunswick the line will be run straight through to near Carteret, and there cross the Kill Von Kull to Staten Island, ending at Stapleton. A ferry will continue the journey to New York City.

CURRENT NEWS AND NOTES.

ELECTRIC LIGHTING IN CANADA.—The Dominion statistican, in his annual report on the use of electricity in Canada, finds that the number of companies doing business in electric lighting is 306, against 259 in 1898. The arc lights, supplied from central stations, increased in this time from 10,389 to 12,800, and the use of incandescent lamps from 463,615 to 815,676. Assuming that an arc light is equal to 10 incandescent lamps, this means that the business has grown to the extent of over 66 per cent in the three years.

ALLEGED THEFT OF CURRENT.—The chief engineer of one of the uptown restaurants in New York was arrested last week and taken to the Tenderloin Police Station on the charge of having stolen some electric current. The complainant in the case was an inspector of the Edison Electric Company, who claimed to have found that one of the wires of that concern was tapped and in use for the purpose of furnishing power to the place. The man was bailed out by the manager of the restaurant, who said that the arrest was one of spite, as the wires of the Edison Company were formerly used to furnish the electricity, but of late had been disconnected, as the place had its own plant for electric light and power.

CALIFORNIA TRANSMISSION PLANT.—The Keswick Electric Power Company's new electric power transmission plant was recently put into operation, and is now successfully transmitting current to Redding, Calif., the distance being 29 miles. The water-power generating plant is located on Mill Seat Creek in the Shingletown district. The company will also supply electric power for the Mountain Copper Company's smelting plant at Keswick, distance 34 miles from the plant, and for the Iron Mountain mine, 14 miles beyond Keswick. The company is preparing to light the town of Keswick, and an extension of 27 miles to Red Bluff is projected. It is also proposed to extend the system to Corning.

ALTERNATING-CURRENT MOTOR.—A patent was issued Dec. 10 to Ernest Wilson, of the County of Kent, England, on an application field Jan. 17, 1893, on an alternating-current motor. The motor is for polyphase currents, and as illustrated is connected to a two-phase circuit. The stator winding is of the usual type, being a distributed winding, two diametrically opposite points of which are connected to one leg of the two-phase circuit and two other points 90 degs. distant connected to the other leg. The rotor has a commutator with four brushes. Two diametrically opposite brushes are connected across one leg and the other two brushes 90 degs. distant, connected across the other leg. If the brush carrier is so moved that points of the brush contacts are in axial planes passing through the points of stator connection with the circuit, there is no motion; if the brushes are moved to the right, there is motion in one direction, and if moved to the left, there is motion in the other direction. A maximum speed is obtained when the brushes are moved through an angle of 45 degs. with respect to the neutral point.

KENNEDY WATTMETER.—A patent granted Dec. 10 to Rankin Kennedy, Leeds, England, describes a wattmeter, the principle of which is that of a balanced dynamometer. The shunt coil is movable, surrounds the series coil and is mounted on one end of a balance beam; at the other end of the beam is an arrangement for producing a fluid resistance. This latter arrangement consists of an air holder hung at one end of the balance beam with its mouth dipping into a fluid so as to be sealed thereby; a very fine tube communicates with the interior of the air holder at one end, and is open to the air outside the container at the other end. In action whenever the dynamometer affects the beam the air holder is either sunk lower into the fluid or lifted upward in it at a rate proportional to the flow of air through the fine tube. The fluid resistance acts in opposition to the dynamometer side with a force proportional to that of the dynamometer; hence the number of oscillations of the balance beam in a given time is directly proportionate to the amount of electrical energy passed during that time. The current in the shunt coil is, of course, reversed at the extremity of each oscillation of the beam.

THE ZOSSEN EXPERIMENTS.—Consul-General Mason, of Berlin, reports during the first few days of the Zossen experiments the speed attained was 55.9 miles per hour. This was gradually increased until the record of Nov. 9 showed a pace of 150 kilometers (93.2 miles) per hour. Mr. Mason states that above that velocity the increasing danger of derailment and the tremendous strain upon track and rolling stock would, it is believed, outweigh the advantages of higher speed with the machinery now available. It is, therefore, understood that the experiments are suspended, at least until some radical changes, suggested by this experience, may be made in the construction of motors and other details of the apparatus. He adds that the official report, when it shall appear, will be replete with new and interesting data for electrical scientists. The motors, although in at least one instance "burnt out" by the powerful current, have apparently done all that was expected of them, and the expected difficulty of "getting the current into the car" from a triple overhead wire seems to have been successfully overcome. The other anticipated obstacle—air resistance—proved less serious than was expected. The maximum pressure registered by the instruments placed in front of the cars was 134 kilograms per square meter—approximately, 16.7 lbs. per sq. ft.

A HIGH COMPLIMENT.—The editor of the Latin journal, *Praeco Latinus,* published in Philadelphia, some years ago obtained the collaboration of a number of eminent scholars throughout the world toward the translation of Thomas a'Kempis from the schoolman's Latin, in which it was written, into the language of the Roman age of Augustus. This work was recently completed, and among the several editions of the book is an elegantly printed edition de luxe of 100 copies for presentation, which includes printed lists of those thus complimented, and an engraved frontispiece for the inscription of the name and qualities of the recipient. The list includes the great Latin authorities of the world, the Pope, the heads of the Anglican Church, the upper hierarchy of the Catholic and Episcopal Church of this country, and some of the European crowned heads who have shown an interest in Latin learning. Among the few names not in the above categories is that of an electrical engineer, Mr. C. O. Mailloux, who has been added to the list in recognition of his constant contributions to the columns of the *Praeco Latinus* since its foundation in 1894. The notice thus conveyed of Mr. Mailloux's accomplishments in Latin will be a surprise to some of his friends, many of whom are also unaware that he speaks fluently all of the principal European languages. The pages of this journal have indeed been graced by several technical translations made by him from electrical journals published in all the civilized tongues.

FRANKLIN INSTITUTE MEETING.—Mr. Paul M. Lincoln, electrical engineer of the Niagara Falls Power Company, will read a paper before the Franklin Institute, Philadelphia, Dec. 19, on "The Parallel Operation of Alternating-Current Generators."

NEW ATLANTIC CABLE.—The cable steamer "Faraday" has just finished laying a cable between the Azores Islands and Ireland for the Commercial Cable Company. This completes the fourth cable of that company between the United States and England.

TELEGRAPHY IN KOREA.—A dispatch received at Yokohama from Seul, Korea, says that the Russian Minister there declares that he is determined to insist on the construction of a Russian telegraph line from Possiet Bay to Seul, contending that the Emperor of Korea has no right to withdraw his consent, which was previously given.

U. S. PATENT CLASSIFICATION.—We note that the United States Patent Office has lately made the following changes in classification: In Division 16, sub-classes are established as follows: In Class 176, electric lighting, lights, incandescent; 317, second-class conductors; 318, vapor conductors. These refer apparently to lamps of the Nernst and Cooper-Hewitt types. Class 178, telegraphy; 319, wireless telegraphs. We note also sub-classes under warp stop motions as follows: 91, electrical; 92, mechanical.

BILL TO BUY TELEGRAPH LINES.—Representative Jackson (Dem., Kan.) has introduced a bill in the House providing that the United States Government purchase the Western Union and the Postal Telegraph companies, and thereafter operate them in connection with the Post Office Department. Provision is made for appraisal of the property of the companies and for the payment of its appraised value when the amount is reported to Congress.

TELEPHONY IN OHIO.—It is stated that telephony will figure in the legislative fights and manœuvres in Ohio this winter. Independent telephones are now operating over some of the private rights of ways of various interurban roads, coming towards Cincinnati along the Miami & Erie Canal, which is now controlled by the Everett-Moore syndicate. Consolidation of all companies is talked of, but the most popular idea is to compel, through the legislature, an exchange of message system, similar to that now in vogue by the different telegraph companies.

LONDON & NORTHWESTERN.—A cable dispatch from London of Dec. 14 says: The question of electrifying the entire system is now engaging the attention of the officials of the London & Northwestern Railway, the greatest railroad in the United Kingdom. The matter seems to have reached such an advanced stage as to justify its mention in the financial columns. The *Globe* says that the directors and the experts who were summoned for consultation are reported to have formed the opinion that, if electrified, the road could considerably accelerate and cheapen its service.

DAMAGE BY FLOODS.—Heavy rains on Saturday night last caused floods which wrought heavy damage to railroad, telephone, telegraph, electric light and electric railway property in various places in Central New York and Eastern Pennsylvania. In Ithaca, N. Y., the street railway car barns were carried away and the electric light and gas plants were flooded, thus depriving the city of light. Port Jervis was in total darkness in consequence of the flooding of the electric light station, and in many other places like conditions existed. The floods were of great severity, and the trunk line railways running through the sections visited by the heavy rains were badly washed out and otherwise damaged in many places.

FRISCO BAY LIGHTS.—The recent ferryboat disaster in San Francisco bay, when lives were lost during a collision, has led to a search for some device that will aid navigation on the bay during thick fogs. President Kilburn, of the Harbor Commission, has instructed Electrician Whorf, of the Board of Experiment, to experiment with different colored lights and effects on the tower of the ferry building. The electrician named finds that green electric lights have greater penetrating power in the dense white fogs peculiar to the bay than either red or white lights. Powerful searchlights with different colored disks will be used at night during foggy weather, and reports on the efficiency of the lights will be received from masters of the ferryboats.

AUTOMOBILISM IN FRANCE.—A dispatch from Paris states that the government refuses to authorize automobile races during the Grande Semaine at Nice, in April. The mayor of Nice was officially advised to that effect. All mayors of communes and prefects of departments on the route of the big races had given their consent, so the government's decision creates surprise. The fourth annual automobile exposition under the auspices of the Automobile Club de France has been opened in the Grand Palais. President Loubet assisted personally at the inauguration. A typical feature of 1902 is the Limousine style of automobile, the body being all enclosed. The occupant is thus sheltered from dust, and the idea of comfort is being enlarged upon.

ELECTRICAL SMOKE DETECTOR.—A patent issued Dec. 10 to O. Freymann and Charles Tolman describes an electrical smoke detector alarm, which depends for its principle upon the peculiar action of smoke on a fiber which has been subjected to a certain treatment. The fiber, which may be of silk or a horse hair, is boiled in a closed vessel for about 20 minutes in a 6 to 10 per cent solution of commercial soda then dried while very moderately stretched in a tube from which the air is exhausted. The inventors state that they are unable to precisely explain what transformation is produced in the fiber by treating it as above described, but it is found that when smoke comes in contact with fiber so treated an elongation invariably results. This elongation is made to close an electrical alarm circuit.

POSTAL SERVICE.—In his annual report Postmaster-General Smith recommends the restoration of the pneumatic tube system in New York, Philadelphia, Boston and other cities. Of automobile mail carrying the report says: "The first contract for the carriage of mails by automobiles was entered into during the last fiscal year for service between the Post Office at Buffalo and the station in the Pan-American Exposition grounds, a distance of 4¼ miles. This distance was covered in 35 minutes, and there were seven trips daily. The service rendered proved satisfactory, and a contract will go into effect on Jan. 1, 1902, for similar service in Minneapolis, which will afford a still better test of the adaptability of the automobile for service in large cities." The Buffalo service was done with electric vehicles.

M'KINLEY MEMORIAL.—Colonel Allan C. Bakewell, of the Sprague Electric Company, representative of the electrical industry for the McKinley Memorial Association, has received and gives out the following letter from Mr. Cornelius N. Bliss: A happy solution of the confusion resulting from two associations appealing for popular subscriptions at the same time for the McKinley Memorial was arrived at by a conference held in Washington, Dec. 7, between committees of the McKinley National Memorial Association and the Washington Memorial Arch Association. The latter decided to withdraw its application for popular subscriptions, leaving that field entirely to the National Association to make provision for the memorial at Canton, and it was mutually concluded to ask Congress to make such provision for a memorial at Washington as should be thought fit and proper by that body. This leaves the field of popular subscription entirely free for the Association with which you are connected, and we trust that prompt and active measures may be taken by all the committees of this association to conclude the work in this State at the earliest possible moment.

RÖNTGEN RAY APPARATUS.—A patent issued Dec. 10 to E. W. Caldwell, New York, describes a Röntgen ray apparatus especially adapted to give stereoscopic images in a fluoroscope. The Röntgen ray tube is a double focus tube, in which the foci are separated to give alternately radiation from two separate points. The fluoroscope is provided with a shutter, which, by means of the equivalent of a polyphase motor contained within the fluoroscope, is caused to rotate synchronously with the emission of Röntgen rays from the electrodes of the tube. Two slight holes in the fluoroscope are alternately closed and opened by the revolving shutter. The image of an object produced by the rays from one of the tube electrodes is seen through one of the holes, and the image produced by the rays from the other electrode is seen through the other hole. The simultaneous effect of the vision of the two images, therefore, gives a stereoscopic image at the place occupied by the object, and the rapid succession of the images produces a blending so that the effect produced is that of continuous vision by each eye of the image seen by that eye, thus approaching very closely normal binocular vision of an object in its proper shape and space relation.

ELECTRIC LIGHT IN SURGERY.—The *Medicinische Woche,* of Vienna, publishes an article by a celebrated Russian surgeon on the use of the violet electric light as an anæsthetic for surface operations, such as the sewing of wounds. He says that the rays have also a healing influence on wounds, burns, sores and skin diseases.

AUTOMOBILE SHOW IN PARIS.—President Loubet, accompanied by the Minister of Commerce, M. Millerand, opened the fourth annual Automobile Exposition at the Grand Palais on Dec. 10. The vast hall was packed with spectators. All the auotmobile firms were represented by tastefully decorated stands. An attractive feature of the show is Tatin's dirigible balloon, built for M. Deutsch, which hangs from the roof, like a huge yellow cigar, in the portion of the hall reserved for exhibits relating to steering balloons. No revolutionary innovation in automobiling is exhibited. The two noteworthy features were the increased lightness and simplicity of the frames and the more luxurious and artistic carriage work. Industrial automobiles are quite a feature.

BRITISH TELEGRAPHS CRIPPLED.—The storm which prevailed in Great Britain last week, has caused a telegraphic breakdown unequaled since 1881. The North was practically cut off from the South, and many of the provincial towns were so snowbound that the courts were closed owing to the litigants residing in the country being unable to reach them. Difficulty was experienced by New York people in communicating with points in the United Kingdom by cable. At the offices of the Anglo-American Telegraph Company it was said that the cables were working satisfactorily, but that the severe storms that had swept the British Isles had severely crippled the telegraph system on the other side. Similar statements were made by officials of the other cable companies. The Commercial Cable Company had open communication with London, but was cut off from other points of importance in the kingdom. Messages to some English points were forwarded by cable with instructions to send them on to their destination by the first mail trains.

LETTERS TO THE EDITORS.

Alternating Current Terminology.

To the Editors of Electrical World and Engineer:

Sirs.—I have been much interested by the editorial in your issue of Nov. 16 and the Digest reference, Nov. 30, page 902, on alternating-current terminology, and hope they will start a discussion and lead to the selection of a suitable term to designate the quadrature components "$I \sin \phi$" and "$EI \sin \phi$." The terms "wattless current" and "wattless e. m. f." are in general use. We have also seen "wattless resistance" and "wattless impedance"[1] used without criticism. And to be consistent, we now have "wattless power."[2]

When it became necessary to speak of the amount of this power, for a power it certainly is, one is forced to use the unit of power and write "wattless watts," however absurd it may seem. The term "wattless volt-amperes" has been used, but the volt-ampere is usually an imaginary quantity, and does not seem suitable here. Neither does the suggestion of the editor of *L'Industrie Electrique* seems to be a happy one. The effect of his "fictive power" is anything but a fiction. M. Boucherot suggests "magnetizing current" and "magnetizing power," which is certainly better, but again confusion is likely to arise when used with reference to condensers. Possibly "reactive current" and "reactive power" might be acceptable.

I should be glad to see the opinions of others upon this subject, and hope we may soon come to some definite understanding.

UNIVERSITY OF ILLINOIS. WM. HAND BROWNE, JR.

To the Editors of Electrical World and Engineer:

Sirs.—I am ordinarily an inveterate enemy of new terms in electrical engineering, feeling that the nomenclature of the art is already overburdened with names and units of no conceivable use save in economizing the time of a few *doctrinaires* to the extent of perhaps 50 words a month. It were better that they should write less and in plain English words. But just now comes to the front *L'Industrie Electrique* with two new and dreadful suggestions, which have in them, nevertheless, a nucleus of reason. The volt-amperes in quadrature in an alternating circuit certainly deserves a better name than wattless power, which is self-contradictory, or fictitious power, which is little better. It is a little difficult to understand, however, why a special name and particularly a name so laborious as "factor of impotence" should be needed to express so simple and commonplace a function as $\sin \phi$. It is perhaps somewhat unfortunate that the term lag factor should have been made to serve for $\cos \phi$ instead of $\sin \phi$, but such has been its fate and we must make the best of it.

The working engineer would certainly find a simple expression for the numerical difference between apparent and true watts of some practical utility. At present we have for this quantity only circumlocutions or purely mathematical statements. Likewise, there is no general term for the difference between the power factor and unity. It seems to me that before terms are devised for other things, that common quantities *versin* ϕ and $E\ I$ *versin* ϕ need attention. The former, as just written, is, in fact, amply competent for the occasional service required for it. I do not see why we should not write or speak as freely as of *sin* ϕ and *versin* ϕ as of $\cos \phi$. Those to whom these trigonometrical functions have not sufficient significance had better keep away from alternating-current phenomena. As for the numerical difference between volt-amperes and watts, why not speak of it as *dephasement* and reckon it in volt-amperes? This would be sufficiently brief and descriptive, and a term for the thing is in some measure needed. Logically, one might go a step further and call the difference between power factor and unity the *dephasement factor,* if anything more than *versin* ϕ should prove to be desirable. At all events, the whole matter of names for functions of ϕ is up for consideration, and should be overhauled carefully before anything so weird as "factor of impotence" gets permanently fastened upon our working vocabulary.

BROOKLINE, MASS. LOUIS BELL.

[1] *Transactions* A. I. E. E., Vol. 9, p. 258, *et seq.*
[2] *Transactions* A. I. E. E., Vol. 16, p. 291.

Long-Distance Transmission in Canada.

To the Editors of Electrical World and Engineer:

Sirs.—THE ELECTRICAL WORLD AND ENGINEER is a constant visitor at my office, and I don't know of any paper in my list that I as willingly give up my money for, but I do feel very touchy when you slight or forget your neighbors across the border as easily as you seem to have done in your issue of Nov. 30. On page 879 you speak of long-distance transmission in California and of the difficulties they have had to overcome, all of which I read with a great deal of interest. Your remark with reference to the reason why California is the center of these long-distance transmission plants in so far as the fuel question is concerned no doubt is true, but I do not agree with you about the climatic conditions existing there being better for the employment of high electric pressure than in western New York. However, that is another story, and one which I hope to deal with later on.

The sting in your editorial is in the last words of the second paragraph, where you state, "Niagara transmission halts at 20 miles." This would be the inference that the price of fuel and the climatic conditions are such that it is not commercially practicable to transmit current in the Niagara district profitably a longer distance than 20 miles. The Hamilton Electric Light & Cataract Power Company are transmitting power from De Cew Falls, which is Niagara water taken out of the Lake Erie level of the Welland Canal and used on the Niagara escarpment about eight miles from Niagara Falls, and two miles south of the city of St. Catharines, where a fall of 270 ft. is obtained. The power house is situated there, and has a capacity of 8000 hp, and the current is transmitted 37 miles at 22,500 volts to the city of Hamilton, where it is employed in operating two suburban street railway lines and one city railway, with an aggregate mileage of about 50 miles, as well as a number of large cotton mills and other power consuming industries, besides furnishing arc and incandescent lighting used in the city of Hamilton, which has a population of about 60,000 people. The longest distance at which the primary current is used from the power house is at Burlington Beach, approximately 42 miles.

That the transmission of power this distance at that pressure has been successful is best evidenced by the fact that it has been in successful operation since August, 1898, and that we have not used any steam since that date for any trouble due to the electrical generating machinery or the transmission line. The company has from its very inception paid a dividend and interest on a capitalization of $5,000,000, which speaks for itself, and I think proves conclusively

that it is not a *"sine qua non"* that the price of fuel or the climatic conditions as they exist in California are necessary for the long-distance transmission of power commercially.

TORONTO, CANADA. J. A. KAMMERER.

U. S. Signal Corps Telephones.

To the Editors of Electrical World and Engineer:

Sirs.—In answer to the letter of Mr. W. M. Lannan, published in No. 23 of ELECTRICAL WORLD AND ENGINEER, I would state that Mr. Lannan is evidently very poorly informed as to the types of telephones in use by the United States Signal Corps.

The Signal Corps uses many types of telephones, each one being specially adapted for the various purposes for which it is to be used. Type "E" kit, the telephone that is usually used in the field, instead of being like the one used by the National Guards and State Militia, is a combination telegraph and telephone set, enclosed in a leather case, about the size of a 3 by 4 camera, with a sling strap, and weighs not more than 5 lbs. I trust this will give Mr. Lannan some information regarding the portable telephone in use by the Signal Corps.

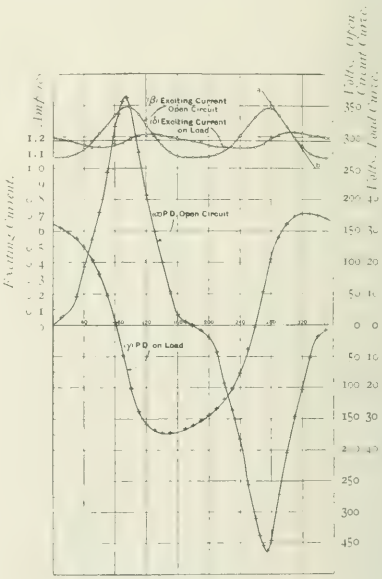
FORT MYER, VA. THOMAS J. STEWART.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Properties of Commutators.—HEYLAND.—A reply to the criticism of Leblanc, noticed recently in the Digest. He agrees that Leblanc's criticism would apply, if an ordinary commutator would be used. But he uses a closed ring, or a commutator, the segments of which are connected together by resistances. He shows that this modification is important, as Leblanc's criticism breaks down on account of it. In a foot note he gives a brief report on his first successful experiments with his new induction motor, as noticed in the Digest last week. In an editorial note a brief review is given of the question at issue. About a year ago Latour suggested this problem: Let three-phase currents be supplied to a direct-current dynamo armature by means of three brushes, properly arranged; if the ring and the brushes are fixed, a magnetic field is produced which revolves in a certain sense with a speed *s*, and to produce it the currents have to overcome the impedance of the circuits. If the ring revolves in the direction of the rotation of the field with the speed *s* and the brushes are fixed, or if the ring is fixed and the brushes revolve with the same speed in the opposite direction, the field will be fixed relatively to the ring and its circuits no longer cut any line of magnetic induction, and, therefore, do not oppose to the passage of the currents any other resistance than the ohmic resistance. The argument in this form seemed correct. In view of the practical importance of the question of the construction of self-exciting alternators, and induction motors with a power factor equal to unity (Digest, Aug. 31, Nov. 30; ELECTRICAL WORLD AND ENGINEER, Sept. 28, page 492), the problem was closely investigated by various authors. It was especially important to investigate whether the complex phenomena of commutation which are not taken into account in the above argument, would not modify the conclusion. In regard to this point, different persons who have investigated it, differ in their opinion. Leblanc concluded that it is impossible to eliminate the impedance of the circuits by means of rotation of the ring or the brushes (Digest, Nov. 23, where there is abstracted a similar paper by Bunet also; see also ELECTRICAL WORLD AND ENGINEER, Nov. 23, page 843). Latour, however, maintained his position and supported it by a theoretical investigation and by experiments made by him and Boucherot, which show that the impedance is a function of the speed of rotation (Digest, Dec. 14). Heyland admits the correctness of Leblanc's criticism for an ordinary commutator, but not for a commutator, the segments of which are connected together by resistance. Heyland's first successful experiments with his motor prove the correctness of his argument. While experiment thus seems to have decided in favor of Latour's and Heyland's arguments, the question is not quite clear theoretically.—*L'Eclairage Elec.*, Nov. 30.

Periodic Variations in the Exciting Current of an Induction Alternator.—DUDDELL and MARCHANT.—The first part of an illustrated article. When the rotation of the moving parts of a dynamo causes variations in the reluctance of the magnetic circuit which forms its field, an alternating e. m. f. will be induced in the field coils if the machine is excited. This alternating e. m. f. produces an alternating current in the field circuit and as a result the exciting current of the machine may be considered to consist of two parts, namely, the normal constant exciting current and an added alternating current induced in the field circuit by the machine itself. They first give the theory for the machine at open circuit. The alternating e. m. f. induced in the field coils has twice the frequency of the armature e. m. f. The added current sent through the field circuit by this alternating e. m. f. will, owing to the large time constant which the field coils usually have, and to the relatively high frequency, lag behind the e. m. f. and have its maximum value approximately when the e. m. f. is zero, and be zero when the e. m. f. is a maximum, and the amplitude will be determined by the self-induction rather than the resistance of the field circuit. If the magnetic circuit is approaching saturation, the self-induction of the field coil will vary with the direction of the added current, being smaller when the added current



WAVE FORMS OF INDUCTION ALTERNATOR.

increases the exciting current of the machine than when it decreases it; so that even if the e. m. f. wave induced in the field coil is symmetrical about its zero line (which is not necessarily the case if eddy currents and hysteresis are taken into account), the added current due to it will not be so, but will be larger in the direction in which the self-induction is less. Thus the added current should tend to increase the exciting current more than it decreases it, and two consecutive half periods of the added current will not be equal in length. If it is assumed as a first approximation that change of exciting current of the alternator only changes the magnitude and not the relative distribution of the lines of force through the magnetic circuit and inductors, the e. m. f. induced in the field coil will bear the same ratio to that induced in the armature for every excitation. There-

fore, the maximum amplitude of the field coil e. m. f. wave will bear a constant ratio to the maximum amplitude of the armature e. m. f. wave. They have investigated experimentally the wave form of p. d. and current in the armature and the variation of the exciting current of a 6-kw inductor alternator; the resistance of the armature is 0.4 ohm, the self-induction of the armature between 0.009 and 0.012 henry, depending on the position of the inductors; the resistance of the field coil varies with the excitation the frequency of the testing current and the position of the inductor, and is 1.08 henrys at 190 p. p. s. and no excitation. The armature reaction in this alternator is very large. The accompanying diagram gives the results of a test in which the frequency was 95, and the mean value of the exciting current 1.175 amperes. The machine was tested at open circuit and on non-induction load. The two upper curves give the exciting current for the two cases, the lower two curves the curve of the p. d. between armature terminals. It will be seen that the total variation in the exciting current at open circuit is considerable, being 27 per cent of the mean value; the frequency of the variation is double that of the armature e. m. f.; the wave form is not symmetrical about the mean line of the exciting current. The paper is to be concluded.—Lond. *Elec.*, Nov. 29.

Measuring the Slip of Induction Motors.—SCHWEITZER.—An article on a method of measuring the slip of an induction motor by means of the stroboscopic method with the aid of Braun's cathode ray tube. Zenneck has shown that this tube can be used for determining the variations of the frequency of an alternating current in a very simple way. The induction coil by which the tube is lighted, is provided with an interrupter so that a certain number of discharges per second are sent through the tube. The cathode ray tube is placed in a rotary magnetic field, produced by the alternating current to be tested. The axle of the cathode ray tube is perpendicular to the plane of the rotary field. If the frequency at which the interrupter is operated is equal to the frequency of the alternating current or to a multiple of it, the screen of the cathode ray tube shows one or several luminous points at rest. When the frequency changes, these luminous points rotate in a circle. They complete a full rotation for a change of the frequency by ± 1. This method can, with some modifications, be applied to the measurement of the slip of an induction motor. For this purpose, the rotary field is produced by the alternating current which feeds the motor, and the interruptions of the inductive coil are made by a revolving interrupter directly driven from the motor. The test consists in the measurement of the number N of revolutions which the motor makes during a certain number Z of total revolutions of the luminous point. The slip is then given by the formula

$$s = \frac{Z}{pN + Z}$$

where p is the number of pairs of poles of the motor. As one can observe up to 6 revolutions of the luminous point per second, it is possible to measure at a frequency of 50 slips up to 12 per cent.—*Elek. Zeit.*, Nov. 14.

Design of Direct-Current Dynamos.—RANKIN KENNEDY.—A brief article in which he says that it is easy to avoid sparking at the commutator. The problem is not so much a scientific question as one of costs. A sparking commutator means a weak magnetic flux and an armature with too many turns of winding, the winding being piled on to make up for want of magnetic flux. He gives the rule that for a bipolar machine the ratio of the total magnetic flux through the armture to the number of turns or bars in the armature winding, should not be below 3. As unit for the induction he takes Kapp lines where 15 Kapp lines per square inch are approximately equal to 14,000 c. g. s. lines per sq. cm. Any value of this ratio below 3 is dangerous in a bipolar machine, hence a good bipolar machine must have a very heavy magnetic circuit and few turns or bars on the armature, and these bars must be multiplied or very heavy, thus introducing air space difficulties. It is, therefore, better to adopt multipolar construction. His rule is then that the ratio of the total flux between any one pair of poles and the number of armature turns or bars between the centers of the two poles, should not be less than 3. At the end of his article he speaks of "the unipolar dynamo in which there is collections, but no commutation. A unipolar dynamo has hitherto been considered as only fit for low pressure and large currents, it being considered impossible to put conductors on the armature coupled in series with each other. But this can be done and a unipolar dynamo made for 500 or 600 volts at, say, reasonable speed. In a unipolar machine the magnetic flux can be easily increased to a very large value. There is no reversal of magnetism, nor of current. No necessity for laminations, and, of course, no commutation. A simple device recently discovered renders this long-sought machine possible. When fully developed and protected, it will be illustrated and described." (We regret that Mr. Kennedy should greatly lessen the value of his article by the use of that still-born absurdity—the Kapp line).—Lond. *Elec. Rev.*, Nov. 29.

Determining Hysteresis and Eddy Current Losses in Dynamos.—STRYMEERSCH.—The methods of Housman and Swinburne for determining the hysteresis and eddy current losses in dynamos and motors, are described, and the necessary precautions are pointed out. The dynamo is run as a motor at various speeds, the excitation being kept constant, the highest speed corresponding to the e. m. f. developed in the dynamo at the load at which the losses are to be measured. Experiment shows that the power lost by eddy currents is proportional to the square of the speed, while hysteresis and frictional losses are directly proportional to the speed. If a curve is plotted with the applied e. m. f. and the current as ordinates, it is a straight line, and this graphical method enables one to find easily the loss due to hysteresis and the loss due to eddy currents. An account of an experiment with a shunt motor is given which illustrates the accuracy of the method.—*Ass. Ing. El. Liege*, July 6; abstracted in *Science Abstracts*, Nov.

REFERENCE.

Extensions of Swinburne's Method of Testing Dynamos and Motors.—BRUNHES.—Swinburne's method of testing dynamos and motors is to run them at no load under the same magnetic conditions as at full load, and hence to find the losses due to friction, hysteresis and eddy currents. The chief cause of error arises from the difference between the mechanical friction in the two cases. In the case of rotary converters and dynamotors the error due to this difference is negligible. Rotary converters can be usefully employed for measuring the power given to transformers, synchronous or asynchronous motors, etc., or for testing alternators.—*Ass. Ing. El. Liege*, July 6; abstracted with some of the formulas in *Science Abstracts*, Nov.

POWER

REFERENCES.

Traveling Crane.—A well illustrated description of a traveling crane made by a British company. It is designed to lift 10 tons, with a span of 40 ft. The hoisting motion was specified to be at the rate of 14 ft. per minute with full load. This motion is driven by a 24-hp motor, running at 1000 revolutions. The cross-traversing motion was specified to be at the rate of 60 ft. per minute, and is driven through spur gearing from 3-hp motor running at 420 revolutions.—Lond. *Elec. Rev.*, Nov. 29.

Electrical Equipment of Cranes.—RUNG.—The conclusion of his long illustrated article. He discusses the brakes. The electric brake alone is not sufficient, and a mechanical friction brake must, as a rule, be added. The ordinary block or band brake are not suitable for this purpose. He finally discusses the general arrangement of supply mains, motors and controlling gears. The article is illustrated throughout with diagrams, showing arrangements and designs used in actual practice, and especially those made by Brown, Boveri & Co.—Lond. *Elec. Rev.*, Nov. 29.

Transverse Stresses in Steam Pipes.—MANN.—The second article on this subject. In the present article the author discusses and gives formulæ for calculating the relative lengths of mains and branches. —*Am. Elec.*, Dec.

Brick Chimneys for Power Stations.—ENNIS.—An illustrated article on the design and construction of brick chimneys for power stations.—*Am. Elec.*, Dec.

Feed-Water Softeners.—An illustrated article describing two British feed-water softeners, and the principles of their operation.—*Am. Elec.*, Dec.

TRACTION.

Milan-Monza Interurban Tramways.—SEMENZA.—This road is about 17 km. in length, and is owned by the same interests as those which operate the city tramways of Milan. Quite a full description is given of the bond used, which is the same as that employed in Milan for the last five years with satisfactory results. Each end of the bond wire is turned up in the form of a small coil, which is brazed to the base of the rail. The poles are made of two U-shaped beams connected with lattice work. Power is obtained from the

hydraulic transmission plant which supplies power to the Milan Edison Company. Current on the transmission line is carried at 15,000 volts, 42 cycles. A storage battery is employed in parallel with the rotaries. The cars have removable upper decks so that they are run as double-deck cars in summer and single-deck cars in winter.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

A Plea for the Bow Trolley.—E. K. Scott.—While American tramway practice is closely followed all over the world, there is one feature of car equipment, in which the Continent has refused to follow America, and that is in the current-collecting trolley. In Germany the fishing rod trolley pole has almost entirely been replaced by the Siemens bow trolley. He discusses the advantages of the bow trolley over the fishing rod. First, and foremost, it is impossible for the bow trolley to jump the trolley wire. With a bow trolley there is nothing to get loose, there are none of the pins, bolts, etc., which go to make up a trolley head. As the rubbing contact of a bow is entirely on the underside of the wire, the overhead fittings may be very simple, and it is possible to pass over switches and go around corners at a good speed. In changing direction at terminals, the height of a trolley wire can be arranged so that the bow will adjust its rake automatically for the return journey. The turning round of the trolley pole to change the direction is a great nuisance. The experiments in Germany on high-speed traction have shown that the bow is by far the best method of collecting current. It will collect larger amounts of current and admit of much higher speeds than a wheel contact, and the spring of the bow itself appears to present important advantages over the more rigid wheel construction. Another point of interest is that it is quite easy to have two bows on one car, and so break the trolley wire connections at crossings or complicated places in much the same way as an electric railway train is worked. To put two trolley poles on one car would be risky and expensive. In some towns the authorities do not allow trolley wires along some of the main streets, and accumulators are used there. In such cases, it is common practice to have two bows, one to collect current for the motors and the other for the cells.—Lond. *Elec. Eng.*, Nov. 22.

Third-Rail System and Safety.—An editorial on an accident which recently occurred on the Central London R'y, in which a passenger fell from the platform on to the bare third rail. There is always a menace to public safety from a bare third-rail conductor in front of the platform at a passenger station. In passenger stations a timber or other protection should be built around the sides of the conductor, in such a way that it would not interfere with the collection of current by the locomotive, but would prevent any person from touching the conductor if he fell on the track. An even better plan would be to dispense altogether with live conductors on those parts of the track which are immediately in front of platforms. The momentum of an incoming train is always sufficient to carry it the length of the station, and if the locomotive were allowed to advance on to the next section of live conductor before stopping, the restarting would not be interfered with. There is the objection that a train could not be restarted in the event of the locomotive stopping short of the third rail. It could be obviated by having a perfectly isolated section of third rail in the station, and making this "live" either automatically or by a switch in the signal carbin, only at times when a train might actually be in the station.—Lond. *Elec.*, Nov. 29.

A New Type of Rail Bond.—A description of the bond used in Geneva, Switzerland. It consists of a U-shaped stranded conductor of fine copper wire, which goes under the fishplate. The bond has solid copper terminals, which are inserted in holes drilled in the rail. In each terminal is a plug of solder. An oxyhydrogen flame is then applied to the rail, and the solder melts out and fills the hole. —*St. R'y Jour.*, Dec., 7, and Int. Ed., Dec.

Rail Bonds on the B. & O. R. R.—Young.—He refers to an article on the same subject, recently noticed in the Digest, and says that the squeezing out of the rail bonds was due to the fact that not sufficient space was left between the angle bar and the web of the rail. As the top of the angle bar wore it was pressed against the bond, squeezing the latter out by mechanical action. He believes that if the angle bar were of a different design with some space between its inside surface and the rail the bond would be perfectly satisfactory.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Brake Tests in Electric Interurban Service.—A description of some tests made on the Union Traction Company's lines of Indiana, with cars equipped with air brakes and weighing about 32 tons. The front truck of each car was equipped with two 150-hp motors, and the rear truck had no motor. When running at a speed of 58 miles per hour stops were made in from 503 ft. to 522 ft. Some particulars are given of the brake equipment.—*St. R'y Jour.*, Dec., 7, and Int. Ed., Dec.

REFERENCE.

Care of Street Railway Controllers.—Berry.—A short article on street railway controllers, directing attention to the necessity of proper inspection and care of the various parts.—*Am. Elec.*, Dec.

Installations, Systems and Appliances

A Model Small Central Station.—Obert.—An illustrated description of the municipal lighting plant at Wappinger's Falls, N. Y. Mixed service is supplied from a single type of alternating-current generator. The equipment consists of a direct-driven two-phase Westinghouse alternator, delivering current to a four-wire two-phase distribution system at 2200 volts and 60 cycles. The arc lighting circuits are supplied from step-up transformers, the current being kept constant by means of floating coil reactive regulators. The commercial service is supplied on meter by transformers at 104 volts. Special precautions are taken to protect the lines from lightning. Banks of arresters are distributed along the lines, and two separate banks of arresters are provided at the station. One at the ends of the pole lines outside the station, and one just inside the station. An induction coil is inserted between the two arresters, and another coil between the first arrester and the switchboard. No motor load is thus far carried.—*Am. Elec.*, Dec.

REFERENCES.

Steam Engineering in Central Stations.—Dawson.—The first of a series of well illustrated articles on "English, American and Continental Steam Engineering." This article deals with the equipment of British lighting and traction plants.—*Eng. Mag.*, Dec.

Electricity Supply Monopoly for London.—An editorial on the scheme of the London County Council to buy out, either compulsory or by agreement, all existing or potential company undertakings for the supply of electricity in the city of London. The scheme aims at complete municipal control of the electricity supply business within the metropolitan area.—Lond. *Elec.*, Nov. 29.

Wires, Wiring and Conduits.

New Automatic Wire Cleaner Used in Brooklyn.—This machine is used to make as good as new the wire in a burned out field, or other part of a street railway equipment. The wire is first heated in an oven to char the insulation and afterward is drawn through a machine. Wooden blocks first remove the insulation and clean the wire. It then passes through revolving and wire brushes, which polish it, and is then drawn through the center of a hollow winding head, upon which are bobbins for the tape. The winding head is hollow and may be filled with liquid insulation, which is thrown against the surface of the tape by centrifugal force at hollow pins placed on the periphery.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

REFERENCE.

Interior Wiring.—An illustrated article with new and elaborate tables for ascertaining the sizes of direct-current feeders and mains. Explicit instructions for using the tables are given in the article. One of the tables gives the sizes of a feeder and a main, or a main and a branch, at a single operation.—*Am. Elec.*, Dec.

Electro-Physics and Magnetism.

Dielectric Constant of Paraffins.—Hormell.—An illustrated account of a series of experiments in which he reached the following results. For reversals as high as 800,000,000 per second the velocity of electrical disturbances along magnetic and non-magnetic wires of different diameters, is the same, thus showing that the magnetic properties of iron are not able to follow such rapid changes. The effective field around the Lecher wires, as far as it can be detected by means of an argon tube, does not extend more than 3 cm. from the wires, and the effect on the half wave within this region varies approximately inversely as the square of the distance from the wires. The dielectric constant of a given paraffin increases with the density of the paraffin. It increases rapidly from a temperature of 20 degs. above the melting point to a temperature of 30 degs. below the melting point. Among different paraffins the dielectric constant increases as the melting point of the paraffin increases. The dielectric constant increases as the wave length decreases. It is greater for short light waves than it is for short electric waves. Cauchy's formula as a

means of obtaining the index of refraction for indefinitely long waves does not meet the experimental facts.—*Am. Jour. of Sc.*, Dec.

REFERENCES.

Pressure of Light.—LEBEDEW.—The first part of an English translation in full of the German paper, an abstract of which was noticed in last week's Digest.—Lond. *Elec.*, Nov. 29.

Magnetizing Power of a Coil.—A didactic article with diagrams, explaining the magnetic field set up in the space about two wires carrying current, and leading up to a simple and concise explanation of reluctance, m. m. f. and the field intensity of a coil.—*Am. Elec.*, Dec.

ELECTRO-CHEMISTRY AND BATTERIES.

Losses of Energy in Lead Storage Cells.—B. HOPKINSON.—The first part of an article, illustrated by diagrams and tables. It has been remarked several times that the efficiency of a storage battery when used for taking up the variations of a rapidly changing load, as, for instance, a "floating" battery on an electric tramway, is very high, especially if compared with the efficiency of the same battery when used in electric lighting service, where the discharges last for long periods, though the rate of discharge may be comparatively low. He has made a series of experiments to ascertain definitely what the efficiency under different conditions might amount to. In order to give definiteness to the results, he put the cell through a cyclical process and repeated the process often enough to bring the cell to a perfectly steady state, as shown by the recurrence of the same value of the e. m. f. at the same period in successive cycles. He charged the cell for a certain time with a constant current, then discharged for the same time and with the same current, then charged again, and so on. The results are given in diagrams and tables. Some of the results are as follows: In one set of tests the loss of energy in one of the 10-minute cycles is from 35 to 40 per cent greater than in 10 of the 1-minute cycles, though the energy put in, in the course of charging, in the two cases is about the same. The latter case may be taken as typical of what goes on in a "floating" battery on a tramway. In such a case the cell is partially discharged, so that practically no gas is given off from the plates, the fluctuations of load have a period of about one minute, and the maximum current in and out is about equal to the one-hour discharge rate of the battery. In such a case an efficiency of about 90 per cent may be looked for, and the potential of the battery varies between 1.94 and 2.25 volts per cell. The conditions of another test approximated to the process in a battery used for lighting and worked normally in a state of partial discharge so that gas is only rarely given off from the plates. The efficiency is found to be 92 per cent, or but little greater than the one-minute cycle, before mentioned, though in the latter case the current is three times as great. The loss per ampere required is more than double that in the one-minute cycle; in other words, the lighting battery behaves, so far as loss of energy is concerned, as though it had a resistance more than double that of the traction battery. A certain part of the loss of energy is due to the internal resistance of the battery. For cycles having periods anywhere between 0.1 second and 10 seconds the dissipation is practically constant, and is that resulting from the resistance. He gives a numerical example to show that only a relatively very small part of the energy is dissipated in the fluid between the plates, while the remainder is due to the plates themselves. It seems probable that what he calls the electrolytic dissipation, i. e., the part of the dissipated energy which depends on the period and vanishes if the period is quick enough, is due to diffusion of the acid. During discharge sulphuric acid is absorbed at the surface of the plates, and it is restored again during charge. This gives rise to local concentration charges; and diffusion, with consequent dissipation of energy, is constantly going on. —Lond. *Elec.*, Nov. 29.

Aluminum Zinc Alloys.—J. W. RICHARDS.—Alloys containing between 1 and 10 parts of zinc to one part of aluminum are not useful. Alloys containing 2 parts of aluminum to 1 of zinc and 3 parts aluminum to 1 part of zinc have very valuable properties for the mechanical engineer, which are described.—*Eng. and Min. Jour.*, Nov. 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electric Polarization Balance.—MACCARONE.—A description of an instrument for showing the polarization of dielectrics and dielectric viscosity. It consists essentially of two equal, plane, horizontal, circular disks of brass with holes in the center. Between the disks is suspended a glass beam with a bifilar suspension. Two glass disks, such as microscope cover glasses, are attached to the ends of the glass beam, with their planes vertical. Two other glass disks are mounted in a fixed position within the orbit of the suspended disks. The oscillations of the beam are made perfectly aperiodic by means of a magnetic damping arrangement. The entire suspension weighs 0.6 gram. The whole apparatus is placed under a glass cover and is kept dry by means of sulphuric acid. On connecting the upper brass disk with the earth and charging the lower one from the battery of condensers, a uniform electric field is created between the two disks, and a gradually increasing repulsion is observed between the movable and the fixed glass disks. The repulsion only attains its maximum after a considerable time. On discharging the upper disk the beam returns to its normal position, but very slowly. The fact that it does not return fully to its normal position shows that no hysteresis proper exists. The apparatus may be used for determining the dielectric constant of any body, which can be obtained in four equal fragments.—*Phys. Zeit.*, Nov. 15; abstracted in Lond. *Elec.*, Nov. 29.

Maximum Demand Indicator.—An illustrated description of the Atkinson-Schattner maximum demand indicator which is suitable for both alternating and continuous-current circuits, and works on the principle of a balanced ammeter, an iron or laminated iron core being sucked into a coil proportionately to the current passing. A bent glass tube contains a certain number of steel balls. The instrument is set to zero by means of a brass ball adjustment. Any current going through the instrument deflects the moving portion and the balls slowly roll and fall down. The number of balls which rolled down is the record of the maximum demand. The action of the balls is said to be certain and slow. It records a current lasting on for over two minutes.—Lond. *Elec.*, Nov. 29.

REFERENCE.

Simple Method of Calibrating a Voltmeter.—BROWN.—An article with diagram showing how to calibrate a voltmeter by means of a standard instrument and an improvised water rheostat.—*Am. Elec.*, Dec.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy in Italy.—An article on the experiments made by officers of the Italian Navy since 1894. Recently they have succeeded in connecting Sardinia by wireless telegraphy with the mainland, the distance being 200 km. over the sea. "In a little while a fixed and regular communication between Rome and Sardinia, and the abolition of the submarine cable now in use, will be an accomplished fact." Besides the wireless telegraphy apparatus working on various Italian battleships, there are at present five stations established in the mountain region, and are in good order. Lond. *Elec. Rev.*, Nov. 29.

REFERENCES.

Wireless Telegraphy in the British Navy.—An illustrated description of the way in which the wireless telegraphy instruments are set up in the ships of the British Navy. All the battleships in the Mediterranean Squadron and most of the cruisers are supplied with these instruments.—Lond. *Elec. Rev.*, Nov. 15.

Cable Laying in the Philippines.—MOORE.—An illustrated article on the laying of cables by the United States Government, between the Philippine Islands. No technical information is given.—*Sc. Amer.*, Nov. 23.

Railroad Signals.—ELLIS.—A long illustrated article on the development of railroad signaling. He first discusses interlocking systems at junctions, crossings, etc., and later the block systems.—*The Polytechnic*, Nov. 22.

MISCELLANEOUS.

Inaugural Address.—LANGDON, PREECE, WORDINGHAM.—The first part of a reprint in full of Langdon's Brit. Inst. Elec. Eng. inaugural address, in which he gives a review of the service which electricity has rendered in the past in assisting the development of railway traffic, first in railway telegraphy, later in the development of tramways and electric railways. As regards the adoption of electric traction for main railways, he believes that the separate electric locomotive is likely to prove more suitable than the motor carriage, in view of the necessity of working both passenger and freight service on a unified system. In an editorial abstracts of two other inaugural addresses are also given one by Preece before the Society of Arts, on the great scientific discoveries of the nienteenth century, and one by Wordingham before the Manchester Section of the Brit. Inst. Elec. Eng. on foreign competition. He believes the British manufacturers bring out just as good machines as the foreigner. Regarding the recent

bills before the Brit. Parliament for power transmission schemes in bulk, he says they show a want of foresight, as they will require, for their carrying out, enormous quantities of plant of very large calibre, and as this demand is suddenly sprung upon the British manufacers who are not ready, the orders will go abroad.—Lond. *Elec.*, Nov. 22.

Medical Electro-Chemistry.—LEDUC.—A French Ass'n Adv. Sc. report on progress in medical electro-chemistry. He describes the various electrodes which are used in medical electro-chemistry and the different effects which they have according to theory. He then gives the results of experiments, and deals with the conductivity of the human body and shows that "the same allows one to determine the velocity of the ions in the organism." He points out the advantages which medicine can obtain from a reasonable application of electro-chemistry.—*L'Eclairage Elec.*, Nov. 2.

REFERENCES.

Glasgow Exhibition.—BATHURST.—The first part of an illustrated article on machine tools at the Glasgow Exhibition, with special reference to the requirements of dynamo and motor manufacturers. This part deals with boring and turning mills, and gear cutting.—Lond. *Elec. Rev.*, Nov. 22.

Telephony.—A description of the underground telephone network of Chaux-de-Fonds in Switzerland.—*Jour. Teleg.*, Oct. 25.

New Books.

THE INDICATOR HANDBOOK. A Practical Manual for Engineers. By Charles N. Pickworth. New York: D. Van Nostrand Company. 132 pages, 148 illustrations. Price, $1.50.

This is the second part of a work on the indicator, the first volume treating of the indicator, its construction and application. The present volume treats entirely of the indicator diagram, its analysis and calculation. The elementary principles involved are discussed in the first chapter, and in the second chapter a diagram is taken up, and through it is traced the action of the steam throughout its entire cycle of operation in the engine cylinder. Three of the seven chapters are devoted to analyses of diagrams from compound engines, gas and oil engines, and air compressors, pumps, etc., respectively. The final chapter is on diagram calculations.

In the three chapters on the specific applications of the indicator, much practical information is given concerning its use in setting valves and indicating defects in valve setting, engine design, leakage, etc. We regret to note that the author has not escaped from the absurd error that a point on an actual indicator diagram may be used to establish what he chooses to call the "theoretical" indicator card. It is astonishing in view of an unknown amount of cylinder condensation which may even attain 25 per cent or more, with a consequent effect on the lines drawn by the indicator, it should be considered possible that by the use of a point on one of these indefinite lines the "theoretical" events of steam action in a cylinder may be established by a construction dependent entirely on the point selected.

ELECTRICAL CATECHISM. An Introductory Treatise on Electricity and Its Uses. By George D. Shepardson, M. E. New York: American Electrician Company. 403 pages, 1516 illustrations. Price, $2.

That the first "Electrical Catechism" really worthy of the name should only now make its appearance, will surprise many, and the more so as the question and answer form of treatment in an elementary book appeals to such a wide circle of readers. However, a glance at the previous attempts at such a work will show the reason, for the average writer of an elementary electrical book does not know how to ask the questions logically and precisely, much less answer them. As a born teacher, and one who has been beset with questions on electrical subjects for at least 15 years, Professor Shepardson knows what questions need the answering, and what sort of an answer will best serve the purpose. The nearly 1100 questions asked by him are, therefore, clearly worded, and the order in which they are asked shows both careful planning and familiarity with modern practice. The answers are always to the point, and usually are supplemented by some bit of allied data or comment, so that this 400-page book is really answering some 3000 timely questions.

The general arrangement, while logical, is unusual in some points, as in using the heading "Elementary Motors" for information on electric bells, sounders and telephone receivers. However, this frequent touch of the unusual makes the volume all the more suggestive. The opening chapter on "Static Electricity" clears up some questions that usually vex beginners, and incidentally gives valuable hints on removing static electricity from belts and other machinery. Then comes a chapter on "Units," with portraits of ten of the men after whom our electrical units are named. Next a chapter on "Electric Circuits" with illustrations of various typical circuits and examples showing how to figure them. Fuses, rheostats, incandescent lamps, arc lamps, electric furnaces and other heating devices are all taken up under the head of "Heating Effects," while both primary batteries and accumulators are treated in the chapter on "Electro-Chemistry."

The part devoted to magnetism shows the range of the work, as it leads up from the simplest experiments on magnetic fields to the formulæ for calculating magnetization effects. The more recent measuring devices, such as electrostatic voltmeters and ground detectors, or the Wright maximum demand meter are briefly explained under "Instruments," while the chapter on "Measurements" tells both how to use such instruments and how to avoid harming them in practice. Also how to use low-reading voltmeters (in series with incandescent lamps) for measuring high voltages, or a voltmeter for measuring resistances, or incandescent lamps for locating grounds. Motor-starting rheostats get due attention in the chapter on "Motors," which, like the one on "Dynamos," abounds in practical hints for those in charge of such devices. The last 120 questions deal with alternating currents about as clearly as the absence of higher mathematics will allow. Compensating transformers for arc circuits, current rectifiers, rotary converters and even devices for determining instantaneous values of voltage or current are duly considered in this chapter.

A few items might well have had more attention, but the author may be saving these for some supplementary articles similar to the columns in *Electrical Industries* and the *American Electrician*, in which the bulk of this work originally made its appearance. Thus some chapters on main and snap switches, on lightning arresters for light and power circuits, and on insulating materials would make the books still more complete. However, these shortcomings are easily forgiven in view of the up-to-date accuracy of the information given and the practical common sense that shows up on almost every page. Thanks to this practical nature of both questions and answers, the careful reader can avoid many of the slips commonly made both in choosing and in using electrical devices; thus the chapters treating of the installation and care of dynamos will alone form a fine substitute for the average book devoted to this special subject. There is also a charm to the writer's pointed philosophy which makes the book unusually readable for a work of its kind, and in some cases this shows a strong vein of humor, as when he asks "if lightning rods are of any value except to the agent," or where he states that "to most people it would make little difference whether they got a shock of 2000 or of 10,000 volts."

The illustrations are ample and more up-to-date than is usual in such works, while an extensive index makes it easy to find every topic mentioned in either questions or answers. Mechanically, the book is also well planned to stand the steady thumbing which it will get as soon as the owner becomes aware of the completeness which makes this "Catechism" almost an encyclopædia.

Professor Shepardson says in his preface that "but little is presented which could not be found elsewhere," but very few will know where else to look for a good deal of the information, or what degree of accuracy to expect from other sources of such information. This accuracy and wide scope of the work will make it a welcome companion for those far along in electrical engineering work, while the simple and commonsense style, and the practical point of view shown on every page will make the volume appeal to the beginner as well. It is, therefore, a most timely work, without which an electrical library can hardly claim to be representative of the principles underlying modern electrical practice.

BOOKS RECEIVED.

METHODE PRATIQUE POUR CALCULAR LES MOTEURS ASYNCHRONES POLYPHASES. By Boy de la Tour. Paris: Ch. Beranger. 216 pages, 70 illustrations. Price, 12.50 francs.

Instruments et Methodes de Mesures Electriques Industrielles By H. Armagnat. Second Edition. Paris: C. Naud. 614 pages, 230 illustrations. Price, 15 francs.

Practical Marine Engineering. By William F. Durand. New York: Marine Engineering, Inc. 706 pages, illustrated. Price, $5.

The Engineering Index. Volume III., 1896-1900. Edited by Henry Harrison Suplee, B. Sc., assisted by J. H. Cuntz. New York: The Engineering Magazine. 1030 pages. Price, $7.50.

Electric Power in a New Jersey Brewery.

The economy of employing electricity in industrial operations is becoming more and more apparent every day. There is hardly any field in the long list of manufactures in the United States where it is possible to affect a saving in the cost of production by the aid of electricity that this agency is not applied. Recently brewers have

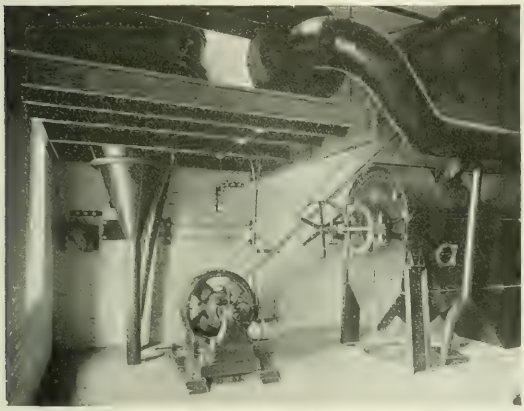


FIG. 1.—ELECTRICALLY-DRIVEN MALT CLEANER AND BLOWERS.

begun to awaken to the advantages offered by electric power, susceptible, they find, of general application to the wide range of apparatus they employ.

In the nature of the business it is necessary to employ heavy machinery in many parts of their buildings, and on many different floors, requiring a great amount of shafting, and many isolated en-

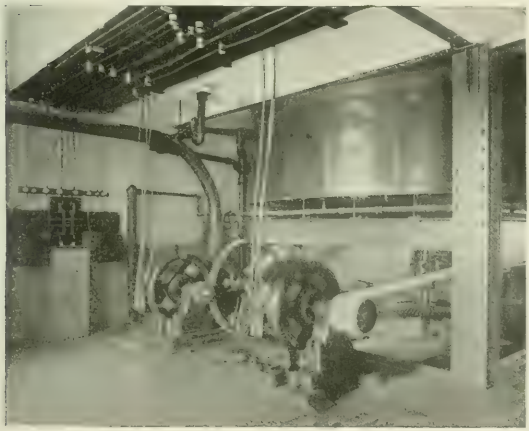


FIG. 2.—PUMP AND MASH MACHINE.

gines. The power loss is tremendous, when the friction and inertia of shafting and heavy gearing, and radiation of heat along the lines of the numerous feeders to isolated engines is considered.

The atmosphere of the breweries, laden with moisture, is a continual source of trouble in maintaining proper tension of belting, especially in such cases where the distance is great between pulleys. The large quantity of shafting employed requires constant attention to keep the bearings properly lubricated.

The employment of separate electric motors for each machine, or set of machines, eliminates nearly all of the trouble mentioned.

FIG. 3.—MOTOR-OPERATED COOKER.

When possible, the motors are direct connected, though the nature of the work of many machines requires the use of short belts that will slip when the motor is suddenly subjected to an overload, which sometimes occurs, and this slipping of the belt prevents injury to the motor.

It is also obvious that when motors act independently, only such machines are operated as are required, thereby saving the power necessary to drive idle pulleys and unused shafting.

The accompanying views are of Bullock motors in the Hudson County Consumers' Brewing Company's plant, Hoboken, N. J. The illustrations show motors operating the cleaning and grinding machinery, the mash machine, rotary pump, cooker and conveyors for

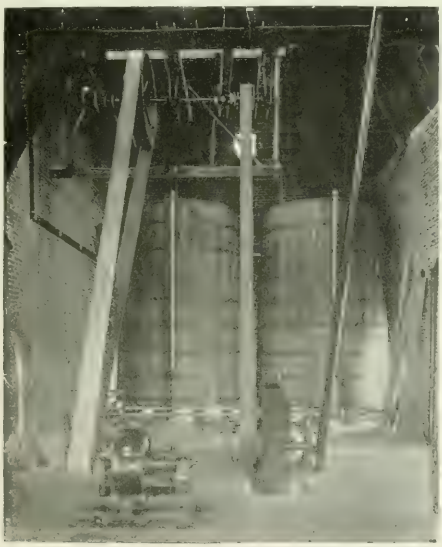


FIG. 4.—ELECTRICALLY-DRIVEN GRAIN CONVEYOR.

grains. Fig. 1 shows a Taber rotary pump direct connnected to the motor with single reduction gears. This No. 6 pump is used for pumping the wet grains at 70 per cent moisture from the mash tub to the bins. There are three other Taber pumps, also direct connected

to motors in this brewery. Two of these pumps are used for pumping beer and hops to the extreme height of 80 ft.; the third is used for circulating beer. Similar motors are also used in other breweries for operating keg washers, keg elevators and the usual machines to be found in well equipped machine shops, such as are maintained in connection with large breweries.

Electrical Trades Society of New York.

The sixth annual meeting of the Electrical Trades Society, of New York, was held on Tuesday, Dec. 10, at 2 o'clock P. M., at 39 Cortlandt Street. Twenty-five members were represented. President R. E. Gallaher gave an interesting address, and reports were read by the secretary, Mr. A. P. Eckert, of the year's work.

The society has a membership in New York of 56 members. It is becoming of greater value every day, and the members speak highly of the work being accomplished.

The following officers were elected for the ensuing year: President, Mr. E. R. Gilmore, of the Western Electric Company; vice-president, Mr. H. A. Reed, of the Bishop Gutta-Percha Company; secretary-treasurer, Mr. A. P. Eckert, of the Safety Insulated Wire & Cable Company.

A New Milling Machine.

The accompanying illustrations show the latest pattern milling machine made by the Cincinnati Milling Machine Company, Cincinnati, Ohio, as exhibited by them at Buffalo. Fig. 1 shows a view of

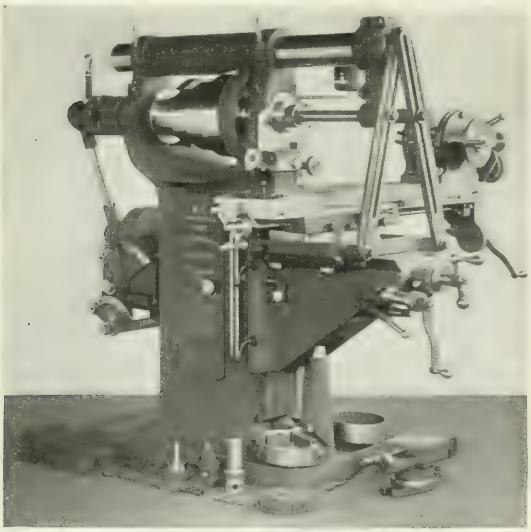


FIG. 1.—NEW PATTERN MILLING MACHINE.

the machine complete. The chief feature of the machine is the positive feed mechanism, which is shown in detail in Figs. 2, 3, 4 and 5.

The features incorporated in the mechanism are a positive gear-driven feed, a wide range of feed changes and means for changing from any one rate of feed to any other rate of feed conveniently and without stopping the machine.

Part of the mechanism is placed at the rear end of the milling machine spindle, and part is incased in a gear box at the rear of the column. The connection between these two parts of the mechanism is by means of a vertically inclined shaft.

Figs. 2 and 3 show, respectively, a section through the upper gear box and the upper gear box complete on the column of the machine. Figs. 4 and 5 show, respectively, a rear view of the lower gear box, with covers removed, and a front view of the same mechanism showing the arrangement of the shifting levers. The operation of the mechanism, briefly stated, is as follows: Referring to Fig. 2, motion is transmitted to the shaft *B* by sliding the gears on *B* so as to bring either one of them into mesh with the proper gear on the spindle, or the gears may be set in the intermediate position, shown in the sectional drawing, in which case no motion is imparted to *B*. This position of the gears throws out the entire feed mechanism. The shaft *B* drives the vertically inclined shaft *M*, which in turn drives the shaft in the lower gear box upon which are mounted the spur gears *R* and *S*, as shown in Fig. 4, through the mitre gears at *G*, which are of steel, case hardened. All the spur gears of the feed mechanism are of steel. Inside of the lower gear box will be seen two cones of four gears each, running loose on their shaft and driven independently by the gears *R* and *S*, the smaller gear *R* engaging the largest gear on one cone, and the larger gear *S* engaging the smallest gear on the other cone, thus imparting widely different speeds to the two cones.

From these cones, motion is transmitted to the various feed screws through an intermediate gear, which is made to slide on its shaft by means of the rack and sector, and placed into correct position for engaging any one of the cone gears, by means of the lever which actuates the sector. This is the lower lever shown in Fig. 5. The position of this lever, at any time, indicates the rate at which the machine is feeding in thousandth of an inch per revolution of spindle, by means of raised figures on the lever quadrant.

The lower lever having been placed into position to obtain the desired rate of feed, the intermediate gear is brought into mesh with

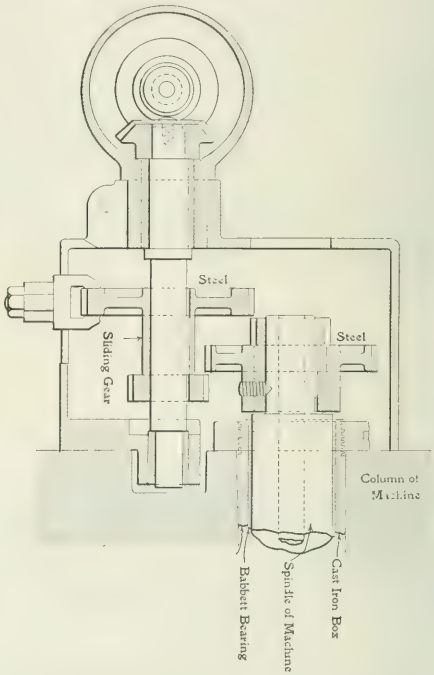


FIG. 2.—SECTION THROUGH UPPER GEAR-BOX AND SPINDLE.

the proper cone gear by the upper lever in Fig. 5, which moves the entire lower portion of the mechanism. This is accomplished by means of a helical groove in the hub of the lever, which engages a pin in the slide upon which are mounted the lower lever, sector, rack and intermediate gear. By means of the combination of these two mechanism 16 different speeds are imparted to the feed shaft, advancing by even graduations from .006 inch to .300 inch for each turn of the spindle. The lower lever acting as an indicator enables any one to tell at a glance just how fast the machine is working.

From the foregoing it is plain that by simply shifting the levers on the feed mechanism, any one of the 16 different rates of feed may be obtained, and a change from any one rate of feed to any other may be made without stopping the machine, since there are no change gears to interpose nor belts to shift. Any one of these rates of feed may be used in combination with any of the 16 different spindle speeds, providing in all 256 different combinations.

The spindle speeds, which are 16 in number, and vary from 9 to 250 turns per minute, have been chosen with a view to secure the proper cutting speed for cutters of standard diameters. As illustrations and taking spindle speeds of 15, 150 and 350 r. p. m., the cutter diameters with a surface speed of 20 ft. per minute are 5 inches, ½ inch and ¼ inch, respectively; at a surface speed of 40 ft. per minute the diameters are 10 inches, 1 inch and ½ inch, respectively; and for a surface speed of 60 ft. per minute the diameters for the two higher revolutions are 1½ inches and ¾ inch, respectively.

These machines are finding great favor among manufacturers of electrical machinery and appliances. We are told on the authority of the manufacturers, that orders have recently been placed by three different electrical houses which aggregate over 100 machines. They consider that their success in placing these orders is largely due to the positive feed mechanism. Some of the advantages of this particular mechanism may be enumerated as follows:

With it the capacity of the machine for removing metal is limited only by the pulling power of the main driving belt. The rate of feed can be changed practically instantaneously. It is positive, at all times, imparting an even motion to the table, thereby avoiding the broken cutters and spoiled work which so often result from a slipping feed belt.

In addition to the new feed mechanism, there are other improvements on these machines, notable among which are a telescopic vertical feed screw which does away with the necessity of cutting a hole through the floor; a clamping device, which enables one to firmly lock the knee to the column or the saddle to the knee when the longitudinal feed alone is being used, thereby wonderfully increasing the rigidity of the machine. Sliding covers on the knee, which protect the feed screws from dirt and cuttings, and a cylindrical overhanging arm, which, in addition to the regular support for the arbor, is also provided with a support which can be adjusted close to the cutter, thus supporting the arbor at any point in its entire length.

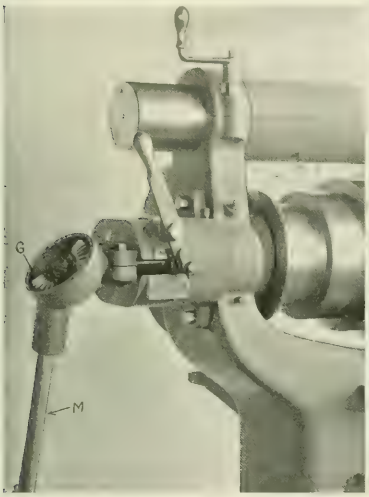


FIG. 3.—UPPER GEAR-BOX, WITH COVER OVER MITRE GEARS REMOVED.

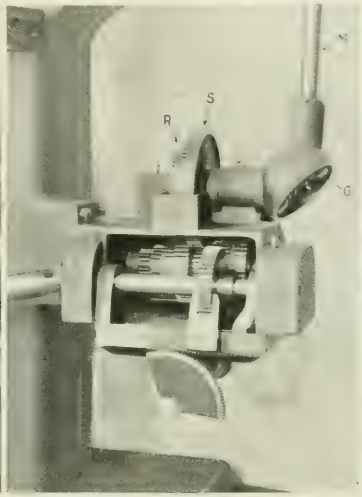


FIG. 4.—REAR VIEW OF LOWER GEAR-BOX.

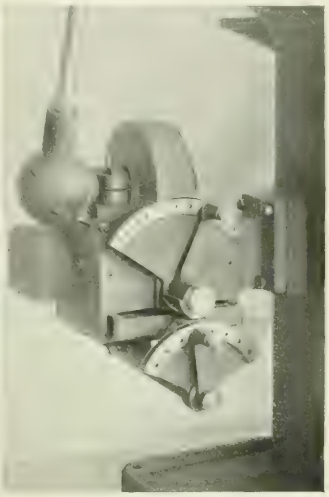


FIG. 5.—FRONT VIEW OF LOWER GEAR-BOX, SHOWING SHIFTING LEVER.

Leich Selective Telephone Signal System.

The Leich selective signal system, which was placed on the market some time ago by the Metropolitan Telephone & Electric Company, of Chicago, is entering largely into use. A recent installation completed by the above-named company for the Northwestern Indiana Telephone Company has demonstrated, it is stated, that the instruments work perfectly, without needing any adjustment when once installed, due, in large measure, to the absence of spring action. The circuits of the instruments have been very much simplified, and the liability of the instruments to deteriorate while in use is no greater than that of the ordinary polarized ringers now used so extensively. The additional apparatus which is used in combination with each polarized ringer to adapt it for selective signaling purposes, consists of one condenser and one impedance coil. The condensers are placed in series in the ringing circuits, so that they check absolutely any unnecessary flow of common battery current while the instruments are in use. The instruments are all provided with approved forms of lightning arrester and protective apparatus, so that the condensers are not influenced by lightning discharges.

The instruments are adapted to operate both from power generators and Warner pole changers, and are thus adapted for both large and small exchanges. The Warner pole changer used in the operation of the system is preferably made in a single instrument, provided with two sets of springs for giving the high and low-frequency currents required, so that very little additional expense is necessary to adapt ordinary central station apparatus for use in connection with party-line telephones.

The instruments as furnished by the company are guaranteed to operate without adjustment of any kind, except that necessary for ordinary polarized ringers, so that no more time is required to install instruments of this character than is required to install an ordinary telephone instrument. When the instrument is installed, the remaining subscribers on the same party-line need not be inconvenienced by sending test currents over the line to test the instruments, as the same, when installed, is ready for use without adjustment.

Novelties in Pliers.

The Smith & Hemenway Company and the Utica Drop Forge & Tool Company, 296 Broadway, New York, are offering as their latest novelty in pliers a side-cutting, long-nose form. The advantages claimed are that having a long, narrow nose it will be of use in deep, narrow quarters, in which an ordinary tool will not work, and also will do the work of a regular tool. It is convenient to carry. Every tool is carefully tested at the factory before sending out. It can be used by telephone manufacturers, machinists, engineers, electricians and jewelers.

LONG NOSE PLIERS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 6 per cent on call; time money, 5@5½ per cent for sixty to ninety days, 5 to 6 per cent for four, five and six months. The stock market, after suffering from speculative liquidation, due to high money rates, became steadier towards the end of the week, and showed a better tone. Apart from money, the principal factors which affected the market were favorable. Railroad earnings continue good, and the business activity of the country does not slacken. Tractions sympathized with the general weakness, and closed with net losses. Brooklyn Rapid Transit kept within a range of about 2 points, closing at 62⅝—a net loss of ⅜. Metropolitan closed at 158⅞, ex-div., which represents a net loss of ⅝. General Electric was the exception to the electric list, closing at 282, a net gain of 1⅞ points, the sales aggregating 8025 shares. Westinghouse closed at 147⅛, a net loss of 2⅜ points, on sales of 2000 shares. Western Union remains unchanged from last quotation, the closing price being 91. Following are the closing quotations of Tuesday, Dec. 17:

NEW YORK.

	Dec. 10.	Dec. 17.		Dec. 10.	Dec. 17.
American Tel. & Cable..	—	97	General Electric.....	282	281
American Dist. Tel.....	—	36	General Carriage.....	1¾	1½
Brooklyn Rapid Transit..	62¼	62½	Hudson River Tel.....	110	104
Ches. & Pot. Telephone..	66	66	Metropolitan Street Ry..	159	161
Commercial Cable.....	—	181	N. E. Elec. Veh. Tran..	—	—
Electric Boat.....	19	19	N. Y. Elec. Veh. Tran...	10	12¾
Electric Boat pfd.....	40	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1⅞	1⅞	Tel. & Tel. Co. of Am...	—	—
Electric Vehicle.....	2½	2½	Western Union Tel.....	91⅛	91¼
Electric Vehicle pfd.....	4½	4	West. E. & M. Co.....	148½	147½

BOSTON.

	Dec. 10.	Dec. 17.		Dec. 10.	Dec. 17.
Am. Tel. & Tel.....	160½	161	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	132	134
Edison Elec. Illum.....	—	235	Westinghouse Elec.....	74½*	—
Erie Telephone.....	16	19	Westinghouse Elec. pfd.	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Dec. 10.	Dec. 17.		Dec. 10.	Dec. 17.
American Railways.....	44	43	Phila. Traction.....	97¾	97¾
Electric Storage Battery.	61	60	Philadelphia Electric.....	4½	4¾
Elec. Storage Batt'y pfd.	61	60	Pa. Electric Vehicle.....	¾	½
Elec. Co. of America.....	6⅛	6	Pa. Elec. Veh. pfd.....	1⅝	2

CHICAGO.

	Dec. 10.	Dec. 17.		Dec. 10.	Dec. 17.
Central Union Telephone.	—	40	National Carbon pfd.....	84*	85½
Chicago Edison.....	155	—	Northwest Elev. com....	36¼	35*
Chicago City Ry.....	185½	187	Union Traction.....	10½	10½
Chicago Telep. Co.....	240	240	Union Traction pfd.....	47	47
National Carbon.....	20	19¾			

*Asked.

STROWGER AUTOMATIC TELEPHONE.—Note was made in this department last week of the Strowger Automatic Telephone Company in Illinois, with a capital of $2,000,000. This company has secured the manufacturing rights for the United States of the Strowger Automatic Telephone Exchange and its manufacturing plant in Chicago. The interests back of it are the people who control the Illinois Telephone & Telegraph Company, which is preparing to compete with the Chicago Telephone Company. It will introduce the Strowger instrument, which is operated without operators. The incorporators of the new company are Edwin W. Gearhart, James C. Law and Albert G. Wheeler, Jr. They represent Clarence D. Simpson, Thomas H. Watkins, of Scranton, Pa.; Charles B. Eddy, of New Mexico, and J. B. Russell & Co., bankers, of Scranton, New York and Chicago. These people recently bought the $5,000,000 bond issue of the Illinois Telephone & Telegraph Company. The Illinois Telephone & Telegraph Company will install telephones in Chicago on the same plan as the gas company furnishes gas to its consumers. The telephones will be placed in offices and residences without charge to the tenants, except as they have use for them. By this method the company expects to be able to install a system in that city of at least 100,000 telephones. A guarantee will be given to each patron that the cost a year shall not exceed $85 for business and $50 for residence instruments. The Strowger system has been used for several years at Augusta, Ga.; Princeton, N. J.; Geneva, Ithaca and Perry, N. Y.; Albert Lea, Minn.; Trinidad, N. M.; New Bedford and Fall River, Mass. The new Automatic Electric Company will begin business with an order from the Illinois Telephone & Telegraph Company for a switchboard and its appliances and devices for 25,000 telephones.

NEW HAMPSHIRE TRACTION.—With the completion of the New Hampshire Traction Company, W. D. Lovell and his associates round out the construction and combination of the extensive system of electric roads stretching from Haverhill and Amesbury on the south to Dover and Rochester on the north, reaching Hampton Beach and Exeter, with connections to Portsmouth well under way. It is understood that the New Hampshire Traction Company is backed by a strong syndicate of Boston and New York capitalists, who will immediately push the development and perfecting of the properties, giving the sections covered by their lines a thorough up-to-date system of electric roads. The New Hampshire Traction Company has a capital stock of $1,000,000. Officers are as follows: President, W. W. Woodman; vice-president, C. H. Tenney; treasurer, H. A. Tenney; clerk, Samuel W. Emery. The completion of this combination leaves Mr. Lovell and his associates free to push the immediate completion of their roads to the West, which will bring the cities of Nashua, Lawrence, Lowell and Manchester into direct connection with the lines of the New Hampshire Traction Company. It is expected that all these lines will be completed, and in operation by early spring. The entire system is being constructed in the most thorough manner.

PNEUMATIC TOOL DEAL.—A syndicate comprising financial interests in New York and elsewhere has been formed by subscribers, to the amount of $5,000,000, to consolidate leading concerns that enter largely into the manufacture of hoists, cranes and pneumatic tools. This has already been noted in our columns. The Chicago Pneumatic Tool Company will be the nucleus of the consolidation, and the authorized capital will be $5,000,000. There will also be an issue of $2,000,000 bonds, bearing 5 per cent interest. Only one class of stock will be issued. The following companies have been taken into the combination: Chicago Pneumatic Tool Company, Chicago; Chisholm-Moore Company, Cleveland; Boyer Machine Company, Detroit; Franklin Air Compressor Company, Franklin, Pa., and New Tate-Howard Pneumatic Tool Company, Limited, of London, England. The syndicate has made a contract with the Chicago Pneumatic Tool Company under which the latter is to issue and deliver its stock and bonds in consideration for stocks of companies named.

OMAHA CONSOLIDATION.—A special dispatch from Omaha of Dec. 13, says: Representatives of the franchise corporations of Omaha, including the Omaha Street Railway, Omaha Gas Company, Omaha & Council Bluffs Bridge & Motor Line & Electric Light Company, are on the way to New York to confer with J. P. Morgan, who is at the head of a syndicate formed to buy these concerns, provided terms can be made. The scheme has been under way for some time, and has gone so far that an expert has been sent to make examinations of all the properties, but the price placed by the street railway company was so high that negotiations were not closed. The company demands $7,000,000 for its property, or 90 per cent of the capital stock plus $2,500,000 in outstanding bonds. The purchase of the Fremont Power & Canal Company will be discussed also. Thirty million dollars are involved in the transaction. The proposed development of water power to furnish current to the Omaha plants has already been discussed in these pages.

ERIE TELEPHONE FINANCES.—It is announced from Boston that Messrs. Kidder, Peabody & Co. and President Fish of the American Telephone & Telegraph Company are arranging the Erie Telephone reorganization plan. The successor company will issue $16,000,000 preferred and $16,000,000 common stock. The American Company, through Erie's successor, will control all except the Michigan Company. As every holder of four shares of Erie stock must take one share at par, the assessment loss is $3.75 per share. Erie people must also surrender one of their Erie shares without consideration. Therefore, Erie at 18 means new Erie common at 29 and preferred at 85.

WESTERN UNION TELEGRAPH.—The report of Western Union for the December quarter confirmed reports that the statement would show a satisfactory gain over last year. The increase in net revenue was $137,170, and the increase in surplus after dividends $132,210. The earnings on the stock were $1,606,000, or 1.6 per cent. Earnings for dividends for the six months have been $3,316,276, or 3.3 per cent on the stock, indicating for the year fully 6 per cent earned, as against 5 per cent paid. This gives a margin over the dividends large enough to strengthen confidence in regard to the maintenance of the 5 per cent rate.

BUFFALO BELL TELEPHONE.—It is announced that the Buffalo Bell Telephone Company has decided to dispose of the remaining $1,000,000 of treasury stock to the present stockholders. The company, it is stated, was originally capitalized for $5,000,000, of which $4,000,000 was issued and sold.

DIVIDENDS.—The Union Switch & Signal directors have declared the regular quarterly dividend of 2 per cent on the preferred stock and 1 per cent on the common. The directors of United Traction & Electric Company have declared a dividend of 1 per cent, payable Jan. 1. The regular quarterly dividend of 2½ per cent and 3½ per cent extra on Westinghouse Air Brake has been declared Three months ago Westinghouse Air Brake declared 3½ per cent extra; six months ago, 3 per cent extra; nine months ago, 3½ per cent extra; a year ago, 3½ per cent extra, and 15 months ago, 5 per cent extra. The directors of the United Gas Improvement Company have declared a quarterly dividend of 2 per cent ($1 per share), payable Jan. 15, 1902, to stockholders of record at close of business Dec. 31. The Western Union Telegraph Company has declared the regular dividend of 1¼ per cent. The Safety Car Heating & Lighting Company has declared a quarterly dividend of 2 per cent, payable Dec. 23. The Hall Signal Company has declared a regular quarterly dividend of 1 per cent. Otis Elevator Company has declared the regular quarterly dividend of 1½ per cent on preferred stock, payable Jan. 15.

CONSOLIDATION AT SAVANNAH, GA.—It is announced that the Edison Electric Illuminating Company has acquired the street railway interests in Savannah. The concern is owned principally in Boston and Savannah. George Parsons was president and majority owner of the stock in the old street railway company, and it is understood that he obtained considerably more than $1,000,000 for his interest. The city and suburban railway lines aggregate more than 25 miles. The Edison Company now operates a lighting plant, and has the city contract. The two companies are capitalized at about $3,500,000. They will be consolidated, and new securities issued. George J. Baldwin, president of the Edison Company, will be president of the new corporations. This consolidated interest a few weeks ago secured control of the electric lighting and street railways in Houston, Texas. It is the understanding that Texas oil will be used as fuel, and that a line of tank steamships will be established between Savannah and Galveston or Port Arthur.

OHIO TROLLEY CONSOLIDATION.—The Tuscarawas Railway Company and the Tuscarawas Electric Company have filed articles of consolidation with the Secretary of State, and hereafter will be known as the Tuscarawas Traction Company, with a capital stock of $350,000. This is supposed to be a step toward the plan of the Pomeroy-Mandelbaum syndicate of Ohio street railway companies. Reports come from Hamilton, Ohio, that the Southern Ohio Traction, Hamilton & Lindenwald Electric Transit, Cincinnati & Northwestern and Miamisburg & Germantown Traction are soon to consolidate, which will include practically all roads between Dayton and Cincinnati. These properties are said to be controlled by the Mandelbaum-Pomeroy syndicate of Cleveland. The capital of the four roads exceeds $3,000,000. The Lake Shore Electric Railway, owned and controlled by the Moore-Everett syndicate, has been opened for passenger service. It is the longest electric railway in the world, stretching from Painesville, Ohio, via Cleveland, Lorain, Norwalk, Toledo and Detroit to Port Huron, Mich.

GENERAL ELECTRIC.—It is stated by Wall Street organs that in the last two or three years there has been a notable accumulation of General Electric stock in the hands of a few people, these people being closely identified with the company. It has been said, in fact, that less than a score of men own two-thirds of the stock. This may be an exaggeration, but it is certain that ownership is now decidedly concentrated, whereas in 1898 and previously, it was very widely scattered. During that time the stock has quadrupled in value, rising from about 70 to 280. Practically the only official information that has been forthcoming in that period has been the quarterly dividends and the annual reports. Up to this time nothing official has been said respecting the intention of the managers to restore the capital written off in 1898, and those stockholders who have regarded only official information know nothing whatever about it.

BIG KENTUCKY TROLLEY SCHEME.—Articles incorporating the Blue Grass Consolidated Traction Company, with a capital of $7,000,000, divided into 70,000 shares, have been filed in Kentucky. The incorporators are H. C. Beatty, George B. Davis and H. B. Davis, of Detroit; C. B. Knapp, Jr., of Chicago, and W. J. Loughridge, Hal P. Headley and M. C. Alford, of Lexington. The purpose of the company is to construct electric railways from Lexington, Ky., to eight or nine surounding county seats. The company will absorb the Blue Grass Traction Company, which has secured the necessary franchises for the system.

COMMERCIAL ELECTROZONE COMPANY.—The Commercial Electrozone Co., Philadelphia, is apparently in serious difficulties. In the suit of Geo. T. Vickers against the company, Chancellor Magie has ordered that stockholders and creditors show cause on Dec. 23 why the receiver should not sell the company's assets. There seems no good reason, however, why an excellent demand for electrozone should not be enjoyed if the business were pushed.

BESSEMER (ALA.) LIGHTING SALE.—The Birmingham Railway, Light & Power Company has purchased the plant of the Bessemer Electric Lighting Company at Bessemer for $25,000. The purchasers will expend $250,000 in the enlargement and modernizing of the plant, and will use the current to operate a loop electric railway system 25 miles around between Bessemer and Birmingham.

NEW YORK ELECTRIC VEHICLE TRANSPORTATION.—The directors have recommended a reduction of the capital stock to $5,000,000 from $25,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received during the week by the mercantile agencies show an enormous business going forward in all the industries, heavy bank clearings and unprecedented railroad earnings. Nearly all advices touching upon jobbing business are encouraging and the year's results so far as ascertained are, on the whole, very favorable. Among the industries iron and steel are easily first in strength of demand and prices, and the situation is buoyant. The railway gross earnings for November are the best on record for that month. Roads with a mileage of over 106,000 report a total of $70,632,181, as against $62,966,000 for November last year, a gain of 12.1 per cent. Pacific Coast roads report the heaviest increase, 28.1 per cent, followed by the grangers with a gain of 22.9 per cent. The business failures for the week, as reported by *Bradstreet's*, numbered 233 against 237 the week previous and 247 the same week last year. The copper market, as noted elsewhere in these columns, continues to be very unsettled, and on Friday a reduction of 1¼ cents was reported, making the price 15.37 cents for Lake and 15.25 for electrolytic.

THE COPPER SITUATION.—In our issue of Sept. 28 last we asserted editorially that 15-cent copper might soon be reached, judging from the condition of the copper market at that time. Since then the conditions have not improved, indeed they have been going from bad to worse, and now the prediction is almost an actual realization, the quotations having dropped within ¼c. of that figure. In London the copper situation has apparently reached the crisis. A cablegram dated Dec. 13 stated that the directors of the Rio Tinto Company had made all the propositions to the Amalgamated Copper Company that it intended to offer, and that whatever settlement may be reached lies entirely with the Amalgamated Company. During the week the Amalgamated Copper Company officially reduced the price for Lake to 15⅜c. and for electrolytic 15¼c. An expert and dealer in the metal predicts that it will fall below 15 for electrolytic. An alliance between Amalgamated and Rio Tinto interests, he asserts, will not avail to decrease the supply from other sources sufficiently to curtail production. The present demand is so short of the accumulated supply that a further break is looked for. In commenting on the situation, the *Engineering and Mining Journal* says the collapse of the Secretan corner was under entirely different conditions from those now existing. There is a general anticipation, it says, that prices must be reduced before long, and in consequence business is almost at a standstill, buyers taking only the limited quantities, which their daily necessities require. The London prices are equivalent to 12 to 12½ cents in New York, for standard, which is equal to 13 and 13½ cents for electrolytic or refined copper. On the New York Stock Exchange Amalgamated Copper was the most active stock on the list during the week, due to the widespread uncertainty which surrounds its position. The price fell as low as 65⅝. A part of the loss was regained, however, towards the end of the week on the apparent predominance of favorable reports concerning the situation. But at the best, the condition of copper is so uncertain that it is impossible to predict with any confidence where the trouble will end.

WESTINGHOUSE PITTSBURG ENTERPRISES.—Note has been made in these columns recently of the new industrial developments around Pittsburg due to the initiative and leadership of Mr. George Westinghouse. With reference to these it is now announced that the Westinghouse Foundry Company, recently organized at Pittsburg, has applied for a charter. The incorporators are George Westinghouse, Herman Westinghouse, George C. Smith, William Scott and W. D. Updegraff. This new company will build a very large foundry at Stewart Station, on the Pennsylvania Railroad, about 25 miles from Pittsburg. The various Westinghouse, steam and electrical enterprises now run into such large units, they might easily, of themselves, keep such an establishment as this very busy.

BOILERS FOR JAPANESE LIGHTING PLANT.—The Nagasaki Electric Light Company, of Nagasaki, Japan, is to be equipped with a 300-hp horizontal boiler ordered from Thayer & Co., Incorporated, Taylor Building, 39-41 Cortlandt Street, New York City. The boiler will be manufactured by the Aultman & Taylor Machinery Company, Mansfield, Ohio.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 11: Argentine Republic—82 pkgs. material, $2,788; 2 pkgs. machinery, $485. Antwerp—3 pkgs. material, $479. Azores—6 pkgs. material, $310. Brussels—23 pkgs. material, $389. British Australia—15 pkgs. wire, $478; 42 pkgs. machinery, $3,290; 139 pkgs. material, $9,702. Birkenhead—3 pkgs. wire, $115. Bremen—2 pkgs. material, $65. Brazil—117 pkgs. wire, $4,584; 266 pkgs. material, $2,716; 4 pkgs. machinery, $300. Berlin—5 pkgs. machinery, $100; 1 pkg. material, $17. British Guiana—10 pkgs. material, $500. British West Indies—47 pkgs. material, $902. British Possessions in Africa —59 pkgs. material, $3,352. British East Indies—91 pkgs., material, $6,079; 17 pkgs. machinery, $3,000. Central America—1 pkg. material, $15; 44 pkgs. material, $639; 2 pkgs. wire, $47; Cardiff—1 pkg. wire, $15. Christiania—1 pkg. material, $50. Cuba—17 pkgs. machinery, $2,853; 96 pkgs. material, $2,496; 140 pkgs. wire, $175. Ecuador—79 pkgs. material, $900. Glasgow—12 pkgs. machinery, $1,320; 41 pkgs. material, $795. Genoa—12 pkgs. material, $1,050. Havre—15 pkgs. material, $725. Hamburg—116 pkgs. material, $2,843; 2 pkgs. wire, $64. Liverpool—72 pkgs. machinery, $5,230; 47 pkgs. material, $2,065; 491 pkgs. material, $26,500; 21 pkgs. wire, $1,394. Lisbon—24 pkgs. material, $692. Leicester—3 pkgs. wire, $330. London—176 pkgs. machinery, $15,083; 141 pkgs. material, $7,558. Manchester—22 pkgs. machinery, $3,800. Marseilles—6 pkgs. material, $550. Mexico—22 pkgs. material, $1,756; 2 pkgs. machinery, $146. Naples—15 pkgs. material, $1,000. Newcastle —17 pkgs. machinery, $2,800. Nova Scotia—2 pkgs. material, $19. Rome—5 pkgs. material, $500. Rotterdam—2 pkgs. material, $145. Southampton—10 pkgs. material, $353; 3 pkgs. machinery, $179. Stockholm—4 pkgs. machinery, $257. Trieste—22 pkgs. machinery, $857; 1 pkg. electrical material, $41. U. S. Colombia—10 pkgs. material, $319. Vienna—8 pkgs. machinery, $920. Venezuela—3 pkgs. material, $41.

CROCKER-WHEELER COMPANY'S LARGE SALES.—The year which has just come to a close has been a prosperous one for the Crocker-Wheeler Company, of Ampere, N. J. They report a record-breaking midwinter business, and find it difficult to keep the production up to the demand. The following are some of the recent shipments: Two 400-kw generators to the Vandergrift Construction Company; one 300-kw generator to Stetson & Co., of Philadelphia; one 150-kw generator to the D'Olier Engineering Company, of West Camp, N. Y., and one 40-kw generator and 28 motors to the Smith-Brooks Publishing Company plant in Denver, Colo. The United States Tube Company, of Buffalo, N. Y., has been supplied with a motor equipment, and the electrical equipment of the Con. P. Curran printing establishment in St. Louis, Mo., which takes the place of line shafting, has been completed. Orders for a large number of motors have been received from Armour & Co., the American Bridge Company and the Marion Steam Shovel Company. An order for a 30-kw special generator has been received from H. H. the Sultan of Linga. The machine is to be installed in the royal palace, which is on an island near Singapore.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., report business as excellent in every respect. The orders booked within the last 30 days represent an aggregate of 513 tons, about 90 per cent arising through specification for electric traveling cranes with the remainder derived from electric hoists. This output will largely be for use in iron and steel mills, although the orders for electric lighting and street railway stations are gratifying. Conspicuous as buyers in these lines are the Commonwealth Electric Company, Chicago, two 8-ton and one 10-ton, and the Wisconsin Traction, Light, Heat & Power Company, Appleton, Wis., one 20-ton electric traveling crane. Pawling & Harnischfeger state that the utility of electric hoists in the smaller electric light and street railway stations is daily becoming more appreciated. Current in such plants is always ready, and at a nominal cost both for service and conveyance. The installation of the hoist merely requires a simple suspended I beam, which can be so arranged as to permit ready switching or transfer of hoist to any part of the building; in fact, it can be run into the yard or to adjoining buildings.

CABLE FOR MEXICO.—In a report to the State Department, W. W. Canada, United States Consul at Vera Cruz, Mexico, says the Mexican Government has contracted with the Safety Insulated Wire & Cable Company, of New York, for a submarine cable to be laid between Vera Cruz, Frontera and Campeche. The cable is to be 472 nautical miles long; there must be enough to reach a depth of 49 ft. in the port of Campeche and 65 ft. in the ports of Vera Cruz and Frontera. It is to be made of nine copper wires, protected by 16 galvanized iron wires for the deep sea and 18 additional steel wires for the coast. The manufacture of the cable will be under the supervision of the Mexican Government. The company is to receive for the work $600,000 gold, of which $283,000 is to be paid when the cable is placed in service and the balance in two and four months thereafter. The cable must be ready for service on April 2, 1902.

OUTPUT OF BELL TELEPHONES.—The American Telephone & Telegraph Company instrument statement for the month ended Nov. 20 shows:

	1901.	1900.	1899.	1898.
Gross output	88,497	52,208	69,117	35,159
Returned	27,510	36,412	19,992	15,486
Net output	60,987	15,796	49,125	19,673
Since Dec. 20:				
Gross output	867,323	576,570	608,715	313,522
Returned	352,173	257,110	183,263	135,568
Net output	515,150	319,460	425,452	177,954
Total outstanding ...	2,467,966	1,899,965	1,550,702	1,097,475

The gain here exhibited is quite noteworthy.

STRUCTURAL MATERIAL FOR NEW DE BEERS POWER HOUSE.—Milliken Brothers, Bowling Green Building, have secured a South African contract calling for the shipment of some 400 tons of structural material, which is intended for the erection of a new power house to be built at the De Beers Consolidated Diamond Mines, Kimberley. The equipment for this plant will include the two 1000-kw Westinghouse-Parsons turbines, direct connected to Westinghouse alternating-current generators of a similar capacity, to which reference has already been made in these columns. Mr. Gardner Williams, the general manager of the De Beers mines, was lately in the United States for the purpose of deciding on further contracts for electrical machinery, etc. These contracts will most likely be placed through Arkell & Douglass, 11 Broadway.

ANTI-PIPE BURSTING COMPANY.—Some time ago a descriptive article appeared in these pages on the ingenious "dome" pneumatic system devised by Mr. Neil Monroe Hopkins—now in charge of electro-chemical studies at the Columbian University, Washington, D. C. Since then the system has been awarded the John Scott Medal by the Franklin Institute, and a company has now been formed at Pittsburg to make and sell the device. It is known as the Anti-Bursting Pipe Company, and has its headquarters in the Standard Building, that city. The device has been subjected to severe experimental and practical tests, and is highly spoken of by such well-known architects and engineers as Bruce Price, John C. Trautwine, Jr., Robert S. Soule, Edward Clark, Ernest Flagg and others. We understand that Professor Hopkins is retained by the new company as its consulting engineer.

PLANTS FOR GOVERNMENT FORTS.—The United States Engineers Corps office has awarded a contract to W. M. Sheehan & Co., whose offices are at 136 Liberty Street, New York City, for two electric lighting and power equipments, which are to be installed in the gun batteries at Fort Hunt on the Potomac. There will be a 50-hp boiler built by P. Delaney & Co., of Newburgh, N. Y.; a 40-hp engine manufactured by the New York Safety Steam Power Company, of Liberty Street, and a 25-kw direct connected dynamo to be furnished by the Crocker-Wheeler Company. One storage battery, manufactured by the Electric Storage Battery Company, of 100 Broadway, is also to be installed at Fort Hunt. The Sheehan Company has also obtained an order for two storage batteries, which will also be furnished by the Electric Storage Battery Company ,for Fort Washington.

HAZARD MANUFACTURING COMPANY, Wilkesbarre, Pa., and 50 Dey Street, New York City, has lately become well-known as manufacturer of insulated wires and cables. It maintains, however, all its old lines, and it is an interesting fact that it has just taken through Mr. G. B. North, New York sales agent, an order for the galvanized steel rigging to be used on Emperor William of Germany's yacht, now building at the yard of the Townsend & Downey Shipbuilding & Repair Company. The riggers are Finn & White, of New York City.

NEW POWER PLANT IN ST. LOUIS.—A huge power plant, to cost $2,000,000, will be built at the foot of O'Fallon Street, St. Louis, Mo., by the Citizens' Electric Light & Power Company. The plans have been completed, and work will begin at once. It is the purpose of the directors to be prepared to compete with rival companies for the World's Fair lighting contract. The contract for the construction of the plant will call for its completion on or before March 1, 1903, under a heavy penalty for delay.

APPARATUS FOR BRAZIL.—Senhor Niccallino Paccarati, Braganca, Sao Paulo, Brazil, writes that he will be glad to receive catalogues of American manufacturers, and prices for a 300-kw alternating-current plant, consisting of two units of 150 kw each. Also for two turbines of 250 hp each for direct connection to the generators. Also for all overhead fittings, switchboard apparatus, transformers, arc and incandescent lamps for the distributing system.

A STILWELL FEED WATER HEATER has been furnished by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, to the Meade Electric Company, of Marion, Ind.

General News.

THE TELEPHONE.

LONE ROCK, ARK.—The Batesville & Winnerva Telephone Company operates 200 miles of toll lines. It has two exchanges of 25 drops capacity each, and has 100 subscribers. It is using the apparatus of the Chicago Telephone Supply Company. President E. A. Farris says that 50 miles of new line is projected, and that the business outlook is very good.

COLORADO SPRINGS, COLO.—The City Council will be asked to grant a franchise to W. C. Robinson and others for a new telephone system here.

KELL, ILL.—A telephone line is being constructed from here to Walnut Hill, via Dix.

COTTAGE GROVE, ILL.—The Cumberland Telephone Company is extending its line west from Cottage Grove.

SHERRARD, ILL.—The Sherrard Telephone Company, capital stock $2,500, has been incorporated by J . C. Vernon, L. R. Trego and H. E. Sudlow.

JERSEYVILLE, ILL.—The Calhoun County Telephone Company has secured a ninety-nine-year franchise from the village board of Hardin to operate a telephone exchange there. The company's lines will have connection with St. Louis.

CLINTON, ILL.—Mr. B. F. Wasson, president of the Farm & City Telephone Company, informs us that he has exchanges at Farmer City, Waynesville, Mansfield, Kenney and Maroa, with headquarters at this place. The company has 800 telephones and 800 subscribers.

O'FALLON, ILL.—We are informed by Mr. E. H. Smiley, of Smiley Bros.' Telephone Company, that it is just commencing operations with bright prospects. A 100-drop Kellogg board will be used. An exchange at Lebanon is to be installed under the name of the Lebanon Telephone Company.

GALESBURG, ILL.—Another country telephone line which will connect Galesburg with contiguous territory is being planned and will likely soon be constructed. It is the design to run a trunk line from Rio to Galesburg with connections, including Henderson, where a local board will be put in. Amos Landon, of Rio, is interested in the projected line.

JOLIET, ILL.—Directors of the Interstate Independent Telephone & Telegraph Company, a new $3,000,000 corporation recently organized in New Jersey for the purpose of acquiring and controlling telephone companies, held its first business meeting here recently. Directors were present from New Jersey, Ohio and Illinois. Officers were elected as follows: President, Senator H. H. Evans, Aurora, Ill.; vice-president, Frank Tracey, Springfield, Ohio; secretary and general manager, E. R. Conklin, Joliet; treasurer, A. B. Conklin, Aurora. The principal office will be located in New Jersey, with branch offices in Chicago and Aurora. The company already owns several telephone systems and expects to at once acquire several more.

EVANSVILLE, IND.—The Grandview & Chrisney Telephone Company has been incorporated, with a capital stock of $5,000.

NEW CROYDON, IND.—The State Line Telephone Company has installed Stromberg-Carlson and Ericsson apparatus and has lately built several miles of line. The outlook is good.

INDIANAPOLIS, IND.—Residents of Russellville have incorporated the Indiana Central Telephone Company with $380 capital stock. Directors: John Grimes, William D. Bowers, John Wilson, James Goff and Fletcher Goff.

MURRAY, IA.—A franchise has been granted to the Southern Iowa Telephone Company.

ELLIOTT, IA.—There is talk of extending east to Center Ridge the Farmers' Mutual Telephone line recently built from Henderson.

COUNCIL BLUFFS, IA.—F. M. Wilson, a banker of Templeton, Ia., wants a franchise to establish and maintain a telephone system in Council Bluffs.

OTTUMWA, IA.—C. M. McFatridge, manager of the Moravia Telephone Company, has sold to the Ottumwa Telephone Company of this city the franchise held by that company, giving it the right to erect and maintain a telephone system in Blakesburg.

WEST BRANCH, IA.—The West Branch Telephone Company uses Stromberg-Carlson apparatus. It operates a 100-drop board, 70 of which are installed. There are 190 subscribers, including eight farmers' lines, and the increase is steady, the service being first class.

HILLSBORO, KAN.—The Hillsboro Telephone Company operates a 120-drop board and has 68 subscribers. The outlook is very good.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company will erect a three-story building next spring to be used for the offices and exchange of the company.

WICHITA, KAN.—Mr. Frank L. Brown, of Topeka, Kan., has obtained a franchise here for an independent telephone exchange, the Council refusing to renew the Bell Company's franchise, which has expired. He new has 600 two-year contracts for telephones at $2.50 per month for business and $1.50 for residence. Nearly all of the signers of contracts are the present users of the Bell telephones. Plans and specifications for the entire plant on the basis of 1500 telephones will be completed in about four weeks and the work of construction pushed to completion as rapidly as possible. The new company will be composed of six citizens of Kansas. Mr. Brown has at present the exchanges at Ottawa with 700 telephones and at Garnett with 150.

DAYTON, KY.—The Eureka Telephone Company, of Chicago, has submitted a proposition to the City Council offering to install an independent exchange. The proposition is received with favor.

PORTLAND, ME.—The Dirigo Telephone Company has petitioned for underground conduit rights.

BOSTON, MASS.—At a meeting of the Massachusetts Telephone & Telegraph Company, the old board of directors retired, and the Telephone, Telegraph & Cable Company of America, which controls the Boston & New York Telephone & Telegraph Company, also the Massachusetts Company, elected the following directors: J. T. Morse, of Boston, Oakes Ames, of Boston, Calvin Austin, of Boston; James M. Thomas, of New York; J. E. McDonald, of New York.

TOWN HOUSE, MICH.—The Rollin Telephone Company, capital stock $10,000, has been incorporated.

GARNES, MINN.—The citizens of this place are discussing the question of establishing a telephone system.

DULUTH, MINN.—The People's Telephone Company has been organized and contemplates doing business on the Range.

DULUTH, MINN.—The Duluth Telephone Company is about to begin work on an extension of its lines to Grand Marais, Minn., on the north shore of Lake Superior.

KNOXVILLE, MO.—Another telephone system is talked of at this place.

KANSAS CITY, MO.—The Kansas City Home Telephone Company, capital stock $50,000, has been incorporated by O. C. Snyder, John Enoch, Ed. J. Barber and others.

ST. LOUIS, MO.—The Supreme Court at Jefferson City, Mo., sustains the State franchise tax law and holds that the assessment of Western Union's franchise by the State Board of Equalization is legal and binding.

SEDALIA, MO.—The representatives of twenty independent telephone companies of Central Missouri held a convention in Sedalia Dec. 3, with F. A. Churchill, of St. Louis, as presiding officer. The object of the meeting is to organize an independent line association for mutual protection and to discuss ways and means for establishing a long-distance independent line.

WINSTON, N. C.—The Mutual Telephone Company connects with independent exchanges at several places and operates long-distance lines. Prospects are very bright.

FRANKLIN, N. H.—At a special meeting of the city government the New England Telephone Company was given permission to set poles and extend a line of wires over the Andover road to the boundary line of the latter town.

MORAVIA, N. Y.—The Empire State Telephone Company has recently established a toll line of eight miles to Dresserville and Sempronius. It operates a 50-drop switchboard and has 23 subscribers, with an expected increase.

COOPERSTOWN, N. Y.—The Ives' Telephone Company, capital stock $25,000, has been incorporated. The charter provides for service throughout Delaware and Otsego counties. The company will immediately take over the present Ives' system in Oneonta and rebuild it in a thorough manner.

HOYTVILLE, OHIO.—A telephone exchange is being established here.

GALLIPOLIS, OHIO.—George Titus, who owns the local telephone system, is building a line to Chambersburg.

CUSTAR, OHIO.—The Weston-Grand Rapids Telephone Company is putting in a branch exchange at Custar.

FAIRVIEW, OHIO.—The Union Telephone Company has increased its capital stock from $10,000 to $25,000.

MANSFIELD, OHIO.—The exchange of the Mansfield Telephone Company will be placed in operation at once.

WASHINGTON, OHIO.—The Union Telephone Company has been granted a franchise by the Washington Council.

GRAND RAPIDS, OHIO.—The Central Union Telephone Company is building a new line between Grand Rapids and Weston.

ASHTABULA, OHIO.—The United States Telephone Company is installing a number of lines in the vicinity of Ashtabula.

TOLEDO, OHIO.—Work is being pushed on the new exchange of the Toledo Home Telephone Company. It will be completed by Feb. 1.

BELLEFONTAINE, OHIO.—Directors of the Bellefontaine Telephone Company have decided to build farmers' lines in various directions.

CLEVELAND, OHIO.—The Cleveland Telephone Company has decided to abandon the use of nickel-in-the-slot telephones as a losing venture.

IRONTON, OHIO.—The Lawrence Telephone Company has increased its capital stock from $24,000 to $50,000 and will make improvements.

SPRINGFIELD, OHIO.—The Central Union Telephone Company is installing a new long-distance line switchboard in its Springfield exchange.

PAINESVILLE, OHIO.—The Central Union Telephone Company will overhaul its Painesville exchange. New wires, poles and cables will be put in.

RAVENNA, OHIO.—The Ravenna Home Telephone Company is enjoying excellent business. Twenty-five orders have been taken in the past three weeks.

ADDISON, OHIO.—A telephone company has been organized at Addison. Mr. Frank Vanden is president, Asa Bradbury secretary and T. J. Daniels, treasurer.

MARION, OHIO.—William Callahan, a Toledo engineer, is in Marion preparing plans and specifications for the new plant of the Marion Country Telephone Company.

BUCYRUS, OHIO.—The Central Union Telephone Company has suddenly stopped work on the reconstruction of its lines in this city and all material is being shipped away.

TOLEDO, OHIO.—The Central Union Telephone Company is making extensive improvements to its East Side exchange. Ten sections of new switchboard have been added.

NORTH RIDGEVILLE, OHIO.—The North Ridgeville Telephone Company has increased its capital stock from $2,000 to $10,000, but only $1,000 additional will be issued.

ASHTABULA, OHIO.—The Central Union Telephone Company will install a branch exchange at Kingsville. Heretofore subscribers have been taken care of from the Ashtabula exchange.

XENIA, OHIO.—Since the recent sale of the Little Miami Telephone Company to the Central Union Telephone Company a number of improvements have been made and expenses have been greatly reduced.

GROVE CITY, OHIO.—The City Council has taken steps to compel the Columbus Citizens' Telephone Company to improve its service and give the same rates as charged by the company it succeeded.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company is considering the advisability of establishing a sub-exchange, to take care of 3000 subscribers. The company will probably erect the building.

NORWALK, OHIO.—The Norwalk & Huron County Telephone Company has brought suit against the Lake Shore Electric Railway Company to restrain the defendant from stringing wires within specified distances from plaintiff's wires.

RAY, OHIO.—The Vigo & Ray Telephone Company has been incorporated, with a capital stock of $5,000. Incorporators: James Boblett, of Vigo; A. J. Graves and P. W. Graves, of Ray; A. H. Reutinger and Charles Duncan, of Chillicothe.

CANTON, OHIO.—The Stark County Commissioners have notified the Central Union Telephone Company that in the future they will not pay more than $27 per annum for telephone service. This is the figure quoted by the new independent company.

RAVENNA, OHIO.—The Central Union Telephone Company has been permanently enjoined from stringing wires past the residence of a farmer near this place. Decision on the right of poles and lines to occupy the land was reserved until January.

BROOKVILLE, OHIO.—The Brookville Telephone Company, J. C. Snider, president, operates a Swedish-American switchboard of 150 drops, and has 70 subscribers. It has 9 miles of toll line, and projects running others into the country and small towns.

HOWARD, OHIO.—A branch of the Bell Telephone Company has been organized here with the following officers: W. A. Ullery, president; C. M. Chubb, secretary; John Berry, Jr., treasurer; T. B. Shipley, manager. The company will build a farmers' system.

BELLEFONTAINE, OHIO.—The new telephone system is a great convenience. The other day a lady called up the exchange stating that she was going to call on a neighbor. She asked the operator to keep her ear on the baby and if it cried to call her up at No. so and so.

KENTON, OHIO.—The Kenton Construction Company has been organized, with a capital of $50,000. It will build telephone exchanges, and the first will be at Orange, Tex. A similar company was organized at Ada a short time ago, and it has built an exchange at Beaumont, ten miles from Orange, Tex.

LIMA, OHIO.—The Lima Business Men's Association is taking concerted action on the proposal of the Central Union Telephone Company to increase rates or else place eight or ten parties on a single line. Party lines were abolished in Lima some years ago, and the citizens do not want them again.

CINCINNATI, OHIO.—Directors of the City & Suburban Telegraph Association have declared the usual quarterly dividend of 1½ per cent, payable Jan. 2. A resolution was adopted to give each male employe a Christmas turkey and to each of the lady operators a dividend of 6 per cent on their wages.

CINCINNATI, OHIO.—It is stated that the City & Suburban Telephone Association, of Cincinnati, is soliciting five-year contracts with the stipulation that any competition will be met. This is taken to indicate that Bell people believe that the independents will secure contracts to the heretofore exclusive field.

TIFFIN, OHIO.—The Central Union Telephone Company has increased its residence rate from $6 to $12 per year. Before the Tiffin Home Telephone Company commenced business the rate was $24, but it was reduced to $6. The Home Company, which gives $12 residence service is now deluged with Bell business.

PORTSMOUTH, OHIO.—The Central Union Telephone Company has completed the work of enlarging and remodeling its exchange. On Dec. 15 more than 200 farmers in Scioto County were connected and given free service with Harrisonville, Sciotoville, Lucasville, Powelsville, Wheelersburg, Rushtown, Buena Vista, as well as towns on the Kentucky side. Lines will be built to Rarden, Otway and Peebles next spring. Two new toll lines will be built to Cincinnati.

COLUMBUS, OHIO.—J. Warren Smith, section director of the Climate and Crop Bureau of the U. S. Weather Bureau, is sending a circular letter to all telephone exchanges in the State, asking their co-operation in disseminating weather reports. The idea is to telegraph daily weather reports to all exchanges in the State, the information to be given to all subscribers who desire it. Weather bureau reports are already circulated by means of the rural free delivery, but the new scheme would insure a much wider circulation and more prompt service.

CHATTANOOGA, TENN.—It is stated by the persons interested that the grantees of the so-called Wilcox franchise will get their charter at once and proceed to construct a telephone system in the city.

SAN ANGELO, TEX.—A local telephone exchange is being put in at Miles City. Mr. S. M. Farmer is the proprietor.

WICHITA FALLS, TEX.—The Texas Telephone Company, with principal office at Wichita Falls, filed an amendment to its charter increasing its capital stock to $6,000.

NACOGDOCHES, TEX.—The local telephone company, owned by Brandt & Sturdevant, has sold out all its interests to an Ohio capitalist. Mr. J. L. Disener is the new company's manager.

ELECTRIC LIGHT AND POWER.

NEW HAVEN, CONN.—It is announced that the New York, New Haven & Hartford Railroad has given contracts for the installation of an electric light and power plant in the new shops of the company at Readville, Mass. The plant will not only illuminate the shops, but will also operate all the shop machinery.

RICHMOND, IND.—The Wayne Works are spending $25,000 in improvements. A new stack is being erected. A set of 400-hp Sterling boilers, and a 125-hp engine are being installed. The engine will be used to run a dynamo and the whole shop will be lighted.

LAKE PROVIDENCE, LA.—The Board of Aldermen has decided to sell at once $20,000 of bonds for a water works and electric light system.

GRAND RAPIDS, MICH.—A $200,000 stock company has been organized and will shortly incorporate to furnish electric light and power and steam heat throughout the city. The company has purchased the street railway's old power house and will remodel it.

LAKE CRYSTAL, MINN.—Fire, caused by spontaneous combustion, destroyed recently Grail Brothers' flour mill, the electric light plant, water works and telephone system. The total loss is $100,000, one-third insured.

TRENTON, N. J.—The United Gas & Electric Company, capital $4,000,000, has been incorporated here. The incorporators are John D. Fearhake and Frank B. Pierce, of New York, and Edward P. Meeker, of Jersey City.

NEWBURGH, N. Y.—The Moodna Light, Water & Power Company, of Newburgh, capital $20,000, has been incorporated. The directors are H. A. Pressey and H. J. Long, of Washington, and W. J. McKay, of Newburgh.

NEW YORK, N. Y.—The following are the local bids for electric lighting for 1902: Manhattan: Brush Electric Light Company, 40 cents per arc light; United States Electric Light & Power Company, 40 cents each; New York Edison Company, 40 cents each, two lights on each post, 50 cents, incandescent, $22.50 a year. The Bronx: New York Edison Company, 40 cents each, incandescent, $25 per year each; Westchester Lighting Company, 40 cents each, incandescent, $25 per annum. Brooklyn: Flatbush Gas Company, 65 lights in Ocean Parkway, 32 cents per night; Edison Electric Illuminating Company, of Brooklyn, 34 cents for 4350 or more. Queens: New York & Queens Electric Lighting & Power Company, 33 cents for 1,650 or more. Richmond: New York & Staten Island Electric Company, 34 cents for 475 or more.

MIAMISBURG, OHIO.—The Miamisburg Council is considering building a municipal lighting plant.

NEW PHILADELPHIA, OHIO.—Messrs. Beyer and Leiser, owners of the electric plant here, are planning to increase its capacity.

CINCINNATI, OHIO.—The Charleston, W. Va., Water, Gas & Electric Company, capital $1,000,000, has been incorporated at Charleston.

ELYRIA, OHIO.—The Citizens' Gas & Electric Company, of Elyria, has been incorporated by W. F. Carr, C. H. Dale, Steven Hitchcock, F. H. Goff and S. H. Tollis, all of Cleveland.

XENIA, OHIO.—John P. Martin, of Xenia, has been awarded a contract for an electric lighting plant at Tampa, Fla. A company in which he is interested is building traction lines in that city.

CUYAHOGA FALLS, OHIO.—The city lighting plant has been abandoned and the machinery is being removed to the water works plant. The two will be operated under the same roof hereafter.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company is preparing to furnish current for the operation by electric power of the Cincinnati & Northwestern Railway, a steam road recently acquired by the Pomeroy-Mandelbaum syndicate of Cleveland.

MASSILLON, OHIO.—It is stated that the recent sale of the Canton-Massillon Electric Railway to the Everett-Moore syndicate did not include the plant of the Massillon Light, Heat & Power Company, the sale of which to the Electric Company of America is probable.

BARBERTON, OHIO.—Some time ago citizens of Barberton voted an issue of $10,000 to build a lighting plant, the plan being to also furnish power to a proposed electric railway. The railway has fallen through and the town is now desirous of making a contract for lighting.

BARBERTON, OHIO.—O. C. Barber is planning to build an immense electric plant to furnish electric light, ice, steam for heating and power, and water, sufficient to supply the needs of the entire town. It will be the aim to make this the only place in the entire town where a boiler or any form of fire will be required.

TOLEDO, OHIO.—The State Board of Public Works has granted the application for a lease of the canal banks, made by George K. Detwiler. The grant will permit Detwiler to string feed wires from his power house on the canal into the center of the city. He will enter into competition for electric lighting with the Toledo Railways & Light Company.

CLEVELAND, OHIO.—The Cleveland Construction Company, which is equipping the Miami and Erie canals for electric propulsion of boats, states that the first section between Cincinnati and Dayton will be in operation April 1. Several engineering difficulties have been encountered, causing delays. Power for the Cincinnati end will be furnished by the Cincinnati Edison Company.

ROCKWOOD, TENN.—The town has voted a bond issue of $6,000 for the purpose of finishing, installing and equipping its electric light plant. The contractors for the Richmond & Petersburg, Va., Electric Railway have completed the road to a point within three miles of Petersburg; the line will probably be completed to this city by Jan. 1. At a meeting of the special lighting committee of the City Council the committee reported favorably on the measure directing the Comptroller to advertise for the building of the municipal electric plant.

DANVILLE, VA.—The Danville Electric Power & Railway Company has been incorporated, with capital stock of $10,000. Geo. F. Anderson and others are interested.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—Articles of incorporation have been filed in Oakland for an opposition ferry system between Oakland and San Francisco to include an electric tunnel railway from Oakland to Goat Island.

FLORENCE, COLO.—The Florence Electric Street Railway Company has been granted a franchise in Canon City.

CHICAGO, ILL.—Nearly 200 trolley cars were burned on the morning of Dec. 15 in a fire which destroyed the barns of the Chicago Union Traction Company at Lincoln and Wrightwood Avenues.

CHICAGO, ILL.—The Chicago Underground Trolley Traction Company, with a capitalization of $2,000,000, has been incorporated at Huron, S. D. The incorporators are D. S. Bergin, A. L. Ringo and Philip Lawrence.

LOUISVILLE, KY.—It is said that early next spring the Jeffersonville, New Albany & Sellersburg Rapid Transit Company will begin the construction of the electric trolley system connecting these three places.

PORTLAND, MAINE.—The Ohio Railway & Light Company, Portland, capital $100,000, has been incorporated by C. D. Booth and H. M. Verrill, Portland, Maine.

FREDERICK, MD.—The promoters of the Washington, Westminster & Gettysburg Electric Railway Company filed a mortgage to the Union Trust Company of Philadelphia, on its property in this State, to secure an issue of $1,850,000 in 5 per cent. gold bonds. The filing of the mortgage is a preliminary step towards the construction of an electric railway from Washington to Gettysburg.

ST. LOUIS, MO.—The Central Belt Railway Company and the Terminal Railway Company of St. Louis are building a fourteen-mile belt line around St. Louis, from the St. Louis and San Francisco terminal on the south to the Burlington & Quincy on the north. The total cost will be over $3,000,000.

EXETER, N. H.—Wallace D. Lovell, of Newton, Mass., has disposed of his electric railway system to the New Hampshire Traction Company, composed of New York and Boston capitalists. The transfer affects the Exeter, Hampton, and Amesbury Railway and its leased lines, the Dover, Somersworth, and Rochester; the Haverhill, Plaistow & Newton, the Seabrook & Hampton Beach, the Amesbury & Hampton, the Haverhill & Plaistow, and the Portsmouth & Exeter railways.

ELIZABETH, N. J.—A certificate of incorporation of another traction company has been filed, the incorporators being Gov. Voorhees, Benjamin A. Vail, of Rahway; Hamilton F. Kean, Julian F. Kean, James Maguire, Frank Bergen of this city, and James B. Cahoon, of New York. The capital stock of the new company is $1,000,000. It is stated that the purpose is to build a street railroad from some point in Elizabeth to a point on the Staten Island Sound, near Boynton Beach. The incorporators elected Mr. Bergen president, James Maguire, treasurer, and Judge Vail secretary.

MONTICELLO, N. Y.—The Monticello, Fallsburgh & White Lake Trolley Company has let the contract for constructing the road to Macatee & Company of Philadelphia.

ALBANY, N. Y.—The People's Traction Company, of New York City, has leased its property and franchises to the Interurban Street Railway Company for a term of 999 years.

BUFFALO, N. Y.—The Lake Shore Traction Company, capital $280,000, has been incorporated. Directors: Arthur C. Wade, A. N. Broadhead, O. L. Becker, W. R. Reynolds, M. R. Stevenson and J. T. Wilson, Jamestown; A. B. Ottaway, Westfield, and Frederick R. Green and Henry D. Kirkover, Jr., Fredonia.

NEW YORK, N. Y.—Mr. E. F. C. Young, president of the North Jersey Street Railway Company, is reported to have said that his company proposes to finish the old tunnel under the Hudson River, between this city and Jersey City, and run its cars through it direct to this city.

ALBANY, N. Y.—The applications of the New York & Brooklyn Union Transportation Company and the New York, Brooklyn & Jersey City Rapid Transit Company to construct and operate railroads through proposed tunnels under the East River from Manhattan to Brooklyn, New York City, has been denied by the State Board of Railroad Commissioners.

BUFFALO, N. Y.—It is stated here that a syndicate of New York, Ohio and Michigan capitalists is now at work securing the right of way for an electric road from Rochester to Buffalo to connect with roads further west now in operation or under construction. The transaction is part of a scheme to extend a trolley line from New York City across New York State into Ohio and ultimately as far as the Mississippi River.

WOOSTER, OHIO.—The Cleveland & Southern Railway has applied for a franchise in Wooster.

DAYTON, OHIO.—The Dayton, Covington & Piqua Traction Company is placing contracts for the erection of its power house at West Milton.

NORWALK, OHIO.—The Norwalk Council has passed an ordinance amending a franchise granted some time ago the Cleveland, Elyria & Western Railway.

LONDON, OHIO.—The Madison County Commissioners have granted a franchise between London and Summerford to the Columbus, London & Springfield Railway.

COLUMBUS, OHIO.—An agreement of consolidation of the Tuscarawas Railway Company and the Tuscarawas Electric Company was filed with the Secretary of State Dec. 4.

AKRON, OHIO.—The city commissioners have approved a franchise asked for by the Northern Ohio Traction Company for a new city line. The company objects to some of the requirements.

PIQUA, OHIO.—The Piqua Council has granted a franchise through town to the Western Ohio Railway Company. This is the last grant required to complete the line from Findlay to Piqua.

FREMONT, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company has applied to the Sandusky County Commissioners for a franchise for its line between Pemberville and Woodville.

ALLIANCE, OHIO.—A blanket franchise for 25 years has been granted to the Alliance Electric Railway Company, covering existing lines and proposed extensions. The company is given the right to furnish light and power throughout the city.

COLUMBUS, OHIO.—The Ripley, Georgetown, Hillsborough & Columbus Railway Company, of Georgetown, has been incorporated with $10,000 capital stock, by M. McKeehan, G. Baumbach, A. M. Kantz, W. J. Marshall, O. E. Bare, and J. R. Moore.

HAMILTON, OHIO.—The promoters of the Cincinnati, Richmond & Muncie Railway are quietly endeavoring to secure the stock of the old Four Mile Valley Railroad which was organized about forty years ago, but never built. It has the right of way into Cincinnati.

CINCINNATI, OHIO.—Stockholders of the Cincinnati, Georgetown & Portsmouth Railroad have ratified the action of the directors in authorizing an increase of capital from $400,000 to $1,500,000, also the issue of $1,000,000 5 per cent. bonds, the money to be spent in extending and introducing electricity.

RIPLEY, OHIO.—The Cincinnati, Georgetown & Portsmouth Electric Railway has made a proposition to extend its line through Ripley, if the citizens will subscribe $100,000 worth of bonds; the money to be due when the road is in operation. At a meeting held Dec. 4, over $30,000 was subscribed and it is believed the balance will be raised.

ST. ALBANS, VT.—The St. Albans Street Railway Company has given the contract for the erection and equipment of the new car house and road to the New England Electric Railroad Construction Company.

THE AUTOMOBILE.

A MOTOR HOT-HOUSE has been constructed for Baron Edmund de Rothschild for the transference during the winter of rare plants and flowers from his country estate to his house in Paris.

FOURNIER SEARCHMONT COMPANY.—The Fournier Searchmont Automobile Company, of Saratoga Springs, has been incorporated, with a capital of $2,000,000, $1,000,000 of which is to be 7 per cent cumulative preferred stock, divided into shares of $100 each. The directors are Spencer Trask, John L. Elliott, Acosta Nichols, L. N. Potter and Cecil Baratt, of New York City; G. Blum, of Philadelphia; Benjamin Prince, of Irvington; Chas. J. Peabody, of Englewood, N. J., and Carl J. Smedborg, of Flushing.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC SPECIALTY COMPANY, Kennett Square, Pa., has been incorporated; capital, $25,000.

THE AUTOMOBILE & CYCLE COMPANY, Kittery, Maine, has been incorporated; capital, $10,000. Incorporators: A. E. Knowlton, Frederick Drowns, Malden, Mass.

THE SHREWSBURY MOTOR WORKS COMPANY, Fair Haven, N. J., has been incorporated; capital, $25,000. Incorporators: Aug. V. Evans, Clarence C. Smock and Warren H. Smock.

THE VEHICLE REPAIR COMPANY OF AMERICA, of New York City, capital $100,000, has been incorporated. Directors: F. C. White, J. H. Burton and L. F. W. Wallace, of New York City.

THE EQUIPMENT MOTOR COMPANY, capital $6,500,000, has been incorporated under New Jersey laws. President Hoadley, of the International Power Company, and A. L. Meyer are said to be interested in the new company.

THE GRINNELL ELECTRIC CABLE CONSTRUCTION AND APPARATUS COMPANY, of New York City, capital $250,000, has been incorporated. Directors: H. B. Grinnell, O. A. Doering and F. E. Thompson, of New York City.

THE CREST MANUFACTURING COMPANY has been incorporated at Cambridgeport, Mass. The business, which is that of manufacturing gasolene motors, automobiles and accessories, has heretofore been conducted under the same name by Messrs. I. H. Davis and E. D. Mullen.

THE UNITED STATES ELECTRIC RAILWAY SUPPLY COMPANY has incorporated in Detroit, Mich., to manufacture trolley stands and other electric railway apparatus. Capital stock, $50,000. Incorporators: Arthur G. and Henry Holland, H. L. Walker, E. L. McConnell, Gordon S. Rutherford and A. E. McKinnon.

THE H. W. JOHNS-MANVILLE COMPANY, of New York City, has been incorporated to manufacture asbestos wares: capital, $3,000,000. Directors: T. E. Wing, H. E. Ballantyne, G. W. Davenport, Robert Dickson, H. M. Wolfe, E. T. Ross, F. W. Knathoff, and H. S. Burroughs, of New York, and W. W. Orr, J. W. Thayer and M. B. Thayer, of Scarsdale, N. Y.

LEGAL.

ELECTRIC VEHICLE ALLEGATIONS.—Two demurrers and an answer have been filed in the New Jersey Court of Chancery in the suits brought by Richard Siegman of New York against the directors of the Electric Storage Battery Company and of the Electric Vehicle Company, on the ground that they participated in various fraudulent stock jobbing transactions and conspiracy to divert from the treasury of the Vehicle company into that of the Battery company certain assets for their personal gain. The demurrers were filed by Corbin & Corbin of Jersey City, representing Martin Maloney and others and

George H. Day and others, the defendants in two of the suits. The answer of the Storage Battery Company was filed by Lindabury, Depue & Foulks of Newark. A sweeping denial is made of the charges in every respect.

TROLLEYMANIA.—A new mental disorder that may hereafter be known as trolleymania was mentioned last week in New York City at the trial of the suit in the Supreme Court by William Hoyt, for many years an employe of the H. B. Claflin Company, against the Metropolitan Street Railway Company for the recovery of $25,000 damages for injuries received in an accident he met with two years ago. According to the testimony, Hoyt was crossing West Broadway at the corner of Worth Street on the evening of March 22, 1899, when he was run down by a trolley car, caught in the fender, and carried a distance of 115 feet before the car was stopped. It was alleged that injuries were received in the accident, and that he suffers from a peculiar delusion, which one of the medical men in the case said might be called trolleymania. Dr. John T. Harrison, of Staten Island, a witness for the plaintiff, testified that ever since the accident Mr. Hoyt had suffered from the delusion that he was being pursued by trolley cars and also that the air was full of the clamor of trolley gongs. A verdict of $10,000 was awarded.

TO REVERT TO CONTROL OF RECEIVERS.—A rather unusual legal tangle resulting from the purchase by the Northern Ohio Traction Company of the property of the Akron Street Railway & Illuminating Company, has been settled by Judge F. J. Wing, of the United States Circuit Court, Cleveland. In May, 1898, a Mrs. De Mangeont was fatally injured by a car in Akron. Her administrator sued for $10,000 and the action was brought against the receivers of the company. Before the case was brought to trial, the road was sold to the Northern Ohio Traction Company, and the receivers applied to the court asking that they be barred from further prosecution, on the ground that they had been discharged from receivership. This claim was set up during the October term of court, and it being a new phase, the attorneys for the plaintiff asked for a continuance to the January term pending further investigation. A motion for the plaintiff was immediately filed in the Circuit Court asking that the discharge of the receivers be vacated for the purpose of having them remain as defendants in the action. Judge Wing granted the order asked for by ordering the Northern Ohio Traction Company, to appear before the Summit County Common Pleas Court as defendant in the case. Failing to do this the court orders that the receivers who were discharged in February, 1900, be reinstated, and that the property now in the hands of the Northern Ohio Traction Company be returned to the control of the receivers until the case is settled.

PERSONAL.

MR. J. L. PUTNAM has recently been elected manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I.

MR. ANDREW CARNEGIE, who was himself at one time a telegraph operator, is said to be entertaining some plans for the benefit of veteran and decayed members of the craft.

MR. LEMUEL BANNISTER, well known from his prominent connection with Westinghouse Electric interests abroad, has, it is stated by cable, resigned from such management, etc.

MR. T. A. EDISON has been reported seriously ill, but "there is life in the old dog" and lots of work for many years to come. The Edisons are a hardy race, live long, and are stayers. It is a pity Mr. Edison has always had a low opinion of holidays, but he keeps Christmas.

COL. ROBERT ANDREWS.—Directors of the Safety Car-Heating & Lighting Company have elected Col. Robert Andrews president of the company, succeeding the late Arthur W. Soper. Col. Andrews was formerly vice-president. The vacancy in the board was filled by the election of A. G. Soper.

MR. C. L. EDGAR, president of the Edison Electric Illuminating Company of Boston, was in New York City last week and spoke with pleasure of the satisfactory close of the consolidation of the lighting interests in that city. He took occasion to make a careful inspection of the new Waterside station of the New York Edison Company.

MR. HENRY C. PAYNE, of Milwaukee, Wis., will become Postmaster-General in President Roosevelt's cabinet. He is a Republican leader in the West. He is an old telegraph operator, and is heavily interested in telephone and electric railway enterprises in Wisconsin. There are rumors that the Government proposes to try taking over the telegraphs.

MR. FRANCIS H. SHEPARD, who has recently been abroad, has just returned. Mr. Shepard has resigned his position with the Sprague Electric Company, where he has acted as assistant to Mr. Frank J. Sprague in his engineering work, and has accepted a very responsible position with an English syndicate to carry on important work in heavy electric traction in that country. Mr. Shepard will return to England in February.

MR. C. C. ADAMS.—It is stated from Philadelphia that C. C. Adams has been agreed upon by the directors of the American District Telegraph Company as president of that corporation, to succeed the late Edward J. Matthews. Mr. Adams is now vice-president and general manager of the company, and his selection for the presidency is in line of promotion and recognition of long service. He is the local manager of the Postal Telegraph Company.

MR. U. N. BETHELL, the general manager of the New York Telephone Company, who lately took charge of Bell telephone work in Washington, etc., has now been elected president of the Chesapeake & Potomac Telephone Company, in the place of Judge Wilson, recently deceased, and a member of the board of directors. It is understood that the headquarters will not be removed to either New York or Baltimore, but will remain in Washington, Mr. Bethell making trips every week to that city.

MR. CORNELIUS VANDERBILT lectured before the Society of Arts at Boston on Dec. 12, in the Institute of Technology, his subject being locomotive boilers. Before he finished he referred to the fact that his boilers are adapted to the use of oil as fuel. Five of his engines are now in use on the Central and several on the Baltimore & Ohio, Union Pacific, Southern Pacific, and other roads. Electricity for trunk lines he considered out of the question, at least for the present, although for local traffic it is all right.

MR. WILLIAM B. CLAFFLIN has been appointed architect to the New York & New Jersey Telephone Company. This company expects to soon erect three or four handsome buildings in Brooklyn for use, in part, by its exchanges, and their design and construction will be in Mr. Claflin's charge. Although a Philadelphian he has spent his active professional life since graduation from the Massachusetts Institute of Technology in New York City, having been connected with the firms of McKim, Mead & White and Carrère & Hastings. In his new duties Mr. Claflin will be closely associated with Mr. Bancroft Gherardi, Jr., chief engineer of the telephone company.

MR. F. S. WILLIAMSON, a member of the firm of Charles Henry Davis & Company, is selected, it is said, as consulting engineer to the Department of Public Works under the Low regime. He is an Englishman. During his engineering experience he has furnished many reports as expert, among them, upon changing the Vera Cruz tramways from horse to electricity, and opened a bridge over the Hudson at Peekskill for Sir Douglas Fox, the English engineer. The city has called him in as expert in several instances, notably upon the failure of the gas-tank on the East Side three years ago. He was also engaged on the Boston Rapid Transit Subways. He has been a member of the American Society of Civil Engineers for fifteen years, and is also a member of the British Institute of Civil Engineers, and the Canadian Society of Civil Engineers.

EDUCATIONAL.

TELEPHONY AT PURDUE UNIVERSITY.—It is announced that Purdue University is to have a new department. It will be a course in telephonic engineering, and will embrace all the scientific theoretical and practical phases of this great and growing branch of electrical work. The new course will begin next February, and the junior and senior members of the school of electrical engineering will be required to devote about one-half of their time to the subject. The course will be complete in every detail and will embrace all the necessary training for the sending out of a skilled workman in this field. The new department was added only after the most serious and careful consideration by the trustees and faculty of Purdue, and was designed to meet a growing demand for competent telephonic engineers. Professor J. C. Kelsey, a graduate of the University of Nebraska, and a man of broad experience and learning, will have charge of the new department. Mr. Kelsey comes highly recommended by telephone men from all over the United States. He is thirty years of age, and is now with the Duluth, Minn., Telephone Company. Mr. Kelsey was formerly with the Western Electric Company, of Chicago, and is considered a most competent and thoroughly up-to-date teacher of telephony. Prof. W. C. Goldsborough of the electrical department, deserves great credit for the efforts that he has put forth in getting the new course arranged and instituted at Purdue. It is also greatly to the credit of the Sterling Electric Company, of Lafayette, Ind., the well known telephone manufacturers, that it has co-operated in securing this recognition of the importance of telephonic work.

Trade Notes.

THE LITTLE GEM ROSETTES, manufactured by Pass & Seymour, Incorporated, Solvay, N. Y., are the subject of a little artistically illustrated pamphlet just issued by the company. These rosettes are made for all classes of wiring.

THE SMITH & HEMENWAY COMPANY, 296 Broadway, New York City, one of the youngest and foremost hardware firms, is the publisher of a unique catalogue known as the Green Book of Hardware Specialties, which will be sent free to any one on application.

"SOLID" TELEPHONE RECEIVER.—Wm. J. Murdock & Company, Chelsea, Mass., makers of the "solid" telephone receiver are calling attention to the good points of this instrument in a neat booklet just issued. This receiver was described and illustrated in our issue of Dec. 7.

HYDRAULIC VALVES.—The Watson-Stillman Company, 204 East Forty-third Street, New York, has in preparation its sectional catalogue No. 63, relating to high pressure hydraulic valves and fittings. A copy may be obtained by any one interested in this line, by applying to the company, stating the line of business, position, etc.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently received an order from the De Beers Consolidated Mining Compony, Limited, of Kimberly, South Africa, for a very large Cross oil filter to be used in its new power house. Only American machinery will be employed in this plant, and the Burt Company considers this a strong endorsement of its filter.

VICTOR COOLING TOWERS.—In a pamphlet issued by the Victor Cooling Tower Company, St. Louis, Mo., is described and illustrated the Victor water cooling tower for condensing engines. Among the illustrations are several half-tone views of actual installations of these towers. The Laufketter-Bendit Mercantile Engineering Company, 810 Olive Street, St. Louis, is the general sales agent.

ELECTRICAL LEAD REDUCTION.—This interesting application of electric power at Niagara Falls is described in the pamphlet of the Electrical Lead Reduction Company, whose principal offices are in Philadelphia, and works at Niagara Falls. This process of converting lead ore into various lead compounds is claimed to be the cheapest, quickest and most efficient. The works at Niagara Falls are shown in a double page illustration.

RECORDING PRESSURE AND VACUUM GAUGES.—The Bristol Company, Waterbury, Conn., recently issued a revised catalogue of its recording pressure and vacuum gauges. The list covers all ranges of pressure adapted to all possible uses. The company will be pleased to mail copies of this catalogue on application. It is now preparing new editions of its catalogues of recording instruments for temperature and electricity.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is rapidly progressing in the making of the special tools, dies and machinery necessary for the manufacture of the many new features in its various

systems for central energy and generator call, public and private telephone plants. From present indications, it is claimed, it will have some of its equipment on the market within the next few months.

ALTERNATING ENCLOSED ARC LAMPS.—The Dayton Fan & Motor Company, Dayton, Ohio, has issued a leaflet calling attention to the main points of the alternating enclosed arc lamps on the Belden system, which are manufactured by it.

STERLING LAMPS.—Symmetrical distribution from incandescent lamps is the subject of a pamphlet just issued by the Sterling Electrical Manufacturing Company, Warren, Ohio. The article, which is reprinted from these columns, refers to the Sterling special incandescent lamp. All interested in lighting should read this pamphlet, which deals with one of the latest developments in incandescent lamp manufacture.

LUNDELL MOTORS.—The applications of Lundell motors of the various types for the driving of machines of different kinds are well shown in Bulletin No. 207, just issued by the Sprague Electric Company, New York. The advantages of operating machines with Lundell motors are briefly enumerated. The Bulletin is almost wholly taken up, however, with illustrations showing a large variety of applications of these well-known motors.

RAILWAY STORAGE BATTERY PLANTS.—Bulletin No. 67 of the Electric Storage Battery Company, Philadelphia, Pa., consists of a description of the storage battery equipment of the Brooklyn Heights Railway Company, written by Franklin E. Morse, superintendent of power, Brooklyn Heights Railway Company, and reprinted from the *Street Railway Journal*. The paper is illustrated by curves, and a feeder diagram of the Brighton Beach line.

HOT WATER PACKING.—After exhaustive tests covering a period of two years the H. W. Johns Manufacturing Company has placed on the market a packing to be used on plungers and rods of pumps, delivering water at a temperature above 180 degrees F. In every test which has been made, this packing has lasted six times as long as any other packing subjected to the same conditions. The Kearsarge asbesto-metallic packings, produced by this company, are meeting with ever widening favor.

"THE NIGHTS OF OTHER DAYS" is the title of a pamphlet containing some "glimmerings of the past and the brilliancy of the present, by Packard," just issued by the New York & Ohio Company, Warren, Ohio. The story, which is brief and lively, starts from the early dawn of light and rapidly leads us down to the Packard incandescent lamp. There is a ring and a melody to it that will arrest the attention of the lamp man long enough to read it through and enjoy a good laugh. Then he will be in the humor to order some Packard lamps.

COLGATE WIRING COMPUTER.—Mr. A. E. Colgate, 56 Pine Street, New York City, has sent us a sample of his neat and handy wiring computer, to be carried in the vest pocket. It is 6 inches long, 1 inch wide and ¼ inch thick, and is of the slide variety. It is strong, with wooden case, ivory slide, and mica cap, bound with brass. The owner can quickly figure out sizes for given loss, carrying capacity, distances, etc. On the back is a table of the safe carrying capacities for interior wiring which must not be exceeded from No. 16 to No. 0000, with the amperes for each.

FEED-WATER PURIFIERS.—The Hoppes Manufacturing Company, Springfield, Ohio, has just issued a catalogue describing and illustrating its line steam feed-water purifier, standard exhaust steam feed-water heater, new cast-iron feed-water heater, the method of connecting feed-water heaters by means of the company's new induction chamber, its steam separator and oil eliminator, and its new cast iron exhaust head. The illustrations are artistically executed, many of them showing views of actual installations, heaters in transit, etc. The catalogue will interest every one concerned in steam generation.

HUBBARD, HALL & COMPANY, of Cincinnati, Ohio, is a live, up-to-date business house. They are shipping goods in larger quantities than ever and are receiving inquiries from all sections. They are agents for the Adams-Bagnall Electric Company's arc lamps for inside and outside lighting, also for the Columbia Incandescent Lamp Company, and are having no trouble in renewing their contracts which were in force last year, and are taking on new ones frequently. They are just issuing their new calendars for this year, which are accompanied by a letter printed on Cincinnati souvenir paper, and make an attractive design and idea.

TELEPHONE APPARATUS.—In a circular addressed to "The Discriminating Public" the Kellogg Switchboard & Supply Company, Chicago, Ill., makes some common-sense remarks on the selection and purchase of telephone apparatus, and it makes a special introductory offer to introduce the Kellogg receiver and transmitter. Telephone outfits and switchboards of the express, the Bell and the combination central energy and magneto types are illustrated, brief descriptive notes accompanying the illustrations. The last page of the circular contains a view of the Kellogg Company's factory and a history of its successful career.

WARREN ALTERNATORS.—The Warren Electric Manufacturing Company, Sandusky, Ohio, recently brought out a fine catalogue, of quarto size, giving seven full-page illustrations of its apparatus of the various styles, and one page showing detail views of the Warren transformer. The illustrations are depended upon to tell their own story, as they are unaccompanied by any descriptive matter. They are so clearly executed, however, that they need no description in words. The cover is of dark slate color, with a panel of silver bearing the words, "Warren Alternator," printed in black letters. It is a very attractive and artistic production.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out a very neat circular on something that is entirely new, and should prove invaluable to contractors and construction men in general. This circular illustrates a new unit type of combined switch and enclosed fuse carrier. By carrying a small stock of these, first-class panel boards of any number of circuits can be built on short notice from these fuse carriers. This would certainly seem to be exactly what every contractor has been looking for, thus saving the delay of having to order boards from the manufacturer. This is one of the most useful and practical devices that has been gotten out for some time.

THE ELECTRICAL MATERIAL COMPANY, Baltimore, Md., has just issued an attractive catalogue of 212 pages covering the electrical field quite fully. It is a very comprehensive production and the claim of the company that it deals in "all things electrical" seems to be justified, since the list includes everything in the way of electrical apparatus and supplies. It is seldom that in a catalogue of this character such articles as dynamos, vitrified conduits, etc., are listed, but in this catalogue these are found, with many other things that rarely enter regular catalogues. The Electrical Material Company carries a stock of supplies in all electrical branches—telephony, telegraphy, electric light, electric railway, transmission, for the household, etc. The catalogue has a neat embossed cover, and is profusely illustrated, the text and illustrations being printed in green.

"THE LIVING AGE."—During the fifty-eight years of its existence this sterling weekly magazine has steadily maintained its high standard. It is a thoroughly satisfactory compilation of the most valuable literature of the day, and as such is unrivalled. As periodicals of all sorts continue to multiply, this magazine continues to increase in value; and it has become quite indispensable to the American reader. By its aid he can, with an economy of time, labor, and money otherwise impracticable, keep well abreast with the literary and scientific progress of Europe in a very satisfactory manner. It is the most comprehensive of magazines, and its prospectus is well worth the attention of all who are selecting their reading matter for the new year. To all new subscribers for 1902, the publishers offer free the Seventeen Weekly Issues for the four months September to December, 1901, inclusive, until the edition is exhausted. *The Living Age* Company, Boston, is the publisher.

A MAMMOTH CATALOGUE.—We doubt if a larger trade catalogue is published than that of Manning, Maxwell & Moore, 85 Liberty Street, New York, the well-known dealers in machinery and supplies. The 1902 catalogue, which is just out, contains a total of 1056 pages, including 7538 illustrations, the pages measuring 12½x9½ inches. The list includes everything imaginable in the way of supplies for railways, steamships, machinists, factories and mills, also electrical supplies. The index alone takes up 38 pages, three columns to the page, and at the back there are several pages of useful tables. It used to be the fashion, in referring to a large and varied business, to say that it dealt in everything, from a needle to an anchor. Here is a case where this idea finds a concrete example, and while we do not find needles in the list we do find anchors and other things of iron and steel much heavier. There are many articles quite as small as needles, however, such as fine drills, etc., hence the application practically holds good. The range of subjects represented by the illustrations is a very wide one indeed, and everything in the mechanical line seems to be included. The volume is substantially bound in heavy boards, and will rightfully claim first place among trade catalogue libraries.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DEC. 10, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

688,008. TOLL COLLECTING MACHINE FOR TELEPHONES; W. A. Foss, Cleveland, Ohio. App. filed March 25, 1901. (See Current News and Notes.)

688,282. ELECTRIC SWITCH; C. A. Bergstrom, New York, N. Y. App. filed July 21, 1900. Details.

688,291. ELECTRIC STORAGE BATTERY OR ACCUMULATOR; Wm. J. Buckley, Chicago, Ill. App. filed Sept. 1, 1900. A high-tension battery in which a partition of ebonite or similar material fits into dovetailed grooves in a receptacle. Each side of the partition has ribs fastened in the form of grooves in which the active element is inserted. The elements consist of a series of thin lead strips which are formed into a metallic frame, and between which the active material is included, the completed plates being slid into the grooves in the partition. To complete the connection between the cells, the plates on either side of the same partition are connected at the top.

688,293. TELEPHONY; Geo. A. Cardwell, New York, N. Y. App. filed Nov. 16, 1899, renewed May 10, 1901. (See page 1026.)

688,317. WINDING FOR ELECTRIC MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed April 17, 1900. Coils are wound into final form before insertion into the core slots, except as to one end; these latter ends being free, the coil is enabled to be inserted in the slot when the free ends are connected up.

688,318. WINDING FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed April 30, 1901. Bars of different lengths are used which are in such groups that the bars of each group shall have a minimum difference of potential. The ends of the bars of each group are spread apart, thus providing sufficient space for attaching the end connectors, and at the same time insuring a sufficient degree of separation for connectors to provide proper ventilation.

688,337. MEANS FOR ELECTRICALLY CONNECTING RAILWAY CARS; E. B. W. Reichel, Berlin, Germany. App. filed Feb. 19, 1901. A coupling consisting of two pivoted levers, one on each car, and one resting by its weight upon the top of the other.

688,340. DIRECT-CURRENT DYNAMO-ELECTRIC MACHINE; August Roth, of Berlin, Germany. App. filed May 19, 1900. An auxiliary magnet is employed, being placed in the pole gap, and at an angle longitudinally with a plane through the axis of the armature; the magnet windings are in series with the armature. The object of the arrangement is to overcome the deleterious effects of armature reaction.

688,346. TROLLEY POLE FOR ELECTRIC CARS; P. Scholtes, Mount Oliver, Pa. App. filed Sept. 16, 1901. A locking device holding the wire upon the wheel until it is released by pulling the rope.

688,359. CIRCUIT BREAKING DEVICE FOR ELECTRICAL CIRCUITS; Lewis B. Stillwell, of Niagara Falls, N. Y. App. filed June 12, 1900. A time-element and non-reversible circuit breaker, A clock-work retards the opening of the circuit, upon excessive current flow in normal direction; upon excessive flow in reverse direction, a small motor causes a locking arm to stop the clockwork before the circuit is broken.

688,364. ELECTRIC FURNACE; E. R. Taylor, Penn Yan, N. Y. App. filed Dec. 21, 1899, renewed April 18, 1901. (See page 1028.)

688,382. MECHANISM FOR TRANSMITTING POWER TO DYNAMO MACHINES; Otto Bohn, Oberschonweide, Germany. App. filed Aug. 22, 1901. Frictional transmitting devices are interposed between the driving and driven parts, which through the intermediary of a spring produces a certain amount of frictional pressure; an electromagnet is provided to counteract this friction pressure. The excitation is controlled by the terminal voltage of the machine driven.

688,393.—ELECTRIC FURNACE; Ramon Chavarria Contardo, Sevres, France. App. filed May 22, 1901. The furnace is mounted on trunnions and means are provided for oscillating the same.

688,394. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. The air pressure in the braking system of a train is used as a part of the regulating apparatus of a train-lighting generator driven from the axle.

688,401. ELECTRICAL APPARATUS; J. E. Everett, Indianapolis, Ind. App. filed Feb. 21, 1901. The armature conductors of a dynamo or motor are connected with a false commutator and the real commutator is held against the false commutator so that corresponding segments will be in contact. This provides for renewing the real commutator without disconnecting the armature wires.

688,403. ELECTRIC BATTERY; G. W. Frazier, Allegheny, Pa. App. filed Feb. 14, 1901. A dry cell is provided with a plugged-up hole in the bottom, through which to introduce moisture and electrolyte, after the cell has become apparently exhausted.

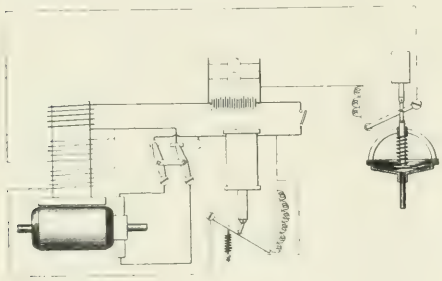
688,404. SMOKE DETECTOR; O. Freyman and C. Tolman, Brooklyn, N. Y. App. filed April 1, 1901. (See Current News and Notes.)

688,423. COMMUTATOR BRUSH HOLDER; H. J. W. Lloyd, Des Moines, Ia. App. filed Feb. 11, 1901. Details.

688,433. TELEPHONE RECEIVER; F. J. Orr, Holland, N. Y. App. filed Jan. 12, 1901. (See page 1026.)

688,452. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 31, 1900. (See page 1026.)

688,456. ELECTRO-MECHANICAL AUTOMATIC STREET RAILWAY SWITCH; Walter J. Bell, Los Angeles, Calif. App. filed July 2, 1901. An arrangement whereby the motorman can switch a car without alighting from it or stopping it. A contact is made on the side of a trolley pole, which



688,394.—System of Electrical Distribution.

closes a circuit supplying power to operate the track switch; mechanical means operated by the car resets the switch.

688,458. STEREOSCOPIC X-RAY APPARATUS; E. W. Caldwell, New York, N. Y. App. filed Sept. 27, 1901. (See Current News and Notes.)

688,480. ELECTRIC LAMP AND SOCKET THEREFOR; D. D. Nugent, Harrison, N. J. App. filed Jan. 4, 1901. The bulb is formed with a bead which is grasped by spring fingers projecting from the socket, the only metallic portion of the base being a disk across the end of the neck.

688,486. TROLLEY CONTACT POLE; E. B. Robertson, Philadelphia, Pa. App. filed July 12, 1901. The trolley pole is provided near its center with a hinged joint and a supplemental spring is inserted between the two parts to cause the wheel to more surely hug the wire.

688,494. THERMO-ELECTRODYNAMIC TRANSFORMER; Philip K. Stern, New York, N. Y. App. filed Feb. 15, 1901. The hollow interiors of the pole piece of a revolving field serve as the steam cylinders of a single-acting engine of the Brotherhood type.

688,506. ELECTRICAL CONTROLLER ATTACHMENT; G. L. Fairbrother, Thompsonville, Conn. App. filed April 19, 1901. A plate adapted to be attached to the top of the controller to lock the controller handle at each point until it is unlocked by the motorman.

688,509. TROLLEY; F. W. Garrett, Johnstown, Pa. App. filed Dec. 1, 1899. To afford good contact between the wheel and harp a brush is secured to the wheel and bears against the harp.

688,554. CIRCUIT MAKING AND BREAKING DEVICE; J. F. Skirrow, East Orange, N. J. App. filed Feb. 4, 1901. A relay or sounder in which the armature is mounted on spring strips instead of a hinge, thus permitting the current to pass directly through the armature instead of through a separate contact strip attached thereto.

688,568. TROLLEY; M. J. Wilson, Painesville, Pa. App. filed Aug. 12, 1901. Details.

688,572. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App filed Feb. 26, 1898. The switch magnet for delivering current from the feeder to the section is mounted on a carriage and drawn through a conduit by a magnet carried by the car.

688,575. ELECTRIC LAMP; Henry Baggett, Blackheath, Eng. App. filed Sept. 13, 1899. Improvements in the braking arrangement of cord lamps. A drag device is provided with a vertically movable gravity support adapted to be raised and lowered by a movement of the carbon-feeding mechanism so as to lower the drag device against the periphery of the pulley and to raise it therefrom.

688,583. ELECTRIC KNIFE SWITCH; W. F. Bossert, Utica, N. Y. App. filed May 20, 1901. Details.

688,614. REGULATOR; Augustine R. [illegible] Lynn, Mass. App. filed May 4, 1899. Two moving contacts operate to vary the turns of the secondary winding from both its ends. The working circuit, instead of being connected across the supply mains, has one of its terminals connected to the one of the supply mains to which the primary of the working transformer is connected, and the other to an intermediate point in the primary.

688,629. TROLLEY WHEEL GUARD; E. W. Gailey, Allegheny, Pa. App. filed May 13, 1901. Fingers projecting radially from disks on each side of the trolley wheel serve as guards to hold the wire in place. The fingers will yield in case they are struck, and afterwards will return to their normal position.

688,649. ELECTRIC ARC LAMP; Chas. H. Kayser, Orange, N. J. App. filed March 5, 1901. A simplified construction of a lamp for use in connection with kinetoscopes, stereopticons and similar projecting apparatus, the lamp being equally adapted for use with alternating and direct currents.

688,650. APPARATUS FOR MEASURING ELECTRICAL ENERGY; R. Kennedy, Leeds, Eng. App. filed Feb. 21, 1901. (See Current News and Notes.)

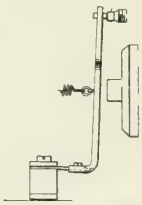
688,673. TELEPHONE SYSTEM; Chas. H. North, Cleveland, Ohio. App. filed May 17, 1900. (See page 1026.)

688,676. TELEPHONE; W. S. Paca, Baltimore, Md. App. filed Jan. 20, 1897. (See page 1026.)

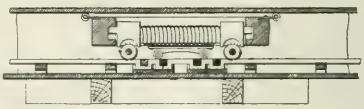
688,724. ELECTRIC SIGNALING DEVICE FOR RAILWAYS; W. A. Farrel, Wellsville, N. Y. App. filed April 1, 1901. Means for sounding an alarm in a cab of a locomotive in case a switch ahead is open.

688,738. ELECTRIC SWITCH; J. Jones and J. Jones, Jr., New York, N. Y. App. filed Nov. 6, 1900. Details.

688,749. STORAGE BATTERY TRAY OR CASE; Elmer A. Sperry, Cleveland, Ohio. App. filed Sept. 13, 1899. The case of each cell is of thin metal constituting one of the electrodes; a tray or receptable for cases has a number of stiff separating partitions which are arranged in contact with the



688,554.—Circuit Making and Breaking Device.



688,572.—Electric Railway.

side walls of the adjacent cases, insulating material being placed between the several individual cases.

688,781. CUT-OUT FOR CRANES; G. A. Hassel, McKeesport, Pa. App. filed July 27, 1901. An automatic circuit opener operating in case the attendant does not stop the motor at the proper time.

688,788. PRIMARY BATTERY; H. I. Lurye, New York, N. Y. App. filed Jan. 30, 1901. A battery comprising an outer jar and an inner receptacle open at top and bottom and having a lower straining portion and an outwardly-extended flange made to form a bottom or support in the outer jar, said outer jar being made to form a reservoir for crystals or the like and said inner receptacle being made to contain elements within said receptacle.

688,797. ELECTRIC RAILWAY SWITCH; Philip Siegel, New York. App. filed June 13, 1901. The track switchpoint is worked by an electro-magnet which is controlled by a switch on the car.

688,805. ALTERNATING CURRENT MOTOR; E. Wilson, County of Kent, Eng. App. filed Jan. 17, 1893. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVIII. NEW YORK, SATURDAY, DECEMBER 28, 1901. No. 26.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1901, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 28, 1901.

CONTENTS.

PAGES
Editorial 1049
November Foreign Trade 1052
Government Wireless Telegraphy 1052
Electrical Engineers of the Day—XXVI.—Arthur Vaughan Abbott 1052
Lighting and Railway Development on Staten Island. By Max Loewenthal, E. E. 1053
Alternators with Dampers. By J. Fischer-Hinnen 1058
Rotary Converters vs. Motor-Generators 1062
The Economic Design and Management of Telephone Exchanges—IV. By Arthur V. Abbott, C. E. 1063
Edison Iron-Ore Extraction in Norway 1064
Electrical Tabulation in the Twelfth Census 1065
A Notable Theft of Current at Madison, Wis. 1067
Bell Telephone in the Central States 1067
Postmaster-General Payne 1068
Committees of the Automobile Club of America 1068
Copper Conditions 1068
Marconi and Trans-Atlantic Wireless Telegraphy 1069
New York Electrical Society 1069
A Woman in Independent Telephony 1069
New Telephone Patents 1070
Current News and Notes 1071
LETTERS TO THE EDITORS:
Direction of Street Car Travel. By J. S. Badger 1072
A 10,000-volt shock. By Henri Pieper 1073
Combined Telegraph and Telephone Service. By Romyn Hitchcock 1073
Money Order Telephony. By Louis J. Abrahams 1073
Properties of Collector Rings. By H. St. Martin 1073
Pressure of Radiation. By J. W. Darley, Jr. 1073
Digest of Current Electrical Literature 1074
New Books 1078
Tests of Mechanical Stokers at the General Electric Company's Works at Schenectady. By William B. Roney 1079
Pile Block Dry Battery 1080
Motor Condensers 1080
Switchboard Apparatus 1080
DEPARTMENTS:
Financial Intelligence 1082
Commercial Intelligence 1083
General News 1085
Trade Notes 1089
Record of Electrical Patents 1089

REMODELING LIGHT AND POWER SYSTEMS.

An unusually interesting article will be found in this issue descriptive of the system of the New York & Staten Island Electric Company. The interest consists not so much, perhaps, in the mere work, for other lighting and railway plants and networks have been merged before this, but in the peculiar conditions that have combined to create elements of difficulty. While dealing essentially with an urban population, the company has had to operate in rural regions close to the sea, very hilly, with houses greatly scattered; and has to meet the present situation with a mass of unrelated and inharmonious apparatus, good in itself, but of almost hopeless difference in function and characteristics. Its problems are, indeed, those of all systems that have to be unified for the sake of simplicity and better service to the community, but those who know Staten Island and its electrical history realize that the work there has been very onerous. There is a report that the company, in its efforts and its large expenditures, has scarcely secured the public support and sympathy to which it is entitled, but we believe that at no distant date the benefits it is seeking to confer with a modern up-to-date lighting and traction service will be fully appreciated.

POSTMASTER-GENERAL PAYNE.

The selection of Mr. Henry C. Payne, of Milwaukee, as Postmaster General, is an appointment which gives pleasure not alone to his countrymen in general and Republicans in particular, but is noted with much pride by all engaged in electrical pursuits. President Roosevelt will find in Mr. Payne a valuable addition to his Cabinet, for Mr. Payne is far more than a shrewd and able politician. He is a man of affairs, who has been trained in the exacting school of electrical development, and has ever shown himself progressive as the electrical arts and industries with which he is associated have advanced. Beginning with the telephone in its early days he has successively become interested in electric lighting and in electric traction, and with regard to these industrial departments of electricity has been a conspicuous figure. There have been other members of our National Cabinets with electrical interests, but so far as we know, Mr. Payne is distinctively the first manager of electrical properties who has reached the exalted position of active membership in any administration.

The fact that Mr. Payne was once a successful postmaster of Milwaukee and has always been an alert and busy telephone man, renders him peculiarly fit for his new office. But we regret to note that attempts have been made immediately to associate him with schemes for government purchase of the telegraphs of the country. The most circumstantial of these reports insists that the Government proposes to purchase the properties by the issuance of 2 or 2½ per cent bonds. Now, it is obvious that the new Postmaster General must know of such plans if they exist, and be in sympathy with them; in fact, one dispatch from Washington goes so far as this:

"It is said that a bill drawn on the plan indicated will be introduced soon after the holidays by a prominent Administration Senator. It has been reported that Mr. Payne, who is to be the new Postmaster General, is in favor of the Government ownership of the telegraphs. In his published interviews since his selection for this office he has refrained from publicly expressing his views, although he has allowed the intimation to be made that the reports as to his position were correct. If, after his arrival in Washington,

it should be developed that part of his programme is to carry to a successful conclusion this new Government enterprise, he would be the seventh Postmaster General who has urged and fought for the proposition. The others have been Johnson, Randall, Maynard, Howe, Cresswell and Wanamaker."

With respect to the above and to Mr. Payne's views, we are glad to give his authoritative denial. Having addressed him in regard to this very point since his selection for the office, Mr. Payne has kindly sent us the following communication:

"There is not the slightest foundation for the report which you say is current in the papers regarding my views as to the purchase and transfer of the telegraphs of the country to the Government. I cannot imagine how such a report should have been put into circulation."

This is, it seems to us, sufficiently emphatic to put a quietus on the reports now being circulated, the only object of which would appear to be the creation by speculators of a little boom in telegraph stocks.

Mr. Marconi's Work.

The encomiums bestowed upon Mr. Marconi for his great feat in signaling across the Atlantic by "wireless" methods have been hearty, universal and well deserved. This inventor is a man of high type in his line of work, and possesses to a marked degree the patience, earnestness and dogged perseverance, without which even the grandest ideas in the arts remain useless to humanity. These qualities are indeed such as Mr. Marconi needs in full measure, for notable as his achievement is, much serious work remains ahead of him if further success is to be attained. It is true that the fine work done this month is far beyond a mere "laboratory" experiment; and yet it is not less true that after years of effort no real success has been reached in making the apparatus "selective" or "speedy." Until it becomes both, it cannot very well compete in any sense with ocean cables, although other great fields of service may be open to it.

We regret to note the clash between Mr. Marconi and the Anglo-American Cable people, but it was perhaps inevitable, or due to misunderstandings. The success of the experiment depended, indeed, on cable co-operation, and aside from the scientific aspects of the case, the cable company had rights and obligations that could not be overlooked. Moreover, there is unfortunately reason to suspect that on the part of some persons aware of what Mr. Marconi was doing, an intention existed to gamble in wireless stocks and on the depression of cable properties. Thus the cable companies, while on one hand made to appear before the public in a dog-in-the-manger attitude, found themselves and their properties subject to severe financial assault. While we have no sympathy with their obstructiveness, if it were really all that has been asserted, it must be allowed that they had some ground for indignation and exasperation. In this connection, the oddest spectacle was presented by some persons in New York City, virtually discrediting or doubting the wonderful performance because, apparently, they were taken by surprise by the premature announcement, and hence "got left" in speculative deals with profit in them.

Electrical Measurements of Projectile Speed.

The method of determining the muzzle velocity of projectiles which was formarly in nearly universal use is attributed to Wheatstone. As is well known, it consists in setting up a pair of wire screens across the path of the projectile, one conveniently close to the muzle of the gun, and the other at a convenient known distance beyond, say, 100 meters. Each wire screen is wound with a wire which is in a circuit of a chronograph, and the projectile, when fired, cuts first one wire and then the other, the time between the two cuts being automatically registered on the chronograph, and thus furnishing a measure of the mean velocity between the two screens. This method has been further perfected by the use, in connection with it, of the Crehore-Squier polarization chronograph.

Wheatstone's method, while accurate, has the disadvantage of requiring a new pair of screens, or new wires on the same screens, to be erected after each shot, since the projectile destroys the wire in its passage. A new apparatus, which has largely supplanted the Wheatstone screen, is the Wolf air-shock indicator. It is well known that a rapidly moving projectile, in displacing the air, sends out a conical wave, something resembling the water-wave which is seen to move from each side of the bows of a moving ship. This air-compression wave is a sort of solitary sound wave, thrown out by the projectile, independently of the steady sound which its friction through the air produces. This air wave is relied upon to displace a diaphragm, as the projectile passes and thereby momentarily to open an electric circuit leading to the chronograph.

One such diaphragm is placed near the muzzle of the gun and the other at the required distance beyond. The chronograph record indicates the interval of time between the passage of the wave past the two diaphragms in succession. The advantage of the apparatus is that it does not require to be reset or readjusted after each firing. If the path of the projectile is not quite parallel to the line joining the two diaphragm instruments, a small error may be thereby introduced into the record, but with ordinary care this error is stated to be trivial. The apparatus is adapted for use with large guns and projectiles, and when so adapted is unfit for use with small arms. On the other hand, however, the Wheatstone screens have to be changed when the diameter of the projectile is considerably changed. The new method may, in a certain sense, be regarded as giving a velocity measurement from the microphonic record of the screech emitted by a moving projectile.

Alternators With Dampers.

The article by Mr. Fischer-Hinnen in this issue deals with the theory of "amortisseurs" or copper loops linked with the field circuits of alternating-current machines, on the basis of the theory of induction motors. There can be no doubt that the action of such dampers is closely associated with the action of the short-circuit windings forming the secondary members of induction motors. Consequently, in synchronous alternators provided with dampers, the action of the dampers, considered as the secondary member of an asynchronous machine, is superposed upon the actions of the synchronous alternator. The article deals at great length with the preparatory theory of induction motors, and it would almost seem that much of this induction motor theory could have been assumed, or epitomized, for the purposes of the special case considered. However, the induction motor theory is interesting in itself, as showing the contrast between the modes of thought on this subject in vogue in this country and in Europe. The usual method in this country of dealing with induction apparatus is to consider the inductance of each circuit as that due only to the flux linked exclusively therewith, in contra-distinction to the flux linked both with that circuit and with the associated circuit. The keynote of the induction motor theory expounded in the article lies in the stray flux coefficients and their implication in the general formulæ. The two methods are not in any

way at variance, and lead to essentially the same conclusions, but the difference in the point of view is remarkable.

The article goes to indicate that when an alternator fitted with dampers is being operated by a driving force which rythmically varies, its steadiness of speed must be largely due to the electrical inertia of the damper, and is by no means solely to be ascribed to the mechanical inertia of the flywheel. The increased stability of the machine in parallel running is, in fact, attributable to this electrical inertia. These facts, of course, are generally understood, although the method of treatment here employed seems to be novel. The fact that alternators provided with dampers are thereby reduced in armature reaction, or apparent reactance, under load, is not, however, generally known, and is important. In the last table of the article the statistics indicate that the weight of copper in the dampers on the field is generally in excess of the weight of copper in the armatures, and more than half the weight of the copper on the field magnetizing coils. The conclusion to which the article leads is that it is not worth while incurring so great an expense, since correspondingly good results can be obtained without dampers by employing in the armture winding a part of the copper that dampers would require. While it is possible that this substitution of increased armature copper for the dampers might secure equally good automatic regulation of pressure under load, it does not seem likely that the same substitution would secure equally good stability in running. In other words, it would seem that in order to secure the best stability in parallel operation under sudden variations of speed or load, the effect of the copper in dampers must be greater than the effect of the same amount of copper added to the armature winding.

Charging for Current.

A long paper read at the last meeting of the British Institution of Electrical Engineers by Mr. Arthur Wright takes up again *in extenso* the matter of the proper method of charging for current, working along the line of maximum demand, as is his wont. It will hardly bear abstracting, but his line of argument is, as those familiar with his system will divine, about as follows: The actual charge for the production of electrical energy in any station is very small compared with the charge which is due to the permanent plant held in readiness for this production. Hence the chief item in an equitable system of charging the consumer is the charge for capacity held in readiness, i. e., the maximum demand. The large preparation charges, mainly fixed charges, are very thoroughly analyzed and made interesting reading for the old-time station manager who figured his cost of energy on coal and labor and trusted to a reorganization after he had unloaded, to take care of fixed charges and depreciation. In a particular case, that of the Brighton station, Mr. Wright shows by an examination of the costs that no less than 72 per cent of the total is preparation cost, that is, cost which does not vary with the length of time the lamps are burning. Hence a vivid illustration of the need of keeping up the load factor if the station is to pay legitimate dividends. He proceeds on the assumption that the plant is a straightforward business enterprise and to be handled as such.

It would be a good thing for every station manager to sit down in cold blood and figure his annual expense after Mr. Wright's methods, and, as a rule, it would be rather a shock to the stockholders to see the results. We do not agree entirely with Mr. Wright's bookkeeping, but his method of segregation is certainly instructive. He classifies as production cost the coal, less all consumed in keeping ready to supply the full capacity when needed, the oil, waste, and supplies including water, less a similar factor, and the repairs to machinery and plant as run. Meter costs, including repairs and attendance, and replacement of fuses, make up what he calls the service cost, which depends only on the number of customers connected. All the other expenses, including fixed charges of every kind, he classifies as preparation costs. Now, based on this line of reasoning a set of charges may be drawn up, showing what each consumer should pay as his proportionate part of each factor of cost. It would obviously show what is generally recognized, that the small consumer using current steadily is a very desirable person to cultivate, while a church, for example, using many lights for a few hours a week only is a costly customer. So far so good, for every one agrees that a steady load as many hours a day as possible is greatly to be desired. But there is another side to the question. A central station is a business enterprise run for the purpose of earning profits, and its methods of bookeeping is a matter that is of no conceivable importance to the consumer. He is willing to pay a fair price for service, but he cares nothing for the load curve of the station, and if he finds that a charge based on preparation costs brings his lights above the cost of gas, or his motor above the cost of a gas engine, he merely says to the manager that he is sorry they cannot do business together and quits. The manager may figure out that it is cheaper to let him quit, but if he is planning to do business on a large scale, the preparation cost still abides with him, and there are instead of inadequate receipts, none. The fallacy of the preparation cost argument if pushed to its conclusion is that such costs cannot be controlled to suit the demand.

If the total preparation cost could be cut up into blocks built up only as they are needed, the problem would be simplified, but in practice a station is built of such size as the business seems to warrant, and the fixed charges steadily hold the fort while the manager wrestles with the task of getting in receipts against active competition from sources which know not the Wright demand system. A condition and not a theory confronts him, and he has to meet it as best he can. It is certain that a good load factor should be built up if a station is to be prosperous, but the exact method of doing it is a matter that must be settled on the basis of local requirements, and we do not believe the same process will work everywhere. If a station is to be organized purely on the demand basis, it will not be well to plan for a large output. In certain cases a demand charge can be made without difficulty, but the customer will not tolerate it if it brings the cost of electricity above its competitive value. In certain places a flat rate, bad as it is in theory, works better than metering, while elsewhere the attempt to work a flat rate simply loses business. The logical thing for a station manager to do is to draw up his load curve and then study his local conditions. He cannot refuse a day service while the gas mains confront him, and he must build up his day load as best he can. He can well afford to take on some load at very near cost if thereby he can withdraw from his competitors some load that will pay him well. After all, the thing which counts when the books are balanced is the average selling price of the product, and that must be kept where it will count against competition. A certain and considerable amount of business at small profit may be a legitimate advertising expense in a live concern. No business enterprise looks after profits more sharply than a modern department store, but it concerns itself with totals, not with a uniform rate of profit on all commodities. There must evidently be considerable latitude in methods of charging for electricity, and while Mr. Wright's system sometimes works well we should dislike to try it on some communities that we know of, particularly against sharp competition. Nevertheless, it sets forth an ideal, and every central station manager would be benefited by following its indications in the determination of true costs, even if local conditions would not permit him to apply the result in the form of a tariff.

November Foreign Trade.

The trade statement for November is encouraging in that the tendencies toward decline are not carried further. Its most notable feature is the continuation of the decline in our trade balance, compared with 1900, that set in largely with the advent of the current fiscal year, although begun last March. Exports for November—$136,511,000—practically hold their own with a year ago, being but $181,000 less. Imports, however, show a substantial gain, being $72,497,000, against $65,354,000 in November, 1900, an increase of $7,143,000. As a result we have for the first four months of the current fiscal year a falling off in excess of exports, compared with 19,000, of $59,924,000; whereas at the end of the past fiscal year the export excess was just $100,000,000 greater than on June 30, 1900.

What encouragement can be found in the statement is that the shrinkage in exports, which marks six out of eleven months of 1901, is but $181,000; and that the $7,143,000 increase in imports, a tendency now continuous since March, is smaller than any since June. This increase in imports really testifies to domestic productive activity, and consequent need of raw materials.

Government Wireless Telegraphy.

Professor Willis L. Moore, chief of the United States Weather Bureau, in his report to the Secretary of Agriculture, says, in part: "Substantial improvements have been made during the past year in the Weather Bureau system of wireless telegraphy. While there is yet much experimental work to be done before our system, or any system of which I have knowledge, is reliable for intership communication, or before any two systems can work within the same field without each rendering the other useless, such progress has been made by the Government experimenters that, with no interference from private systems, stations can be successfully operated over at least 150 miles of coast line, and they are now in operation on the North Carolina and Virginia coasts, and soon will be instituted between the Farallone Islands and the mainland, and the Tatoosh Island and the mainland, on the Pacific Coast.

"If a system of selective telegraphy cannot be perfected so that one system does not interfere with and render useless another, and thereby prevent all use to commerce of recent discoveries in wireless telegraphy, it may become necessary, on account of the value of these discoveries to our marine interests, for the Government to take exclusive control of all systems of ether space telegraphy and to establish stations along our extensive coast lines at such distances and in such relation, the one to the other, that they shall not interfere. Even then there will occasionally be difficulty in communicating with the mainland whenever two ships in close proximity are attempting to transmit or receive messages at the same time."

Electrical Engineers of the Day—XXVI.

Arthur Vaughan Abbott.

Arthur Vaughan Abbott, who was born in Brooklyn, N. Y., in 1854, is a scion of the family of that name which has given so many distinguished authors and religious instructors to the world. After graduating from the Polytechnic Institute of Brooklyn in 1875 he began work in the Department of Parks, New York City, where he served one year. He then entered the Engineer's Department of the East River Bridge, where he designed and perfected some of the important details utilized in the construction of what was, in certain particulars, at that time an experimental structure. Among these noteworthy inventions and patents were the cable wire splice, wire cutting machinery and testing machines for steel and cement Mr. Abbott superintended the cable construction, and had general charge of material inspection during a period covering seven years.

After the completion of the famous bridge he built testing machines and large railway and lock scales for E. T. Fairbanks & Co. during a period of four years. Mr. Abbott was then chief engineer of the Boston Heating Company for three years, during which time he designed, installed and operated a plant for supplying heat from a central station over about two square miles of the city of Boston.

As mechanical engineer for the Daft Electric Light Company, Mr. Abbott designed and had charge of shop construction of dynamos and motors, designing, building and operating the electric roads at Meriden, Conn.; Bloomfield, N. J.; Atlantic City, N. J., and Bloomington, Ill., and operating storage battery cars on the Fourth Avenue road, New York City. As a builder of electric roads, Mr. Abbott's experience has been signally successful. Among the roads he built, aside from those above enumerated, may be mentioned the systems of Ogden and Salt Lake, Utah; Augusta, Ga.; the Lake Roland Elevated, Baltimore, Md., and the equipment with electricity of the Interstate Road, Kansas City. As consulting engineer for the Ogden City Water Works, the Bear River Canal and the Waukesha Water Pipe line, he varied his work and added largely to his experience.

In 1892 Mr. Abbott entered upon a long period of telephone construction and reconstruction for the Chicago Telephone Company. Up to June, 1901, he had erected 12 new offices and buildings and relay switchboards, aggregating nearly 40,000 lines; the necessary conduits, underground cables and aerial lines covering the city of Chicago and adjacent territory, aggreating nearly 100,000 wire miles, and the installation of 35,000 subscribers' sub-stations. To have successfully handled work of such magnitude during nine years indicates an excellent business ability, and implies a familiarity and grasp of the management and expenses in detail of all parts of the Chicago Telephone Company. Mr. Abbott has also designed, installed and operated lighting plants on all systems aggregating 10,000 lamps.

But perhaps Mr. Abbott's chiefest claim upon the public attention (saving one to be considered later) lies in his authorship of a

widely known engineering treatise entitled, "The Electrical Transmission of Energy." This work involved an extraordinary amount of application in its achievement, and of experience for its conception and realization. It has been translated into German and is used as a text book in many American and European universities. Mr. Abbott has also written smaller works of value, namely, "A Treatise Upon Fuel," and "Testing Machines," besides numerous magazine articles and professional papers.

The chief claim upon the public appreciation and appraisement of Mr. Abbott's merit as an engineer, however, lies in his fidelity to his ideals, and his unwavering refusal to do unworthy or perishable work. The writer has frequently heard him speak with horror of the Ashtabula Bridge disaster, and the suicide of the engineer because the faulty construction of the bridge had precipitated so many unsuspecting souls into eternity; and Mr. Abbott has ever affirmed that an engineer's conscience and his religion should manifest itself in the integrity and virility of his work for the people. The doing of the world's work rightfully involves a conception of the organic nature of society and the responsible and intelligent effort that is necessary in every department to secure a frictionless and rhythmical adjustment of the large life to the larger movement; and in this particular Mr. Abbott's work suggests a model standard to all his brother toilers, whose science and art and labor it is to utilize and distribute the forces and materials of nature.

Mr. Abbott is a member of the American Institute of Electrical Engineers and of the Institutes of Mining and Civil Engineers.

Lighting and Railway Development on Staten Island.

By Max Loewenthal, E. E.

EVER since its admission into the sisterhood of boroughs, constituting the great city of New York, Staten Island, now known as Richmond Borough, has made wonderful strides in its lighting and railway facilities.

Staten Island, with a population of about 70,000, is situated about five miles south of Manhattan Island, from which it is separated by New York Bay, while the Narrows separate it from Long Island on the northeast, Staten Island Sound from New Jersey on the west, and Newark Bay and the Kill von Kull from the same State on the north. It is of an irregular triangular shape, its greatest length being about 13 miles, its greatest breadth about 8, and the total area about 58½ square miles. The entire island is traversed by roadways and turnpikes, and a large number of towns and villages are scattered throughout its territory. It must be noted, however, that it is the north shore which is most densely settled, it being along this shore and the eastern shore that the main line of the steam railroad and the trolley lines run. The chief towns in this district are Clifton, Stapleton, Tompkinsville, New Brighton, Snug Harbor, Livingston, West Brighton and Port Richmond. The chief town at the southwestern end of the island is Tottenville.

On this entire island only one electric light and power company holds sway, which, like a Phœnix, rose out of the ashes of a number of other companies, whose works were either burned down, never completed, abandoned or absorbed. This company, called the New York & Staten Island Electric Company, owns in the neighborhood of 2000 miles of lighting circuits, supplying current for 4000 series incandescent lamps and 500 arc lamps, which light about 20 villages. In addition, current is supplied for 20,000 commercial lights and about 500 hp in motors.

The Staten Island Electric Railroad Company, which is owned by the above company, owns 30 miles of single and double-track, 26 cars being operated in winter and 70 cars during the summer months. The railway runs along the entire north shore of the island, and along the south shore to South Beach. The Southfield Beach Railroad Company, also closely allied with the above interests, has just completed a line, on which aluminum wire was employed for feeders, from South Beach to Midland Beach. The rolling stock of both roads consists of Brill cars, with Peckham trucks and G. E. motor equipments. These roads are supplied with current by the New York & Staten Island Electric Company.

Fig. 1.—Map of Staten Island Showing Lighting and Railway Circuits.

HISTORY OF THE CONSOLIDATION.

The electric lighting industry on the island started during Erastus Wiman's time, about 12 years ago, when a plant was located at St. George. It was at this time also that the Staten Island Rapid Transit Railroad Company was formed to operate a ferry and steam railroad along the shores of the island. The railroad at that time ran eight passenger cars filled most of the time, but now that electric railway has absorbed a great portion of their business, but three cars constitute a train. It was at the St. George plant, it is claimed, that the first high-pressure boiler ever put in actual practice in this country was erected. It was of 600-hp capacity, carrying a pressure of 250 lbs., and was located in the open air without any covering.

About the year 1890 Mr. Wiman attempted to consolidate all of the electrical industries on the island, and erected a large plant at Livingston, but before its completion he failed, and the plant lay idle for several years with just the side walls of the building standing. The boilers had been placed, but were removed.

The old St. George plant was equipped with seven engines of different makes, Ft. Wayne and Westinghouse single-phase alternators, and American Wood & Brush arc machines. From this old plant

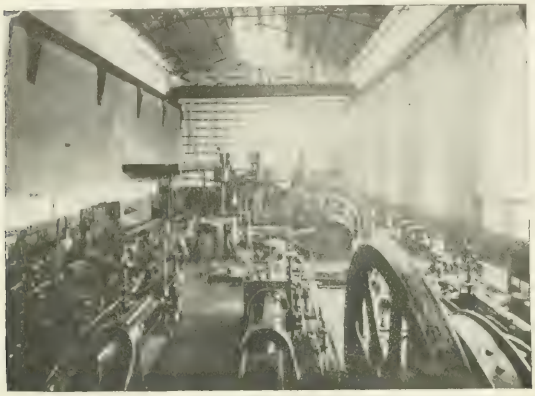


FIG. 2.—OLD STATION AT LIVINGSTON.

some 10,000 incandescent and 150 arc lamps were supplied with current. The electric railway first made its appearance at about that time with a power house at New Brighton having an equipment of two Allis engines and two General Electric generators of 500 kw capacity. This plant was built by Sheaff & Jaastad, and it is claimed that its efficiency has not been surpassed by any plant up to date.

It was then that the New York & Staten Island Electric Company was formed to complete the Livingston plant. It absorbed the street railway and moved that plant, also the St. George and several minor plants to Livingston. This plant was never completed in a satisfactory manner, owing to the fact that the St. George plant was burned to the ground Aug. 3, 1891, and apparatus had to be installed in any manner possible. The St. George plant was rebuilt temporarily, but is now torn down. The Port Richmond and the New Brighton plants are also entirely abandoned, and the latter is now used by Mr. McLeod, the contractor for steam fitting for the Metropolitan and Manhattan roads.

THE CONDITION OF THE OVERHEAD SYSTEM.

The overhead construction, as is usually the case when a number of companies consolidate, was a very bad mess, and owing to the fact that each plant employed different voltages and different periodicity of alternations it was a very difficult problem to straighten the matter out. The entire system had to be changed from single-phase to two-phase, and brought down to a universal period of 60 cycles. The accompanying map (Fig. 1) clearly shows the amount of territory covered by the lines of the company. The very heavy black lines indicate the route of the railway, and the single heavy black lines indicate the primary lighting circuits of the company. It must be understood that miles and miles of wire are strung simply to feed a few series and incandescent street lamps. These lamps are run in series of 10 and 20, as circumstances permit, both 50 and 110-volt lamps being used. The power factor of the system is necessarily extremely poor, owing to the fact that a great many small transformers and shunt coils are in operation on the system. It is practically an impossibility to lay out centers of distribution and run feeders to them. Hence the method adopted is a system of local "static" boosters located on poles in various parts of the island and feeding small isolated territories. These boosters are ordinary small transformers connected into the line in such a manner as to raise or lower the voltage a given percentage, which varies from 5 to 20.

THE LIVINGSTON PLANT BEFORE RECONSTRUCTION.

Judging from the great variety of machinery which was housed in the Livingston station before its reconstruction one might almost have called it a Pan-American for high-grade machinery manufactured during the past decade. The original equipment consisted of two 250-kw General Electric railway generators driven by Allis engines, one 1000-kw Walker-Allis combination and two triple-expansion vertical McIntosh & Seymour engines, direct connected to 300-kw, two-phase Stanley alternators. Four years ago there were added two McIntosh & Seymour engines direct connected to two 300-kw Stanley two-phase generators, Onondaga exciters direct connected to Harrisburg engines, and three 160-light Brush arc machines belted to tandem Ball & Wood engines. In the boiler room there were ten Babcock & Wilcox 350-hp boilers, four of which were removed from the New Brighton plant. The arc lighting and railway switchboard panels were built by the General Electric Company, and the incandescent board by the Stanley Electric Manufacturing Company .

The installation of the additional machinery a few years ago was necessitated by the large increased demand for current. The company at that time decided upon some radical changes, one of which was the elimination of their open-arc system and substituting in its place a constant-current transformer system. South Beach and Tottenville are the two localities which were originally equipped with this system, nearly three years ago, and it proved so entirely satisfactory that the company is at present changing its entire arc system to the system above referred to. The advantage of this system is clearly shown in the lighting of the village of Tottenville, 17 miles from the power house, where a system of tub transformers is located and operated from the Livingston plant. The drop in pressure between the power house and Tottenville is 350 volts on a primary line of 2400 volts; and still, with this great drop, the constant-current

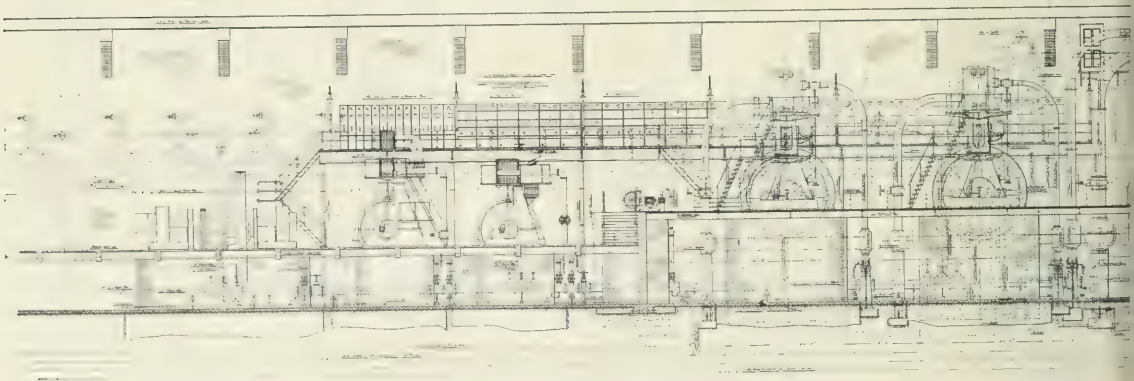


FIG. 3.—LONGITUDINAL SECTION OF POWER HOUSE AT LIVINGSTON.

series alternating-current arc system has worked satisfactorily. South Beach also received a tub transformer equipment, which is operated from the Livingston power house. In changing over the other circuits, all the transformers will in the future be located in the power house instead of being placed in the line. The reason for locating the transformers at Tottenville and South Beach is that commercial circuits and street lighting circuits are taken off the main feed lines between these points and the power house. It is evident under these conditions that the same feed lines from the power house feed and operate arc lamps at the terminal of the line and incandescent lamps between the power house and the transformer station.

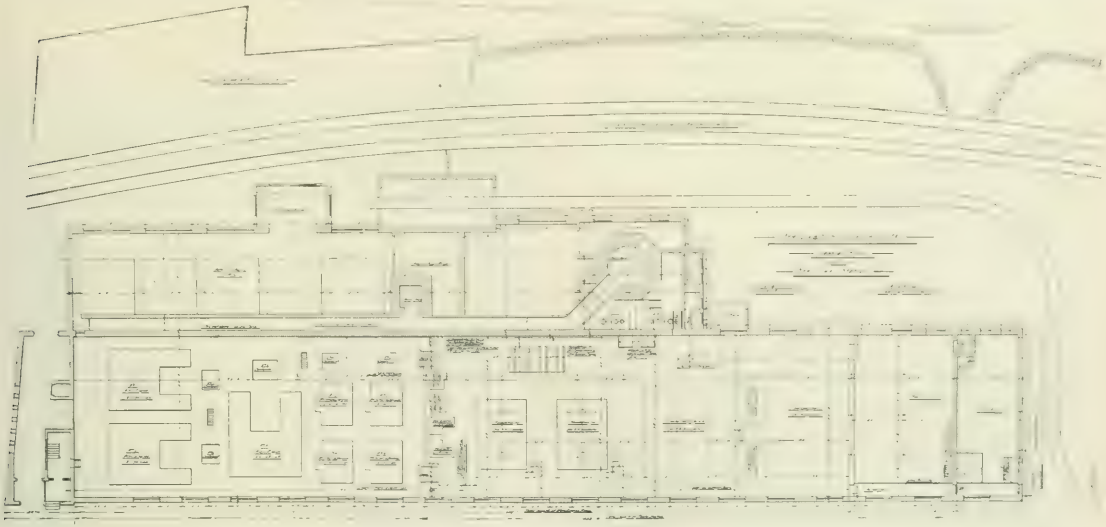


Fig. 4.—General Plan of New Power House.

Fig. 3a.—Longitudinal Section of Power House at Livingston.

THE RECONSTRUCTED LIVINGSTON PLANT.

It was soon found that the station equipment was inadequate to meet the growing demand of the company's customers, and hence it was decided last year to greatly enlarge the plant at Livingston. Some radical departures from common practice were decided upon, and Mr. A. B. Proal, Jr., the chief engineer of the company, to whom this task was entrusted, feels confident that when the new plant is completed it will efficiently meet the extraordinary conditions existing on the island.

It is contemplated that in the near future the railway will be operated by the use of rotary transformers, and the general plan, which is now under consideration, is as follows: During the day the lighting and railway loads being very small, the company expect to operate a rotary transformer from the lighting engines, thereby using large units. In the early part of the evening the lighting load is heavy as is also the railroad load, when it will be necessary to operate both the lighting engines and railroad engines. Again, later in the evening both drop off very rapidly, when the operation can be reversed and the railroad machines can operate the lighting, or vice versa.

The building, which runs parallel with the water front, being separated therefrom by the tracks of the steam railroad is 434 ft. 6 inches in length, 63 ft. 6 inches high and 70 ft. 6 inches in width. It is constructed of Hurricane Island granite and pressed brick. At the western end are the executive offices and the chief engineer's and draughting rooms. Adjoining these is the old plant, shown in Fig. 2, with

the switchboard running transversely across the building. The new portion of the building adjoins this, and the 130-ft. switchboard, which runs along the northern wall, extends partly into the old plant. At the far end of the plant is the machine shop, the arc lamp repair department and the carpenter shop, beyond which is the storeroom, which is three stories high and of fireproof construction, entirely isolated by fire-brick partitions. This portion of the building is equipped with electric elevators and with all conveniences for the handy disposal of material. Still further, and at the extreme end of the new building, there is sufficient space to allow electric cars to run around to the back of the property, where the ashes are removed from the ash holders, and where stores are received. Underneath the machine shop are the stables, which are modern in every respect. They are fitted with Schrader patent floors, which are removable and laid on a concrete foundation, which facilitates the cleaning of the stable. At the back of the engine room proper is the boiler room and the stack house. In the latter, opening on to the main floor, are the lavatories

FIG. 6.—WICKES BOILERS INSTALLED AT LIVINGSTON.

for the employes, and on the second floor of the stack house are the bathrooms. Still above these are the locker rooms for all employes. A 20-ton traveling crane, built by the Union Iron Works, spans the building and runs along its entire length. A longitudinal section of the station, as it will appear when it is completed, is shown in Fig. 3.

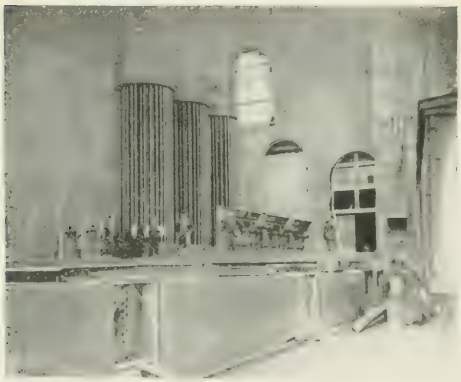


FIG. 7.—LIKES BOILERS, WITH BRICK COVERING REMOVED.

In Fig. 5 is shown a transverse section, while Fig. 4 shows the general layout of the various machines and the location of the station.

In the spacious engine room, the floor of which consists of concrete, upon which 2-inch spruce boards and then 1-inch narrow maple boards are laid, there are now being installed upon extra heavy concrete foundations, two vertical cross-compound Allis engines direct connected to two 500-kw Westinghouse rotating armature, two-phase, 60-cycle, 2400-volt alternators. These units are connected to a

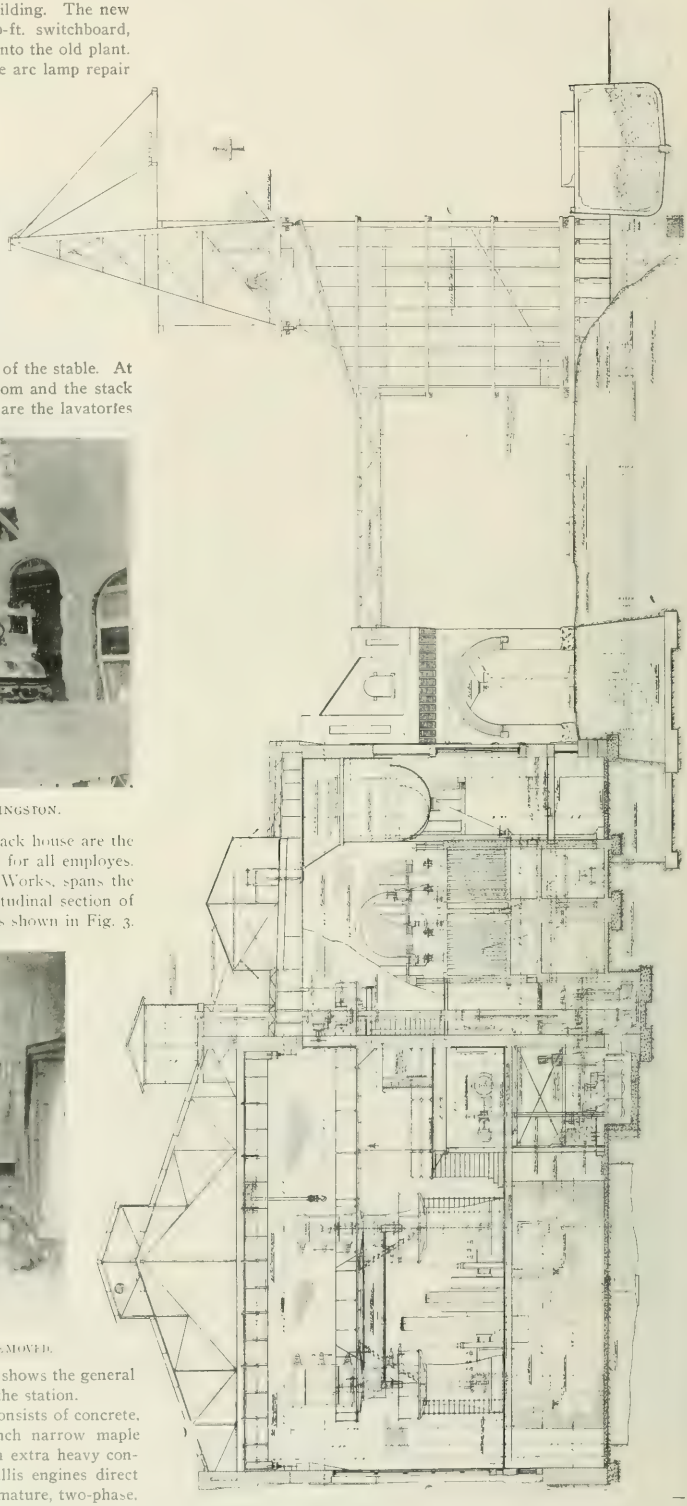


FIG. 5.—TRANSVERSE SECTION OF NEW POWER HOUSE.

Worthington central condensing system. This system is operated with centrifugal pumps, made by the Lawrence Machine Company, of Lawrence, Mass., and driven by Buffalo Forge Co.'s vertical direct-connected engines. They are also arranged so that they may be driven electrically by motors. The general scheme provides for the future installation of considerable additional machinery.

The new boiler equipment consists of three 333-hp Wickes Brothers vertical water-tube boilers, equipped with Acme mechanical stokers.

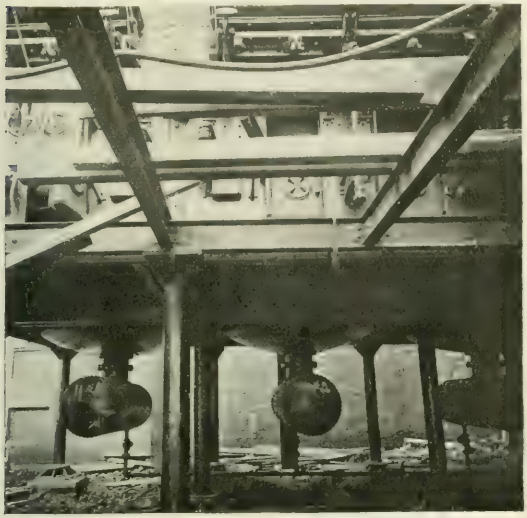


FIG. 8.—MUD DRUMS ATTACHED TO BOILERS IN POWER HOUSE.

There is also room for three more boilers of the same type. These boilers, shown in Figs. 6 and 7, carrying a pressure of 150 lbs., were especially built for this plant with extra large mud drums, which are shown in Fig. 8.

Foundations have been built for a new stack, which will be constructed as soon as the additional boilers are installed. The foundation is constructed of German pressed heavy radial brick, the inside diameter being 13 ft. The brickwork around the boilers from the floor line is also made of hollow brick made by Augustus Weber Sons, of Weber, N. J.

In the pump room are four compound duplex pumps, which are used for boiler feed and for injection purposes. The company has driven several artesian wells, and the water from them will be pumped by means of compressed air into a 35,000-gallon tank. This will tide over any possible break in the city water supply pipes.

The coal-handling apparatus is being built by the Robins Conveying Belt Company, and will take coal from boats with a one-ton steam shovel and deliver it in a 2000-ton coal pocket, from which it is taken by means of belts and distributed in the coal hoppers over the boilers. The ashes are removed by steel dumping cars from under the boilers, hoisted up by means of an elevator and dumped directly into the cars.

The new switchboard, when completed, will occupy a space along the length of the building, and will be 130 ft. long, the railroad panels being close to the railroad machines, then the rotary panels, machine panels, equalizing panels, then the circuit panels, and finally the house panels.

A NOVEL SWITCHBOARD SIGNAL SYSTEM.

As great difficulty was experienced in connecting the machines in parallel, owing to the large variations of speed of the different engines, some varying as much as 20 per cent from their normal speed, a system of signals was adopted which materially helped both the switchboard operator and engineers. This device, shown in Fig. 9, consists of a box frame with glass panels in the front, on which letters and numbers are outlined, the main body of the glass being painted black. Enclosed in each small box-like partition is an incandescent lamp which is connected to a keyboard, and is handled there by the operator. A street railway foot gong is used to signal to the engineer and attract his attention to the board. These signals are also used to call the attention of the various employes to the switchboard, as the local telephone service of the company is operated from the main board, and it is often found convenient to call some employe directly to the telephone switchboard. The company operates 40 telephone stations on the island, from which the inspectors report directly to the switchboard.

The officers of this enterprising company are General Samuel Thomas, president; J. H. Swinarton, vice-president and treasurer, and president of the allied railway companies on the island, and H. M. Work, secretary. Those in immediate charge of the power house and local business are Fred K. Lewis, superintendent; A. B. Proal, Jr., chief engineer; Edward S. Cliff, line superintendent; E. S. Terhune, electrical engineer, and George Fox, mechanical engineer. Fifty men are employed in the power house, besides eight machinists, as most repairs to machinery are made in the well-equipped machine shop.

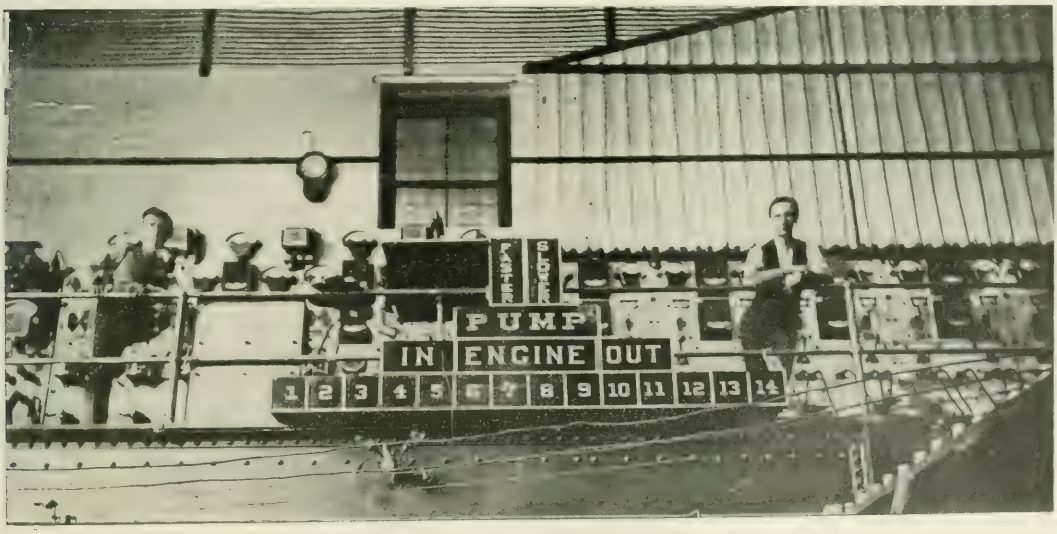


FIG. 9.—SIGNALING DEVICE IN USE IN POWER HOUSE.

The company, in its desire to keep abreast with the growth of the island and give to its customers uninterrupted service as well as the benefit of the latest development in engineering practice, contemplated the above improvements, now being completed, over a year

[illegible] strikes, fires and floods, however, the various contractors were unable to carry out their contracts, which caused the work to be unavoidably delayed for six months. Now that the installation on which $275,000 will have been expended, is nearly completed, the company is in a position to give the very best service to its customers and keep pace with present and future developments on the island as well as in the electrical arts.

Alternators with Dampers.

By J. Fischer-Hinnen.

UP to the present time very insufficient data have been published in regard to machines with dampers (amortisseurs). Most articles limit themselves to a superficial description of this system, and an enumeration of the various advantages which are claimed for the system. It might, therefore, be of interest to mathematically determine the influence of the damper on the operation of the machine, based on actual experiments with machines of this type.

The damper, in the form originally described by Leblanc, consists of a sort of short circuit ring, with which the magnet poles are provided. For this purpose the latter contain slots or holes parallel to the direction of the armature wires, as shown in Fig. 1, into which the

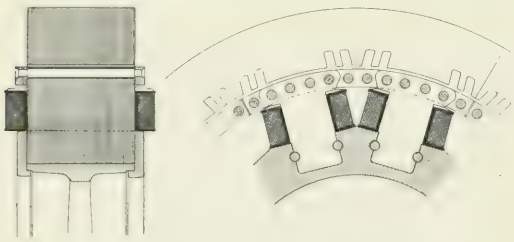


FIG. 1.—SHOWING DAMPING ARRANGEMENT.

insulated copper bars are buried. The insulation is only used for the purpose to insure a close fit and prevent rattling, and if it were not for this it would not have to be used. At the two ends the bars are interconnected by rings of copper or bronze. Such damper possesses the following properties:

1. The drop of pressure of the machine is reduced by choking a part of the armature reaction.
2. The machine is made more stable for paralleling.

Careful observations show that both advantages cannot be obtained at the same time in a machine. In the case of single-phase alternators, for example, only the first advantage is completely realized, while the damper in reality acts rather unfavorably on the synchronism, necessitating, as is the case with single-phase alternating-current motors, the employment of outside energy for synchronizing the rotor. Conversely, however, when using more than one phase, a rotary field is produced, which rotates synchronously with the magnets and has therefore no effect on the damper. The latter only begins to act when the machine for some reason, gets out of synchronism and has the effect of bringing the machine back to synchronism.

The action of the damper is therefore identical with that of the secondary winding of an asynchronous motor. The calculation is, therefore, made in a very similar way. Let us briefly review these formulæ so far as they enter into the discussion of the damper, and on account of its simplicity, we will consider the theory of polyphase motors.

GENERAL THEORY OF POLYPHASE MOTORS.

The well-known diagram for such motors is shown in Fig. 2. In this diagram

$\nu_1 \Phi_1$ represents the rotary field produced by the primary ampere-windings.

Φ_1 that part of it which enters the secondary winding after deducting the stray lines.

$\nu_2 \Phi_2$ the rotary field produced by the secondary winding, of the same phase as the secondary current.

Φ_2 that part of it which enters the primary winding.

Φ_a and Φ_m the resultant fields.

A little thought shows us that the secondary current I_2 has the same phase as the resultant pressure E_2, and in consequence follows ϕ_2 by 90 degs. The resultant pressure E_2 must not be confounded with the induced e. m. f., which has the direction $a\,c$ and is in advance of the former by the angle ϕ_2.

Furthermore:

E is the effective pressure of one phase (in the case of the delta connection the same as the terminal pressure, and for the star connection it equals the terminal pressure divided by $\sqrt{3}$).

I is the effective current, which flows through the wires.

m the number of phases.

n the revolutions per minute.

v the peripheral speed in m.

g the slip.

$100\,\epsilon$ the ohmic loss (in per cent) in the primary winding.

$100\,\epsilon_1$ the percentage loss in the iron.

$100\,z$ the percentage loss due to friction.

$c = \frac{1}{T}$ the number of total periods.

p the number of poles (not pairs of poles).

$\omega_1 = 2\,\pi\,c$.

$\omega_2 = g\omega_1 = 2\,\pi\,cg$.

D the diameter of the rotor in cm.

l the length of the rotor in cm.

r a reduction factor for the cross section of air, in consequence of the slot openings and the paper insertions, approximately $= 0.7$ with open and 0.87 with closed slots.

N_1 and N_2 the total number of wires (not windings) on the periphery, primary and secondary.

q the number of circuits connected in parallel.

L_1 and L_2 the self-induction coefficients.

a the relation between the total magnetic resistance and the air resistance alone $=$ 1.05 to 1.15 approximately.

δ the single air-gap in cm.

ν_1 and ν_2 the Hopkinson waste field coefficients.

The secondary phase distortion ϕ_2 is given by the formula

$$tang\ \phi_2 = \frac{g\,\omega_1\,L_2}{R_2} = x$$

As x is proportional to the —— slip, and is, therefore, one of the principal factors of the motor, we will hereafter represent all variables (current, torque, etc.) as functions of x and express the remaining goniometric functions of the angle ϕ_2 in tangents. To the actual magnitude of the term x we will return later.

For the sake of simplicity it is best not to consider the copper losses (a complete sub-division of the equation may be found in the author's paper on "The calculation of asynchronous alternating-current motors," in the *Zeitschrift fur Elektrotechnik*, Vienna, 1900, Nos. 29-33).

With these approximately correct assumptions in mind, the following simple formula may be deduced:

FIELD STRENGTH.

$$\Phi_m\ (\text{approx.}) = \frac{4\sqrt{2}\,.\,10^8\,.\,m\,q\,E}{K_1\,.\,w_1\,.\,N_1} \qquad (1)$$

The values of K are given in the following table:

Number of teeth per pole and phase.	2 Phases.		3 Phases.		4 Phases.	5 Phases.	6 Phases.	Closed circuit ring.
	a	b	a	b				
1	2.00	..	2.00	..	2.00	2.00	2.00	2
2	1.85	..	1.93	..	1.96	1.98	1.98	2
3	1.82	..	1.92	..	1.954	1.97	1.98	2
4	1.81	2.77	1.91	1.66	1.952	1.97	1.98	2
α	1.79	2.54	1.91	1.66	1.94	1.97	1.98	2

a represents winding with separate phases.
b represents winding with overlapping phases (similar to the drum winding of continuous current machines).

The number of lines of force can also be calculated from the ampere-turns. It is

$$\Phi = \sqrt{2}\ \frac{4\,\pi}{10}\ .\ \frac{I\,.\,N}{p\,q}\ \frac{D\,\pi\,l\,r}{p}\ \frac{k}{2\,\delta\,a}\ \nu \qquad (2)$$

According to whether the primary or secondary number of ampere-turns is substituted for $\frac{I\,.\,N}{q}$, the primary or secondary rotary field will be the result.

The following Table II. gives values for the factor k:

TABLE II.

Number of teeth per pole and phase.	2 Phases		3 Phases		4 Phases	5 Phases	6 Phases	Closed circuit ring
	a	b	a	b				
1	0.5	...	0.415	...	0.411	0.410	0.410	0.410
2	0.38	...	0.396	...	0.405	0.406	0.407	0.410
3	0.374	...	0.394	...	0.404	0.405	0.406	0.410
4	0.372	0.570	0.392	0.340	0.402	0.403	0.405	0.410
6	0.368	0.520	0.392	0.340	0.400	0.402	0.405	0.410

(For meaning of a and b see Table I.)

From the equations (1) and (2) we obtain by proper elimination:

THE NO-LOAD CURRENT STRENGTH.

$$i_0 = \frac{E_1}{w_1\left(\frac{K_1 k_1 \nu}{2 \cdot 10^8} \cdot \frac{N_1^2}{m_1 q_1^2 p} \cdot \frac{D l}{\delta a} \cdot \nu_1\right)} = \frac{E_1}{w_1 L_1} \qquad (3)$$

PRIMARY CURRENT.

The primary e. m. f. $-E_1$ can be considered as the resultant of two e. m. f.'s, the primary self-induction $w_1 L_1 I_1$, which is proportional to the primary rotary field $\nu_1 \Phi_1$ and follows the same by 90 degs. and the so-called mutual induction e, which is caused by the secondary rotary field ϕ_2 and is, therefore, perpendicular to it.

According to Fig. 2:

$$e = w_1 L_1 I_1 = \Phi_2 \nu_1 \Phi_1 \frac{1}{\nu_1 \nu_2} \cdot \frac{x}{\sqrt{1 + x^2}}$$

From the triangle $a\ b\ c$ we get:

$$E_1^2 = (w_1 L_1 I_1)^2 + e^2 - 2\,(w_1 L_1 I_1)\, e \cdot \cos 90 \qquad (2)$$

Substituting the value of e we get

$$I_1 = \frac{E_1}{w_1 L_1}\sqrt{\frac{1 + x^2}{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}} = i_0\sqrt{\frac{1 + x^2}{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}} \qquad (4)$$

For loads between no load and full load the expression $1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2$ which in the future we will call A differs but little from unity. For small motors it is slightly higher, say, 1.15, for large motors somewhat smaller, say, 1.05. A mean value of 1.1 may be safely assumed.

SECONDARY CURRENT.

According to Fig. 2:

$$\frac{i_2\ \Phi_2}{\Phi_1} = \sin \varphi_2 = \frac{x}{\sqrt{1 + x^2}}$$

and substituting for Φ_1 and Φ_2 the values found in equation (2) we get

$$I_2 = I_1 \frac{k_1 N_1 q_2}{k_2 N_2 q_1} \cdot \frac{x}{\nu_2\sqrt{1 + x^2}}$$

or,

$$I_2 = i_0 \frac{k_1 N_1 q_2}{k_2 N_2 q_1} \cdot \frac{x}{\nu_2\sqrt{A}} \qquad (5)$$

SECONDARY PRESSURE.

From the triangle $a\ e\ f$ and $a\ g\ d$ we get

$$\Phi_a = \Phi_m \cdot \frac{1}{\nu_1\sqrt{A}} \qquad (6)$$

in which Φ_m may be taken from equation (1). Also from equation (1) we get

$$\Phi_a = \frac{4\sqrt{2} \cdot 10^8 \cdot m_2 q_2}{K_2 g\, w_1 N_2} \cdot E_2$$

or,

$$E_2 = g E_1 \frac{N_2 K_2 m_1 q_1}{N_1 K_1 m_2 q_2} \cdot \frac{1}{\nu_1\sqrt{A}} \qquad (7)$$

POWER FACTOR.

$$\cos\phi = \frac{e \cos \varphi_2}{E_1} = \frac{w_1 L_1 I_1}{E_1 \nu_1 \nu_2} \cdot \frac{1}{\sqrt{1 + x^2}} = \frac{1}{\sqrt{1 + x^2}}$$

$$\cos\phi = \frac{I_1}{i_0} \cdot \frac{x}{\nu_1 \nu_2 (1 + x^2)} = \frac{1}{\nu_1 \nu_2}\sqrt{\frac{x^2}{1 + x^2 \cdot A}}$$

We must not lose sight of the fact that up to now we have not taken the iron and copper losses into account. This omission is permissible as long as we only consider the currents, pressures and lines of force where a few per cents do not make any material difference. But in determining the cos φ this omission would cause a grave error.

If

100 ε is the ohmic loss in the primary winding in per cent,

100 ε_1, the hysteresis and foucoult current losses in per cent,

then more accurately

$$\cos\phi = \frac{1}{(1 - \varepsilon)(1 - \varepsilon_1)} \cdot \frac{1}{\nu_1 \nu_2}\sqrt{\frac{1 + x^2}{1 + x^2 \cdot A}} \qquad (8)$$

TORQUE.

The torque is equal to the useful work divided by the speed; that is,

$$\text{Torque} = \frac{m \cdot I_1 E_1 (1 - \varepsilon)(1 - \varepsilon_1)(1 - g)(1 - \varepsilon_2)\cos\phi}{9.81 \cdot n}$$

or substituting the values of I and cos φ found in equations (4) and (8), we get

$$Z = \frac{m E_1 i_0}{9.81} \cdot \frac{60 \cdot 100}{D \cdot n} \cdot \frac{(1 - \varepsilon)(1 - \varepsilon_1)(1 - g)}{\nu_1 \nu_2} \cdot \frac{x}{\sqrt{A}} \qquad (9)$$

It is interesting to determine for what value of x the torque is a maximum. If we assume that there is no change in the value of

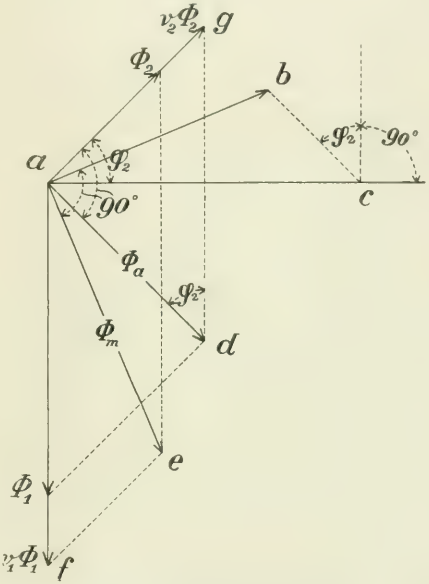


FIG. 2.—DIAGRAM OF POLYPHASE MOTOR.

$(1 - g)$ and $\nu_1\ \nu_2$ then the only variable in the above equation is the quotient:

$$\frac{x}{\sqrt{A}} = \frac{x}{\sqrt{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}}$$

which is a maximum when $x = \frac{1}{1 - \frac{1}{\nu_1 \nu_2}}$.

Therefore,

$$Z\,(max.) = \frac{m E_1 i_0}{9.81} \cdot \frac{60 \cdot 100}{D \cdot n} \cdot \frac{(1 - \varepsilon)(1 - \varepsilon_1)(1 - g)}{2\left(1 - \frac{1}{\nu_1 \nu_2}\right)} \qquad (10)$$

In reality $Z\,(max.)$ is smaller, because the slip increases with the load. On the other hand the stray lines are generally reduced, so that the error is somewhat equalized.

Remark.—The above equations will serve completely for the determination of the dimensions and the winding of a polyphase motor for a definite output and a given *cos* φ. The operation will be about as follows: After the efficiency, i. e., the division of losses of the various parts has been decided upon and suitable values have been as-

sumed for the waste field coefficients, the value of x is obtained by means of equation (8) and by deciding on a definite peripheral speed, the no-load current is obtained from equation (9). The calculation may be simplified by eliminating the peripheral speed entirely. For this purpose both sides of equation (9) are multiplied by $9.81 \times v$ and divided by $m E_1$, then the useful current will be

$$J = i_0 (1 - g)(1 - \ldots) \frac{x}{\ldots} \qquad (11)$$

The external dimensions of the rotor, as well as the primary winding, is obtained from equation (3). The result is quickly obtained when one introduces the so-called current density (number wires $\times$ current strength). This term grows almost in proportion to the square of the diameter D, so that

$$\frac{J N_1}{q_1} = \beta D^2$$

in which β, according to the size of the motor, lies between the limits of 5—8 for low pressures and 4—5 for higher pressures.

If D and Z have been determined in the manner described, the calculation of the iron dimensions follows, and equations (1) and (6) are made use of.

There only remains now the secondary winding, for the calculation of which we make use of the term x.

Substituting in the expression $x = \frac{g w_1 L_2}{R_2}$ the values of L_2 and R_2, that is,

$$L_2 = \frac{K_2 k_2 r}{2 \cdot 10^8} \cdot \frac{N_2^2}{m_2 q_2 p^2} \cdot \frac{D l}{\delta a} \cdot \ldots$$

and

$$R_2 = \frac{2}{10^6} \cdot \frac{N_2 \lambda}{s_2 m_2 q_2}$$

in which λ is the length of a single wire in cm. and s_2 the cross-section in sq. cm., then by a slight transformation we obtain

$$N_2 s_2 = 63 \cdot x \frac{\delta a p^2 \lambda}{g c K_2 k_2 r D l w_2} \qquad (12)$$

The left side of this equation is nothing more than the cross-section of all the wires of the secondary winding, while the right sides contains only quantities with which we are acquainted. The connection of the wires, as we will see, has no effect on the value of x, so far as the product number of wires $\times$ cross-section is not altered, but it is self-evident that the secondary current is dependant on it (compare equation 5), which has to be taken into consideration in machines with collector rings.

In the case of short circuit armatures, to which the damper belongs, the method of calculating is slightly different. Especially the derivation of the resistance R_2 is a trifle more complex. Only the resultant equations are given below. The complete derivation is given in the paper cited above.

If we call

l^1 the distance between the two lateral rings in cm.

s_2 the cross-section of the wires on the periphery in sq. cm., and

s^1_2 the cross-section of the lateral rings, then

$$R_2 = \frac{8}{10^6 p} \left(\frac{l^1}{s_2} + \frac{0.63 D N_2}{p^2 s^1_2} \right)$$

and according to equation (3), in which we can call

$$q_2 = \frac{p}{2} \text{ and } m_2 = \frac{N_2}{p}$$

$$g w_1 L_2 = 2 \cdot c g \left(\frac{1.62 r}{10^8} \cdot \frac{N_2 D l w_2}{p^3 \delta a} \right)$$

and by division

$$x = \frac{g}{80} \cdot \frac{N_2 s_2 r D l c w_2}{c a \left(l^1 p^2 + 0.63 D N_2 \frac{s_2}{s^1_2} \right)} \qquad (13)$$

This equation may be written

$$N_2 s_2 = 80 \delta a \frac{\left(p^2 l^1 + 0.63 D N_2 \frac{s_2}{s^1_2} \right)}{c g r D l w_2} \cdot x \qquad (14)$$

The value of $\frac{s_2}{s^1_2}$ is assumed at the start, as is also the number of wires, and the calculation will give no further difficulty.

APPLICATION TO POLYPHASE GENERATORS WITH DAMPERS.

Having now presented the fundamental equations which, while quite numerous, are very essential for the better understanding of what follows, we will consider the machines with which this paper deals.

It is clear that the above formulæ can only be employed in the calculation of alternating-current generators with certain reservations, as the chief condition, a constant self-induction coefficient, is missing. While the calculation will on account not be very accurate, it is further aggravated by the coefficients ν_1 and ν_2 which can only be approximated. The following data will serve rather the purpose of giving an approximate idea of the method of operation of a damper than to give definite figures.

The problem is to investigate the influence which a damper has on a flywheel machine, which has a variable speed on account of the unfavorable positions of the crank. For this purpose let us use equation (9) for the torque.

For E_1 we cannot take the line pressure E, but only half the resultant of the e. m. f.'s E_2 of the two machines (see Fig. 3). That is,

$$E_1 = E_2 \sin \frac{a}{2}$$

Usually the angle a is very small, so that the sine can be replaced by the arc. In this case

$$E_1 = E_2 \frac{a}{2} \qquad (15)$$

and, therefore,

$$i_0 = \frac{E_1}{w_1 L_1} = \frac{E_2}{w_1 L_1} \cdot \frac{a}{2} \qquad (16)$$

The maximum phase angle a can be determined in the manner: In the case of a single cylinder engine there is an energy

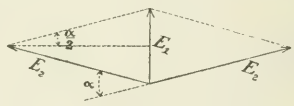


FIG. 3.—RESOLUTION OF E. M. FS.

equalization between steam engine and flywheel four times during each revolution. During each revolution the flywheel traverses an arc πp, in consequence of which the greatest advance or retardation of one machine with respect to the other for the most unfavorable crank position and a degree of uniformity u, is

$$a = \frac{1}{4} \frac{\pi p}{u} \qquad (17)$$

In the case of two-cylinder machines there is an energy exchange eight times during each revolution. The maximum variation is, therefore,

$$a = \frac{1}{8} \frac{\pi p}{u} \qquad (18)$$

The secondary angular velocity w_2 is finally obtained from the primary w_1, the factor u and the simple equation

$$g = \frac{1}{u} \text{ as follows:}$$

$$w_2 = g w_1 = \frac{2 \pi c}{u} \qquad (19)$$

We are now acquainted with every member of equation (9), and we can now calculate the torque Z, or, by multiplying both sides by the speed v, the output in kg. m. seconds. At present we are concerned with a comparison between the work of the flywheel and that of the damper. In consequence of this, we need not consider the output per second, but only the work P_1, which is done by the damper during the time, in which the flywheel delivers energy to the steam engine or accumulates energy.

This time, in the case of a single-cylinder engine amounts to $\frac{60}{4 n}$ and for a double-cylinder engine $\frac{60}{8 n}$ seconds.

Hence:

$$P_1 = Z\,v\,\frac{15}{n} \text{ for the single-cylinder engine.} \qquad (20)$$

and

$$P_1 = Z\,v\,\frac{7.5}{n} \text{ for the double-cylinder engine.} \qquad (21)$$

The work of the flywheel P_2 is represented by the well-known equation,

$$P_2 = \frac{G}{9.81} \cdot \frac{v^2}{u} \qquad (22)$$

in which G is the weight of the revolving masses and v the velocity at the central point of the revolving masses.

Example.—It is interesting to determine the values of P_1 and P_2 for an existing 350-hp, two-phase flywheel machine. The machine was coupled to a single-cylinder steam engine. The data for this machine are as follows:

Terminal voltage $E = 88$ volts.
E. M. F. E_2 (for $\cos\phi = 0.9$) $= 120$ volts.
Current strength per phase $I = 1420$ amperes.
Revolutions $n = 65$
Number of periods $c = 39$
Number of poles $p = 72$
Diameter $D = 530$ cm.
Width $l = l^1 = 21$ cm.
Air-gap $\delta = 0.7$ cm.
Number of bars $N_2 = 432$
$s_2 = 5.21$ sq. cm.
$s^1_2 = 20$ sq. cm.
$r = 0.8$
$a = 1.1$
$v_1 = v_2 = 1.2$
$w_1 L_1$ (from test) $= 0.059$
$G = 23{,}200$ kg.

$$v = 4.4\,\pi\,\frac{65}{60} = 15\ m.$$

$u = 115$

From which

$$a = \frac{1}{4}\,\frac{\pi p}{u} = \frac{\pi\,72}{4 \times 115} = 0.49$$

$$E_1 = E_2\,\frac{a}{2} = 120 \times \frac{0.49}{2} = 29.4 \text{ volts.}$$

$$i_0 = \frac{E_1}{w_1 L_1} = \frac{29.4}{0.059} = 500 \text{ amp.}$$

According to equation (13)

$$x = \frac{g}{80}\,\frac{N_2\,s_2\,r\,D\,c\,l\,v_2}{d\,a\left(l^1 p^2 + 0.63\,D\,N_2\,\frac{s_2}{s^1_2}\right)}$$

$$= \frac{432 \times 5.21 \times 0.8 \times 530 \times 39 \times 21 \times 1.2}{115 \times 80 \times 0.7 \times 1.1\left(21 \times 72^2 + 0.63 \times 530 \times 432\,\frac{5.21}{20}\right)} = 0.9$$

and finally by neglecting the slip and the friction resistance:

$$P_1 = Z\,v\,\frac{15}{n} = \frac{m\,E\,i_0}{9.81} \cdot \frac{x}{v_1\,v_2\,d} \cdot \frac{15}{n}$$

$$= \frac{2 \times 120 \times 500 \times 0.9 \times 15}{9.81 \times 1.2 \times 1.2 \times 1.1 \times 65} = 1600$$

$$P_2 = \frac{G\,v^2}{9.81\,u} = \frac{23200}{9.81} \times \frac{152}{115} = 4630$$

These figures show that the damper actually influences to a certain degree the uniform running of the machine. This influence, however, is but slight under normal operating conditions, especially as the torque decreases with the third power of the constant u. Besides, this factor is of little account, except that it insures greater stability for paralleling the machines. If we shift the phases by 90 degs., which would ordinarily cause the machines to get out of step, we obtain the maximum torque and in addition an amount of work,

$$P_1 = 9000 \text{ kgm.}$$

in other words, twice as much as the flywheel itself furnishes. It must be kept in mind, however, that the equalizing current i_0 increases correspondingly up to about 1400 amperes, which is of no small account in considering the safety of operation.

A single-cylinder engine has been chosen in order to bring the influence of the damper out more clearly. The result would have been quite different if a compound engine had been selected. In this case the phases would have been shifted only one-half as much as in the first instance, the torque is reduced to ¼ and the quantity P_1 to ⅛ of the original values. There will be a further reduction on account of the increase of the factor u, the change varying as the third power of this factor. The ratio $\frac{P_1}{P_2}$ will also be considerably more unfavorable. The question now arises whether single-cylinder engines are not preferable in a number of cases to compound engines. This question, which seems almost superfluous in view of modern practice, is nevertheless justified when we consider installations principally used for lighting purposes. Such machines generally operate at full load for only a few hours and with no load the remainder of the day, as they only have to furnish the no-load current for the transformers.

Under such conditions a good single-cylinder engine is much more advantageous with respect to steam consumption than a compound engine, aside from the other advantages which it possesses for rapid regulation and paralleling. The answer may be made that during the day a smaller machine might be used, but frequently this method cannot be employed. I know of some cases where a large machine which was fully capable of carrying the night load, was not capable of furnishing the no-load current for the transformers during the day, because the drop pressure was too great, although the current was far below the normal.

Finally, I should like to point out a property of single-cylinder engines, which, in my opinion, has not received sufficient attention in the past, that is, their comparatively uniform operation. By this is not meant the so-called degree of uniformity, i. e., energy variations during each stroke, which variations are greater, of course, in the case of single-cylinder engines, than in the case of compound engines; the essential feature is the steadiness of the change from minimum to maximum speed. This is brought about by the single control and the small number of elements which are subjected to disturbances. If we consider now that the momentary value of the pressure depends directly on the speed, it will be easily seen that every irregularity in the operation of the steam engine has the effect of forming higher harmonic waves. Instead of seeking the causes of such phenomena in the alternator itself, it would frequently be advisable to subject the regularity of the steam engine to close investigation.

SINGLE-PHASE GENERATORS WITH DAMPERS.

In the case of single-phase generators the thing which interests us in the first place is the influence which the damper exerts on the drop of pressure of the machine. As we are only concerned at present with comparative figures, we can neglect the small ohmic resistance of the primary winding and consider the drop of pressure in the primary winding proportional to the field $v_1\,\Phi_1$. The calculation will be considerably simplified, if we consider the field $v_1\,\Phi_1$, which varies in strength, replaced by two rotating constant fields of half the strength which have the opposite direction from the angular velocity w_1. One of these fields revolves synchronously with the magnets, i. e., the damper, and has, therefore, no effect on the latter. The other rotary field moves opposite to that of the damper with a velocity $2\,w_1$ in a backward direction, and produces therein currents of twice the number of periods. It is clear that under such conditions the quantity x, which has been explained above, will be very large, so that the angle ϕ_2 may practically be assumed as 90 degs.

Let us construct in the well-known manner the parallelogram of field intensities. For this purpose it is only necessary to replace the components Φ_1 and $v_1\,\Phi_1$ in Fig. 2, by $\frac{\Phi_1}{2}$ and $\frac{v_1\,\Phi_1}{2}$. Under the practically correct assumption that $\vartheta_2 = 90$ degs., the primary and secondary fields have opposite directions. From this it follows that

$$\Phi_m = \frac{v_1\,\Phi_1}{2} - \Phi_2 = \frac{v_1\,\Phi_1}{2} - \frac{\Phi_1}{2\,v_2} = \frac{v_1\,\Phi_1}{2}\left(1 - \frac{1}{v_1\,v_2}\right)$$

The total self-induction of a machine with damper has therefore

the following relation to the self-induction of a machine without a damper,

$$\frac{1}{2} \cdot \frac{1}{2} \left(1 - \frac{1}{r_1 r_2}\right) = \left(1 - \frac{1}{2 r_1 r_2}\right)$$

If it were possible to construct a machine without a stray field (i. e., $r_1 r_2 = 1$), then the original drop of pressure would be reduced to one-half by the damper. In reality, the stray field is quite large in consequence of the large air-gap. Even in the case of an ordinary induction motor with only a 1 mm. air-gap and nine teeth per pole, $r_1 r_2$ varies from 1.1 to 1.15. For the small number of teeth, usually employed, and an air-gap of from 5 to 7 mm., this value must be assumed much greater and can hardly be less than from 1.5 to 1.6. The greatest reduction of the drop of pressure which can be obtained, can therefore be, under the most favorable conditions, about 30 per cent, but may be considerably less. Decreasing the drop of pressure 30 per cent, however, means an increased output of the machine of 30 per cent. It must not be forgotten, however, that the damper requires considerable copper in its construction, and therefore adds considerable to the cost of the machine.

The following Table III., which presents data of machines which have been constructed, will more clearly demonstrate this contention:

TABLE III.—WEIGHT OF COPPER ON MACHINES WITH DAMPERS.

	Kilowatts	40*	125*	350	600	1000
Weight of Copper	Armature	50 kg.	150 kg.	1200 kg.	580 kg.	1800 kg.
	Field ...	115 kg.	350 kg.	1900 kg.	2140 kg.	3640 kg.
	Damper ...	114 kg.	200 kg.	1030 kg.	1650 kg.	1530 kg.

As will be seen, the average weight of copper on the damper is more than one-half of the weight of copper on the fields.

There is no doubt that the same purpose could have been achieved by slightly strengthening the magnetic field and the use of less copper, aside from the fact that this also has the effect of decreasing the weight of copper of the armature wires, presupposing the same drop of pressure. In going through the calculation of these five machines, for example, it is found that on an average of one-fifth of the weight of copper on the damper would have been sufficient to cause the same drop of pressure.

Summing up all of the above, it must be admitted that in some cases the employment of the damper possesses certain advantages, but these advantages are out of proportion to the enormous first cost. Furthermore, there is no doubt that the same purpose can be accomplished in a simpler and cheaper manner by a corresponding distribution of the winding.

Finally, the construction of the damper interferes materially with the simple exchangeability of magnet coils, which is an important factor. Best suited for this purpose is the so-called inductor type, to which I referred in another article (ELECTRICAL WORLD AND ENGINEER, Sept. 2, 1899).

Rotary Converters vs. Motor Generators.

An article presenting the motor-generator side of the rotary converter vs. motor-generator controversy appeared in our issue of Sept. 21, and later was reprinted in our London contemporary, the *Electrician*. In a recent issue of that journal, Mr. H. S. Meyer criticizes some of the data and statements contained in this article, as follows:

Firstly.—Machines of entirely different makes are compared. This hardly ever leads to satisfactory figures, unless all the points of design are most carefully studied, and the tests based on exactly similar methods.

Secondly.—In the case of motor-generator sets, the figures given are taken from curves obtained either by calculation or tests, while the figures for the rotary converter are values guaranteed by some other manufacturer.

From a German technical paper, where the same article appeared, we learn that the rotaries referred to were of American make, and as it is common practice in the States to allow in all guarantees concerning electrical constants of a machine a safe margin of at least ½ per cent to 1 per cent under the value obtained in actual test, the comparison should be corrected from this point of view. To illustrate this, I give in the following table figures taken from test reports of some standard 25 cycle rotary converters made by one of the large American firms of exactly the type chosen for the above comparison—i. e., a 250-kw and 500-kw three-phase converter, with necessary step-down transformer cooled by air blast.

Efficiency.	250 kw. Trans	Rotaries.	Combined.	As given.	500-kw Trans.	Rotaries.	Combined.	As given.
Full	97.1	94.83	92.0	89.5	97.88	95.0	93.0	90.5
½	96.3	92.25	88.7	85.0	97.01	93.1	90.3	85.5
¼	93.1	86.55	80.6	....	94.75	88.2	83.5	....

If a new comparison is made on the basis of the above figures, it will show already a decided advantage on the side of the rotary converter; but it should further be borne in mind that the motor-generator sets seem to be built on special order, while the rotaries and transformers quoted are of standard make. It will be readily understood that a special machine may be built with much higher constants than it would be advisable to use for a standard line where cost and weight are the most important items. Incidentally, it might be mentioned that the values given in the table are not all in accordance with the curves. I mention as a case Fig. 4 of the 350-hp induction motor, where the curve indicates for full load, cos $\phi = 0.79$, which apparently should read 0.89, while the table gives 0.91.

Thirdly.—The comparison of heating constants given in the article shows similar inconsistency, as here, again, values obtained on actual tests, after full load run of 10 hours are compared with guaranteed limits which can only refer to tests of a much severer character corresponding to the standard American heating guarantees for this class of machine, and which read as follows: No part of the converter, as measured by thermometer after a run of 24 hours at rated load and unity power factor, will rise more than 35 degs. C. above that of the air surrounding the machine, provided the temperature of the air does not exceed 25 degs. C. With the load then increased to 50 per cent overload and unity power factor, no part of the converter will rise after a two hours' run at this load more than 55 degs. C. above that of the surrounding air.

This is further illustrated by the following table, which gives the heating values from the same test reports for the two sizes of rotaries, which compare very favorably with those given for the motor-generator sets:

	250-kw 10 hours, full load.	250-kw 50 per cent. overload, two hours.	500-kw. 10 hours, full load.
Arm. core by therm.	20.7	24.8	31.5
Windings by res.	30.8	32.8	29.6
Commutator by therm.	29.9	49.6	34.6

Fourthly.—As to the weight, even the table of the Oerlikon test per kilowatt for the different combinations given is as follows: shows a considerable advantage for the rotary converter. The weight

	Lbs. per kw.
Induction motor-generator set	168
Synchronous motor-generator set	145
250 rotary converter and transformers	110
500 rotary converter and transformers	94

The costs, which are not considered at all in the article referred to, form about the strongest point in the comparison, which is shown by the following information, and which gives the cost of the different items under discussion. The cost per kilowatt will be approximately as follows:

	£	s.	d.
Transformers cooled by air blast, 100-200 kw....	£1	10	0
Rotary converter, 25 cycles, 250-500-kw.....	2	0	0
Oil-cooled reactance coils for obtaining 10 per cent compounding by phase control, for plants of 300 kw.	0	6	0
Direct-current generators, 250-400 kw, running at about 375 r. p. m.	3	1	0
Synchronous motor, 50 cycles, running at about 375 r. p. m., 250-400 kw, wound for 6000 volts....	2	10	0
Three-phase induction motor, 50 cycles, running at about 370 r. p. m., 150-250 kw, wound for 6000 volts	3	2	0

The last two machines would be somewhat cheaper if wound for a low voltage, but then additional transformers would have to be used,

*I should like to call special attention to the two types of machines referred to, of which five have been in operation at Saumur, France, since the middle of 1897, because they are provided with a special form of armature slots, patented this year by a well-known firm, and shown in Fig. 1. At the time when I designed that machine, I did not believe for a moment that there was anything novel in this form of slot, which undoubtedly had been used by others for a long time, and I did not think of applying for a patent. That this was done by another party simply demonstrates the mania with which certain professional inventors attempt to monopolize every thought, no matter how natural, for themselves.

which would reduce the efficiency and increase the total cost of the system.

The proposition for a 300-kw plant would compare as follows:

(1)	Three 110-kw transformers	£495
	One 300-kw rotary converter	600
	One oil-cooled reactance	90
	Total	£1,185
(2)	One 300-kw synchronous motor	£750
	One 300-kw direct-curent generator	915
	Total	£1,665
(3)	One 300-kw induction motor	£930
	One 300-kw direct-current generator	915
	Total	£1,845

These arbitrary cost figures, which are based on actual practice, and which are chosen rather favorably for the motor-generator sets, show a marked saving in capital outlay for the rotary converter—i. e., £480 when schemes 1 and 2 are compared, and £660 for schemes 1 and 3. It should be stated that these prices only hold good for the case cited by the Oerlikon Company, and have to be adjusted for any other proposition.

Fifthly.—From the point of view of floor space required, still another advantage for the rotary converter vs. motor-generator may be brought forward, as the transformers can be located either in the basement or on an elevation in the sub-station, leaving only the rotaries to be placed on easily accessible ground. With the motor-generator proposition, more than double the actual floor space is required for the two machines, and, as the sub-stations are mostly situated in a part of the town where real estate is very expensive, a further saving in capital outlay may be effected by choosing the converter instead of the motor-generator.

A number of other favorable points could be added by an advocate of the rotary converter, as, for instance, its almost unlimited overload capacity and the easy method of compounding on the alternating current side by phase control, etc. But the writer, on the other hand, fully appreciates that there are cases where the motor-generator is at all events to be preferred in spite of all the advantages set forth in this article. As this part of the subject is treated in detail by the article referred to, it is not necessary to make any further comments on it. Both classes of machines have their field, but wherever possible, from the requirements of the system, a rotary converter should be given the preference as being cheaper, more efficient and taking less floor space.

The Economic Design and Management of Telephone Exchanges—IV.

By Arthur V. Abbott, C. E.

(d) the wire plant.

STRUCTURALLY the wire plant may be divided into (a) aerial lines, (b) underground lines.

(a) Aerial lines comprise all of the wire plant that is above the ground.

Aerial lines may be divided into (1) open wire lines and (2) aerial cables.

(1) *Open Wire Lines* are those in which individual wires are supported upon insulators set on cross arms carried upon line poles.

(2) *Aerial Cables* consist of a number of insulated conductors bunched together in a lead sheath and supported upon cross arms upon a pole line. Aerial cables are usually 10, 25, 50, and occasionally 100 pair.

Anchor Pole.—The last pole at the end of an aerial line upon which the wires are terminated, and which must be sufficiently strong to sustain the longitudinal stress of the wires.

Balcony.—A small platform built upon a pole carrying a cable head upon which workmen may stand, for the purpose of access to the cable head.

Common Return (sometimes called *McClure System*).—It was formerly customary to use the earth as one conductor for every telephone line, but inductive disturbances became so severe as to compel the resort to a complete metallic circuit to afford the best service. The use of one wire of somewhat larger section than the ordinary line wire serving as common conductor for a number of lines (a partially successful compromise between the more expensive complete metallic circuit and defective ground) has received the preceding title.

Distributing Pole.—A pole from which a number of drop wires pass to sub-stations.

Messenger, sometimes called *"strand."* A wire rope carried upon a special cross arms (usually angle iron) of a pole line and used for supporting an aerial cable.

Transposition.—By arranging the wires of an open-wire line so that instead of preceding straight along on the same pin through the entire line, each wire frequently changes from one pin to another in such a manner as to thoroughly interlace all the circuits among themselves, inductive disturbances may be prevented. Such interlacing is called *"transposition."*

Terminal Pole.—A pole carrying a cable head or terminal, sometimes called a distributing pole.

(b) underground plant.

The underground plant comprises all of the conductor installation which is placed below the street level.

Block System.—The plan or design of a telephone cable plant involving the extension from the central office of one or more main cables that are subsequently split into a number of subordinate branches and extended from one distributing point to another in series.

Cable Entrance or *Cable Run.*—Where cables, either aerial or underground, leave the street and enter the central office building, proper facilities must be provided to convey them from the street to the cable side of the main distributing board. All the space taken for this purpose, together with all the necessary supports or fittings to hold the cable, is called the *cable entrance.*

Cable-head, "Terminal" or *"Cable Box."*—A device into which a cable is extended and to which the lead sheath may be soldered forming a water-tight joint. The cable head is usually in the form of a long rectangular box, preferably of iron, upon the inside of which the cable wires may be fanned out and attached to binding posts, which project through the sides of the box, the whole being supplied with a water-tight cover. By this means the individual pairs of an aerial cable may be connected to the open wire lines by means of short pieces of wire called "bridles" or "jumpers."

Distributing Box.—A device similar to a cable head, through which a main cable passes, which permits a portion of the cable pairs to be taken off and distributed to adjacent sub-stations. Distributing boxes are now becoming obsolete, and are replaced by "Y" splices.

Lateral Cable (sometimes called "Subsidiary Cable).—That portion of the underground cable plant which extends from a main cable or distributing box to a terminal pole or building terminal.

Conduit.—A structure installed beneath the street level for the purpose of carrying electrical cables. Conduits may be divided into (a) drawing-in systems, so planned as to permit of introducing or removing the cable at any time after the structure is completed; (b) built-in systems, in which the cable is placed at the time the conduit is constructed and cannot thereafter be removed or changed. Built-in systems are gradually becoming obsolete.

Duct.—Such a longitudinal portion of the conduit as is intended for the reception of one or more cables. The tendency of present practice is to so construct conduits that each duct shall receive only one cable. Ducts are divided into:

(a) Main ducts which carry feeder cables or main cables, and (b) lateral ducts, or those which branch from the main conduit to a disturbing pole or office terminal.

Encasement.—The concrete or other material with which the ducts forming a conduit are surounded for the sake of mechanical strength and protection.

Fish Wire.—A wire which is placed in a duct for the purpose of drawing in a cable.

Main Cables (sometimes called "feeder cables").—That portion of the underground cable plant extending from the office, along a highway to a distributing box or lateral cable.

Manhole (sometimes called "vault").—A chamber constructed beneath the street level and giving access to a portion of the conduit for the purpose of introducing and removing cables.

Office Manhole.—A manhole or vault, usually much larger than standard size, placed as close as possible to the central office to which

all the conduit system converges, and from which the cable entrance extends into the office.

Pot Head.—A peculiar kind of cable terminal, consisting of a piece of lead pipe somewhat larger than the cable sheath, onto which it is soldered, making an air-tight joint. Into this sleeve the cable conductors are extended and connected to okonite or other water-proof wire. The sleeve is then filled with a water-proof compound melted and poured in, thus effectually sealing the cable from the incursion of moisture, yet permitting the conductors to be extended at pleasure.

Rodding.—The operation of introducing into a duct a fish wire to facilitate the future introduction of a cable.

Section.—That portion of a conduit extending between adjacent manholes.

Underground Cable.—A collection of conductors surrounded with a lead sheath and designed for service in underground conduits. Underground cables are usually 25, 50, 100, 120, 150, 200 and 300 pair.

"Y" Splice.—The separation of a feeder cable into two or more parts by splicing to the cable one or more branch cables, the sum of whose conductors is equal to the main cable. This splice is made by soldering to the main cable sheath lead sleeves to which the smaller cables are attached, thus forming a "Y." A cable thus divided is said to be *tapped,* and each part is often termed a *tap.*

Battery Wires (also called "power wires").—Lines which are used for the purpose of carrying battery currents or electricity for other purposes than talking.

Branch Exchange Line or *Trunk.*—A line extending from a central office to a branch exchange.

Call Wires (also called "order wires").—Circuits used to permit operators to talk to each other for the purpose of giving instructions regarding exchange business.

Combination Line.—A line which is used both for talking and for telegraphing.

Distributing Line.—A line branching from a main lead running to various sub-stations. Distributing lines are usually aerial. As in many cases such lines are built in alleys they are frequently termed "alley" lines.

Drop Wires.—The portion of the subscribers' line which extends from the outside of the wall of his premises to the nearest wire run.

Long-Distance Lines.—Toll lines which extend over such a distance as to pass through the offices of a number of companies.

Main Line (sometimes called a "through line," a "trunk line" or "main lead").—A portion of the wire plant which extends from the exchange to the distributing lines.

Private Line.—A line extending between subscribers not used for exchange service.

Subscribers' Line.—A wire or pair of wires used to give service to subscribers. Sometimes called an exchange line.

Toll Lines.—Trunk lines extending outside the territory of an exchange, and upon which an extra rate or charge for service is made.

Trunk Line.—A wire or pair of wires extending between two central offices used to transmit originating calls in one office to subscribers in the other.

(e). SUB-STATION.

Subscriber's Instrument.—This term includes the complete talking and signaling apparatus used by the subscriber, and comprises a hand telephone, receiver, call bell and means of signaling. Subscribers' sets are commonly classified into cabinet desk sets, or instruments which are mounted in a kind of desk or cabinet, at which one using the telephone may conveniently sit and write; desk sets, or those which may be semi-portable by the use of a flexible cord, and so may be placed upon a table or desk; extension sets, or those consisting of a duplicate set (often of a different pattern), placed on a line that is an extension or addition to the first set, usually running to an adjoining room. The circuit in such instruments is frequently so designed that the first instrument upon the line may receive the call, and the extension instrument subsequently used on a secondary signal. The use of such circuits is common in offices where a clerk or other employe first receives the calling signal and subsequently summons his principal. Party-line sets, or instruments which are designed to be operated upon lines having more than one subscriber; wall sets, or those which are supported by being fastened to a partition wall. Each set consists of the following parts:

Transmitter, or apparatus used by the subscriber in talking to another party.

Receiver (also called *"Telephone"*).—The instrument for receiving conversation. When held in the hand receivers are called *"hand telephones."* When supported at the ear by a band or cap on the head, receivers are called *"head telephones."* Receivers are divided into common battery receivers and magneto receivers. Common battry receivers are of lower resistance than magneto receivers.

Ringer or *Bell.*—The device for making an audible signal at the sub-station, usually consisting of an electromagnet carrying a pivoted armature, to which a bellclapper is attached, the passage of an alternating current through the magnets, causing the armature to vibrate, thus sounding the bell. Ringers may be high wound, 200 to 1600 ohms (for bridging bells), or low wound, 25 to 150 ohms (for series bells).

Generator (sometimes called "magneto-generator" or "magneto").—A small hand-operated alternating-current dynamo capable of giving from 10 to 20 cycles per second, usually at a potential of from 50 to 125 volts, used for sending alternating currents to operate ringers. Generators may be high or low wound, depending upon the service to which they are to be devoted, high-wound generators giving a greater e. m. f. than the low wound.

Back Board.—Strictly the wooden board to which subscribers' sets are attached, but frequently expanded to mean the entire woodwork that is used for supporting a sub-station outfit.

Bell or *Call Bell.*—Usually understood to mean the entire signal bell, including the gongs, clapper and ringer magnets. Bells are usually designated by the resistance to which they are wound, as 40, 60, 80, 100 or 1000 bells.

Biased Bell.—This term is sometimes applied to a polarized bell, but strictly relates only to bells in which the ringing armature is pulled in one direction by a spring, and thus given a set in one direction. Pulsating currents of one polarity will affect such a bell, while it is unaffected by similar pulsating currents of opposite polarity. Used as a selective signal for party lines.

Hook or *Telephone Hook.*—A pronged support arranged on a sub-station set to hold the receiver. The hook also forms an automatic switch operating contacts in the sub-station circuits.

Induction Coil.—A coil consisting of two electrically separate windings forming a small step-up transformer. The low winding of the induction coil is placed in circuit with the transmitter, while the high winding is placed in series with the line. The office of the inductoin coil is to raise the potential of the impulses set up by the transmitter.

Polarized Bell.—A bell in which the armature or ringer cores or both are permanently magnetized so that the armature is held in a predetermined position with the reference to the ringing magnets. Currents of one polarity will then cause such bells to ring, while currents of the opposite polarity will not effect it. Used in connection with a party line as a selective signal.

Wall Plugs.—Wooden plugs placed in holes drilled in house walls to which sub-station instruments are fastened, and by which they are supported.

Edison Iron Ore Extraction in Norway.

Mr. Campbell W. Adams, of Utica, N. Y., and Mr. Herschel Roberts, of Albany, and assistants have returned from Norway, where they have been making surveys for the Edison ore milling (English) syndicate, which has recently acquired from the Norwegian Government great ore beds inland from Mo, a little settlement on the Ronen Fjord in the North Sea.

It is estimated that there are 50,000,000 tons of ore in one deposit, which, when mined, show 40 per cent iron. The syndicate now has a large force of engineers at work, and if their reports are favorable, between $2,000,000 and $3,000,000 will be expended in the mining properties.

The heaviest deposit of ore is 18 miles from Mo. Messrs. Roberts and Adams have made surveys of the harbor facilities, and for a line for a standard gauge railroad running to the mine. Turrettini, the well-known Swiss hydraulic engineer, is making plans for the building of an electric plant midway between the mine and tidewater.

There is a waterfall of 112 ft., and there is capacity for from 10,000 to 15,000 hp. The current is to be used in Mr. Edison's process of reducing the ore. This is in the Dunderland Valley. The railroad and the electric plant will be equipped by American factories.

Messrs. Roberts and Adams will spend the winter in Albany tabulating their data preparatory to submitting them to the syndicate. They will return to Norway in the spring, by which time it is expected that the work will be begun.

Electrical Tabulation in the Twelfth Census.

One of the most interesting features in connection with the twelfth United States census is the use of electrical apparatus in the work of tabulation. It is true that this special application is not new, having been employed in the eleventh census and adopted also by Canada and Austria, but in this latest numbering of the people the use of the electrical apparatus has been extended to details and departments involving far more complication than are presented by the simple data in regard to population. Many readers of this journal are doubtless familiar with this remarkably ingenious apparatus of Dr. Herman Hollerith, as it was described and illustrated very fully in the *Electrical Engineer* of Nov. 11, 1891, by one of the editors of this journal, who had opportunities for studying the system in Washington in all its details. The system in its latest use and refinements was described this year, before the American Association for the Advancement of Science, by Mr. H. T. Newcomb, to whom we are indebted for some of the very interesting data now presented.

The work devolving upon the Hollerith apparatus in the tabulation of population statistics is that it must count. This time it has been put upon the compilation of agricultural statistics which necessitated that it must also be able to perform sums in addition. The general method of controlling all the tabulating machinery invented by Dr. Hollerith is the utilization of an electric current transmitted by means of needles arranged to pass through perforations which, by their locations, express certain facts that have been transcribed, by punching, from the original schedules or other primary sources, to cards. Each of these cards, in the case of population statistics, is arranged so as to provide for a complete description of an individual, there being one or more perforations for each inquiry, the answer to which is to be tabulated, and the location of each indicating the particular answer made. In addition, certain perforations indicate geographical location. The cards used in the tabulation of statistics of agriculture are of two kinds, one providing for the transcription from the schedules of the descriptive facts ascertained for each farm in its entirety, and the other for those in regard to each product or kind of farm animals on each farm. The card first referred to has become known in the Census Office as the "farm card" and the second as the "crop card." Fig. 1 is a reproduction of a farm card except that words designating the character of the facts transcribed in each of the different fields have been added. Fig. 2 represents a farm card to which the description of an imaginary farm has been transcribed.

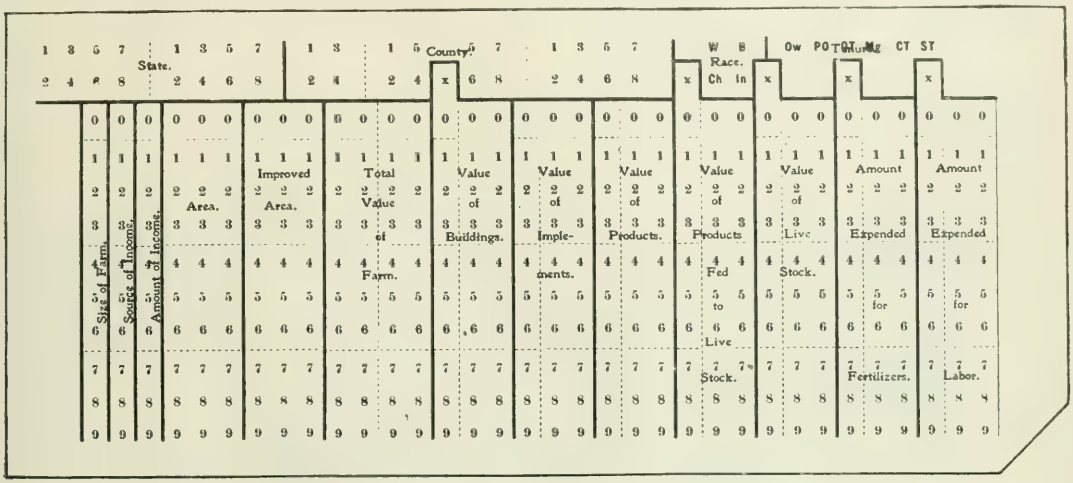


FIG. 1.—ELECTRIC TABULATING FARM CARD.

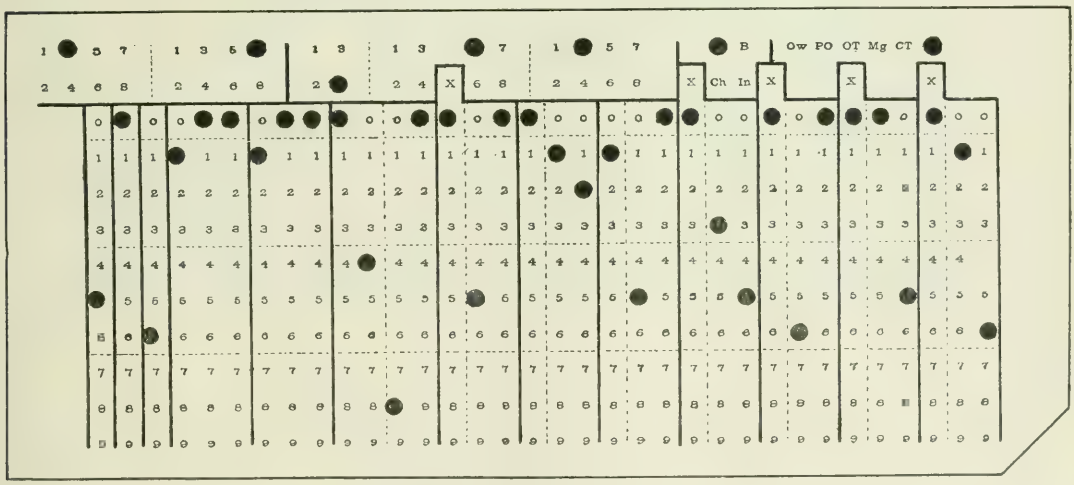


FIG. 2.—PERFORATED CARD FOR TABULATION.

The perforations indicated in Fig. 2 describe a farm of 100 acres, located in Shiawassee County, Michigan, and managed on June 1, 1900, by a white farmer who held the land as a tenant, paying a share of the products to his landlord. They show, further, that on

June 1, 1900, the entire farm was improved; that it was valued in the aggregate at $4,800, and that this total included buildings worth $500; that the implements owned or otherwise available for use in its cultivation were worth $120; that the products raised on it during the crop year 1899 were worth $1,500; that those fed on the farm to live stock during the same period were worth $350; that the live stock on the farm on June 1, 1900, was worth $600, and that the amounts expended, respectively, for labor and for fertilizers during the crop year reported were $160 and $50. It will be noticed that the units figures were disregarded in punching most of the amounts representing values. The first and third perpendicular columns at the extreme left of the card, indicated in Fig. 1 by the terms "size of farm" and "amount of income" do not provide for any additional information, but were incorporated for convenience in tabulation. They facilitate the assortment of the cards under the different size and income classes. The column between them, indicated in Fig. 1 by the term "source of income," shows from which one, if any, of 10 classes of products 40 per cent or more of the total farm income of the crop year 1809 was derived. The perforation in this column in Fig. 1 indicates that not less than 40 per cent of the 1899 income of the farm described thereon was derived from "hay and grain"

responding cup of mercury and form a separate electrical circuit. A properly prepared card being fed into the machine, however, and the platen similarly depressed, only those pins which correspond to perforations in the card remain sufficiently extended to enter their reciprocal cups of mercury, while the others, striking the card and meeting with its resistance, are pushed backward upon the springs in which they are set. The arrangement of the electrical connections between the actuating device thus controlled by the card and the adding machinery is such that a failure to punch an answer to any question or the omission of part of an answer, will prevent the operation of the tabulating machinery, and in this way errors of these classes are readily detected. The adding machinery consists of a series of adding devices sufficient in number separately to add the amounts of each character contained on the cards used. These adding machines work simultaneously, and each of them receives its impulse by means of the current transmitted through and controlled by the cards in the manner previously described. The tabulating machine in the form adopted for aggregating the data from the "farm cards" comprises 10 adding machines, and, in one of its adjustments, for a particular portion of the work, carries, in addition, 21 separate counting devices. Each of these machines is in charge

Fig. 3.—Hollerith Electrical Tabulating Machines in U. S. Census Office, Washington.

The reader will understand that perforations differently located from those indicated in Fig. 2 would express different facts.

As has been said, the perforated cards control the tabulating machinery which is actuated by means of an electric current passing through the perforations. The transmission of this current is effected by feeding the cards upon a bed plate. The "bed" of this device consists of a non-conducting material with perforations corresponding to each possible perforation in the card. Each perforation in this bed is the opening of a cup of mercury which is separately connected electrically with the proper portion of the adding machinery. The "platen" holds an arrangement of pins set in springs, which are compressed by light pressure, one pin corresponding to each perforation in the bed and to each possible perforation in the card. Thus as adapted for tabulating the data that are transcribed on the farm cards (the perforations for geographical location, race and tenure are used in sorting, but not in the mechanical tabulation) each bed contains 345 cups of mercury each electrically connected with the adding machinery, and each platen consists of 345 pins, each separately and similarly connected. In their normal position these pins are extended sufficiently so that if the platen is depressed as far as it will go, upon the bed, each pin will enter the cor-

of a single operator whose work consists of feeding and removing the cards, depressing the lever so as to make the electrical connection through each card, and recording the totals from the register.

Mr. Newcomb reports that the Division of Agriculture has been employing 12 of the large "farm card" Hollerith machines and 86 of the smaller "crop card" machines. He estimates that the total work that should be credited to them may be reckoned as equivalent to running 5,750,000 farm cards four times and 115,000,000 crop cards twice. This he sets down as being equal to adding up over 800,000,000 items, all of which otherwise would have been done as "hand work," with consequent increase of expense and labor, coupled with greater chance of inaccuracy, a much longer time in reaching results and a higher cost for the work.

In connection with the work of compiling the population and vital statistics of the Twelfth Census, the newer Hollerith development has been in the direction of an automatic tabulating machine. This machine is arranged with a magazine, into which is placed a stack of from three to five hundred cards. The machine is operated by a small electric motor, and automatically feeds the cards successively into operative position. If the card be properly punched, and tabulates, a deflector plate is operated to throw the card into one com-

partment. If, however, the card is not properly punched, or for any other reason does not tabulate, the deflector plate does not work and the card is rejected into a different compartment. After the cards for a given district have been run through the machine in this way, the rejected cards are inspected, the errors in punching are rectified, and the cards are again fed through the machine. While the operators can tabulate on the old form of machine at a speed of from 50 to 60 cards a minute, with the automatic machine the cards are tabulated at a rate of from 250 to 300 per minute, one operator being able to attend to a number of such automatic machines.

In connection with this automatic tabulating machine an automatic sorting machine has also been developed, and the automatic tabulating and automatic sorting apparatus may be combined in one machine. The sorting machine consists of a number of pockets or compartments, and a number of chutes or guides which, according to the hole punched in the card, establish communication from the magazine to the particular pocket or compartment. This automatic sorting machine is especially applicable for use with the form of tabulating machine employed for compiling the agricultural statistics, on account of the considerable amount of sorting required to arrange the farm and the crop cards according to size, character, etc., the tabulations all being made with reference to such classifications.

A new departure in connection with the present census is the use of the automatic machine for the purpose of mechanically verifying the correctness of the punched transcript. It is understood, of course, that practically the only source of error in this system of tabulation is the more or less remote possibility of a mistake in the punching of a card; but if such a mistake occurs the machine itself serves to detect it. For example, it is known that a person born abroad, residing in this country less than five years, cannot be a naturalized citizen, although such cases are sometimes reported. The machine as used for verification is connected so that the circuit through the deflector magnet will not be completed unless the card for a person punched "naturalized" is also punched more than five years in the United States. In the same way cards which are punched for certain occupations, as for example, blacksmith, shoemaker, engineer, etc., will be rejected unless the sex is punched male. Similarly, the deflector magnet will not operate if the card should represent a male milliner. In the case of such occupations as are common to both sexes, the deflector magnet will operate for either sex. In like manner cards representing inconsistent combinations, as for instance, typewriters and stenographers who cannot read, would be rejected. Again, certain facts may be reported that, while not necessarily erroneous, are at least suspicious; for example, such cards as represented married males, less than 21 years of age, and married females less than 18 years of age, and in the case of cards so punched they are rejected by the machine for the purpose of verification by comparison with the original returns. The object is to reject all such cards as were apparently inconsistent. For example, a card might be punched correctly, except in the case of conjugal condition, where it might be punched widowed instead of single. If the age of the person was given as less than 18, of course, such a card would be rejected, and in this way if there was an error in punching the conjugal condition it would be detected. Likewise, if an error were made in punching the sex "female," and it happened to be a card relating to an occupation such as "blacksmith," such error would be detected, or at least the card would be under suspicion and investigation until the existence of a female blacksmith, or a female car conductor, or a female dynamo tender had been actually proved.

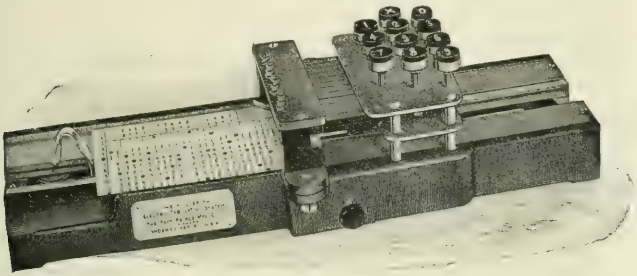


FIG. 4.—APPLIANCE FOR PUNCHING CENSUS CARDS.

A Notable Theft of Current at Madison, Wis.

Note is made occasionally of theft of current, but one of the most interesting cases is that of recent occurrence at Madison, Wis., where a small local electrician, was lately arrested by the Madison Gas & Electric Company on the charge of defrauding the Electric Company by tampering with the meter connections. The arrangement of the wires used by Mr. Harloff was very cleverly made and difficult to detect. The pressure wire running to the Westinghouse wattmeter was cut up in the partition back of the meter, and then a wire run from this pressure wire from the meter down through the partition into the basement, across the basement, then up along a wall, through the floor and into a wall receptacle, which was within easy reach of a person sitting at the office desk. From the opposite side of the wall receptacle the wire was led back down through the basement and tapped on to the same side of the circuit as the pressure wire of the meter was originally connected to.

Into the wall receptacle was screwed an extension plug, which was short circuited. When this extension plug was screwed in, the meter would register the current passing through it, as the pressure wire was then properly connected up onto the meter, though by a circuitous route. When the extension plug was unscrewed, the pressure wire on the meter was cut off, and the meter was then "dead." Several times representatives of the company on inspecting the meter found it "dead," but before leaving the building found it alive again, after some one had found an opportunity to give the plug a turn.

The offender pleaded guilty when tried in the Municipal Court, and this being his first offense he received a very light punishment. The punishment was imposed under Wisconsin Statute, Section 4415C, R. S., 1898, which reads as follows: "Any person who shall wrongfully take, entice or carry away, without the consent of the owner thereof, any bird ordinarily kept in a state of confinement, or any dog or beast of any value, not the subject of larceny at common law, or who shall wrongfully divert and apply to his own use, or wrongfully deprive the owner of any electrical current or power, or of any water stored in a dam or reservoir for use as power, or which is in pipes for the purpose of being furnished to persons who are entitled thereto, or any coal or other gas designed for use for illuminating, heating or other purposes, shall be punished by imprisonment in the county jail not more than one year, nor less than ten days, nor by a fine not exceeding $100, nor less than $5."

The company also has an alleged case against another local electrician. In the latter case, it is reported, a "jumper wire" was found permanently attached to the line wire before entering the wattmeter, and again just after leaving the wattmeter, thus giving two paths for the current, one through the current coil of the wattmeter, and one through the jumper wire. In the preliminary hearing, the man pleaded not guilty, and the case will come up in the January term of the Circuit Court.

The work of detecting the theft of the current was carried on by Mr. C. H. Williams, the superintendent of the electrical department of the Madison Gas & Electric Company, and Messrs. Schuster and Rowell, assistant professors in the electrical engineering department of the University of Wisconsin, who acted as expert witnesses. We are indebted for our information to Mr. Williams.

Bell Telephone in the Central States.

In discussing the recent telephonic developments in the Middle West, the Boston News Bureau, reflecting current opinion at the Hub, says: The Central Union Telephone and the Chicago Telephone companies have taken on a new lease of life since General John I. Sabin took charge. These properties cover the largest, but for some time the most unproductive, territory which the American Telephone & Telegraph Company controls. General Sabin has introduced Pacific Coast methods in Chicago. He has installed thousands of "nickel in the slot" instruments throughout the city of

Chicago, and within six months has served 10,000 new subscribers within the city limits, and he claims that he will bring the total up to 110,000 subscribers within the next two years. He now has nearly 275,000 telephone subscribers under his charge, divided as follows: Pacific Coast, 110,000; Central Union, 104,000; Chicago Telephone, 60,000. Total, 274,000.

Since he took charge he has not met the competition of the independent companies, but throughout the Central Union territory he has standardized rates, and announces that a subscriber can now sign a service contract at the present rates for one month or 20 years. He is letting the independent companies do their worst, on the ground that they are taking business at suicidal rates and that there can be but one result—the more they grow the quicker they will kill themselves.

On the Pacific Coast General Sabin has brought the telephone into greater use than was thought possible a few years ago. In Los Angeles, which has a population of 100,000, there are now 11,000 telephones in use, and in San Francisco, with 300,000 inhabitants, there are over 30,000 telephones. This is telephone development on the basis of 10 per cent of the population. On the Pacific Coast telephone rates are down to so fine a point that a person can have a 30-second conversation and be charged only for that time.

General Sabin believes that he can reproduce the conditions existing on the Pacific Coast in the Central Union Chicago Telephone territory. He is now adding 200 subscribers per day to the Central Union service and 100 per day in Chicago, and so far in Chicago he has secured nothing but the cream of the business. All his efforts are at present being centered in increasing the service in the Central Union territory, and he has placed this work in charge of his veteran canvassing agent, C. F. Nestor.

Postmaster-General Payne.

HENRY C. PAYNE.

ALL who are interested in electrical work and electrical enterprises have noted with much pleasure during the past week that the Hon. Henry C. Payne, of Milwaukee, Wis., has been selected by President Roosevelt as his new Postmaster General. The work is not new to Mr. Payne, and the appointment has been generally welcomed with much cordiality and approval.

Mr. Payne comes of Puritan stock, and was born at Ashfield, Franklin Count, Mass., Nov. 23, 1843. His early education was obtained in the village school and also in the Shelburne Falls Academy. From this institution he was graduated at the age of 16, and went into business in Northampton, Mass. In October, 1863, he removed to Milwaukee, Wis., in which city he has since resided. His first business engagement was with a dry goods house, with which he remained four years. In 1872 Mr. Payne became interested in politics, and assisted in organizing the Young Men's Republican Club, which later became the Republican Central Committee, of Milwaukee County. He was afterwards chosen chairman of the State Central Committee. For ten years following 1876 he held the office of postmaster of Milwaukee, having been appointed by President Grant. Mr. Payne has for a number of years been prominently identified with the business interests of Milwaukee, as president of the Wisconsin Telephone Co., a director of the First National Bank, president of the Milwaukee & Northern Railway Co., vice-president of the Milwaukee Electric Railway & Light Co., controlling the electric lighting and street railway interests, and in lumber enterprises in the timber belt of Wisconsin. Mr. Payne has also served a successful term as president of the American Street Railway Association. Mr. Payne is popular with all who know him, either socially or in a business way, being a man of engaging manners and of genial disposition. His activity as a Republican national leader has given him considerable public prominence as well as the warm personal friendship of such men as Senator Hanna and other exponents of Republican policy.

Committees of the Automobile Club of America.

The following standing committees have been announced for 1902:

TECHNICAL COMMITTEE.—Dr. Schuyler Skaats Wheeler, chairman; Peter Cooper-Hewitt, Lewis Nixon, Louis Duncan, L. T. Gibbs, E. T. Birdsall, A. L. Riker, Professor Elihu Thomson.

RUNS AND TOURS.—Jefferson Seligman, chairman; George B. Adams, Frank Eveland, John Aspinwall, J. C. McCoy, Percy Owen.

HOUSE COMMITTEE.—J. M. Hill, chairman; William Iselin, Bradford B. McGregor, Samuel H. Valentine, Henry K. Browning.

LIBRARY COMMITTEE.—Albert R. Shattuck, chairman; James L. Van Alen, T. C. Martin.

MEMBERSHIP COMMITTEE.—General George Moore Smith, chairman; Juan M. Ceballos, Sidney Dillon Ripley.

LAWS AND ORDINANCES.—George F. Chamberlin, chairman; Judge James C. Church, Dave H. Morris, Henry Rogers Winthrop, William W. Niles, Morris Putnam Stevens.

SIGN POST COMMITTEE.—A. Ward Chamberlin, chairman; George B. Adams, Frank Eveland.

GOOD ROADS COMMITTEE.—Albert R. Shattuck, chairman; George R. Bidwell.

COMMITTEE ON FOREIGN RELATIONS.—J. Dunbar Wright, chairman; Clarence Gray Dinsmore, Hart O. Berg, Eugene Higgins.

RACING COMMITTEE.—Albert C. Bostwick, chairman; Dave H. Morris, Clifford Brokaw, William Henry Hall, George Isham Scott,

AUDITING COMMITTEE.—George W. Young, chairman; W. M. Van Norden, W. McMaster Mills.

Copper Conditions.

The recent agitated and depressed condition of the copper market has already been noted in these pages. Further attention is called to the subject by the cut in the quarterly dividend of the Amalgamated Copper Company to 1 per cent, and the reduction in the price of copper virtually to 12 cents. The stock of the concern now selling at about 65 was double that figure only six months ago, and millions have been lost all over the country in consequence by investors and speculators. The following statement has now been issued by the directors of the Amalgamated Company:

The conditions prevailing in the copper trade up to the commencement of the present year were very satisfactory, and so far as this country is concerned are still so, every copper wire, brass and electrical manufacturing concern being run to its full capacity. A large proportion, however, of the copper produced in this country has to find a market abroad. The unsatisfactory trade conditions which have existed during the present year in Europe, together with the fact that the supplies of copper to Europe from sources outside this country have increased, have jointly caused a falling off in exports of about 65,000 tons. This decrease has in some degree been compensated for by increased domestic consumption.

By adopting the policy of maintaining a firm price, a large proportion of the loss arising from the decrease of exports has been borne by the companies whose shares are owned, wholly or in part, by the Amalgamated Copper Company. This policy has in the past been the best for these companies, as the portion of the copper which has been sold has realized a larger profit than would have been realized had all the copper which had been produced been sold at a much lower price. It has likewise prevented fluctuations in price, which would tend to demoralize the business of manufacturers consuming copper.

The officials of these various companies, after carefully considering the situation in all its phases, decided that it would be better, in the interests of the companies they represented, to refrain from forcing upon the market more copper than was actually needed, as such action would only have led to abnormally low prices. The selling agents of these companies were, therefore, instructed not to attempt to force upon the market more than was actually needed for consumption, but to maintain a firm price. If officials of other copper producing companies had taken the same view of the situation and maintained a firm price, there is little doubt that the present unsettled conditions of the market would have been in part, if not wholly, obviated.

During the present month the United Metals Selling Company, the selling agents for the companies in which the Amalgamated Cop-

per Company is interested, has, nothwithstanding these conditions, sold considerably over 100,000,000 lbs. of copper for future delivery.

During the last two years the companies in which the Amalgamated Copper Company is interested have equipped their mines and smelters with the latest improvements and most modern labor saving appliances, and one of these companies has built the largest and best equipped smelter in existence. This can be put in commission early in the new year, so that from now on these companies can produce copper at a cost that can successfully compete with any copper producer in the world. The future prosperity of the copper business depends largely upon such a revival of foreign trade as will bring the total consumption of copper nearer to the production than is the case at present.

Marconi and Trans-Atlantic Wireless Telegraphy.

The ill-advised action of the Anglo-American Cable Company in interfering with the trans-atlantic signaling experiments of Marconi, will probably result in interrupting all further work in this line on the part of Mr. Marconi until he has established a station in Nova Scotia or elsewhere. The action of the Cable Company has met with severe criticism everywhere, and especially in Newfoundland. Ex-Premier Sir William Cavendish, in a letter to the press, advocated that the legislature cancel the Anglo-American Cable Company's monopoly, even if it be necessary to compensate the company for any damages sustained during the unexpired period of two years. A local St. Johns paper suggests to Mr. Marconi that he seek a site on the French shore of Newfoundland from the French Government, arguing that this step would probably induce the British Government to secure the withdrawal by the Anglo-American Company of its opposition to the location of a station at St. Johns. The trepidation exhibited by the Anglo-American Company resulted in a large drop in the stock market value of its shares.

Professor Alexander Graham Bell has offered the use of his estate in Cape Breton as the site for a wireless station. Finance Minister Fielding, of the Dominion Government, offered to Marconi, on behalf of the Canadian Government, every facility for locating wireless telegraph stations on the Nova Scotia seaboard. In consequence of this offer Mr. Marconi, it is stated, will, instead of returning to London, leave by the first steamer for Ottawa.

On Dec. 19 Sir Cavendish Boyle, Governor of Newfoundland, gave a luncheon in honor of Marconi, which was practically a state affair, Premier Bond, the Cabinet Ministers and the heads of departments being present. In replying to a toast by Governor Boyle, Mr. Marconi referred to the important factor in the progress of civilization which lies in a facility of communication between different countries and said further:

"If my system of wireless telegraphy can be commercially established between different parts of the earth, of the possibility of which I may state, I have not the slightest doubt, it would bring about an enormous cheapening in the methods of communication at present existing. The system of submarine cables of to-day fulfils the demands of communication to a great extent. But the great cost of the cables themselves and their heavy working expenses cause the existing method to be beyond the reach of a majority of the people inhabiting the various countries of the world. But could this new method be applied, I believe the cost of what we now call cabling to England might be reduced at least twentyfold. The present rates are 25 cents a word. I do not see why, eventually, with the wireless system, this cost should not be reduced to one cent a word or less."

Observing that he was half an Englishman by birth, Mr. Marconi continued:

"With regard to the British Empire, the wireless system has quite a special importance, as facilitating the methods of communication between the mother country and her great colonies beyond the seas, and it cannot but result in still more firmly cementing the bond of unity and a common cause in the interest of civilization, of which the empire has, during the anxious times of the last two or three years given such a splendid example to the world. This colony of Newfoundland is the first in which a message was received by cable from across the ocean, and I am glad to say it has also been the first to receive a message across this same ocean without a cable. It is my sincere wish that if there is anything useful in my method, that this country should not be the last nor the least in participating in its benefits. It is my sincere wish that Governor Boyle and the members of his government may, in the future, always have cause to look back with satisfaction to the great assistance and encouragement they have afforded me in the carrying out of my work."

New York Electrical Society and Polarized Light.

At the College of the City of New York at the 219th meeting of the New York Electrical Society on the 19th inst., before a large and enthusiastic audience, Professor Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, lectured on "Polarized Light." The nature of light considered as a wave motion in the ether was explained by means of models and demonstrations. The meaning of the term, "polarized light," was illustrated with the aid of a series of original models and projections with double image prisms and tourmaline plates. While this kind of light is everywhere, the eye does not thoroughly detect its peculiarities, and some form of analyzer is used to find it. To obtain polarized light in convenient form for experimental investigation, a polarizer is also required. These two devices constitute the polariscope. The conditions were considered upon which interference or refraction and dispersion may produce various colors, from white light, and demonstrations were made, including the projection of the spectrum of the arc light. The essential features and offices of the several parts of the polariscope in various forms, consisting either of Nicol prisms, glass piles, or other polarizing devices, were brought out, and the effect produced upon polarized light by thin films of doubly refracting substances was shown. Professor Miller stated that the colors which are produced are always pleasing, because they may be made to occur in complementary sets. These effects were vividly and beautifully illustrated. Polarized light is not only of scientific interest, but it has many important applications. Among these is its use in the study of mineralogy in enabling genuine emeralds, rubies and other precious stones to be distinguished from artificial ones. It is used extensively for determining the purity of sugar and for many purposes of chemical research. It is an important aid in the glass industry to determine whether the product is properly annealed. If imperfectly annealed, internal strains result and the glass may burst, and glass strained is worthless for optical instruments. Very striking examples of glass under strain were shown. Polarized light may be used also as an aid in artistic designing, and it furnishes scientific amusement of the most interesting kind. Perhaps no other experiments give such exquisite color effects as are produced by natural or artificially arranged crystal plates. The pictures are not only beautiful and complicated in design, but are brilliantly tinted. A movement of the specimen causes one combination of colors to dissolve into another in a fascinating manner. While the light reflected from the polished top of a table is polarized and a fragment of glass is sufficient to render these effects partly visible, yet complicated optical instruments are necessary to show them in all their perfection. In the lecture Professor Miller employed a large and complete projection polariscope, and a Nicol polarizer of more than 2½ inches aperture and many accessories for the purpose of demonstrating these phenomena by the aid of electric light. A collection of unusually perfect specimens of crystals and special preparations was exhibited. The attention of the audience was held closely all the time, and the applause was frequent and hearty, there being a great many present who could appreciate the cleverness and skill of the lecturer as an experimental demonstrator.

The following members were elected: Frank Scott, Crocker-Wheeler Company, Ampere, N. J.; Hugh A. Brown, 64 Orient Way, Rutherford, N. J.; Edward B. Brisky, 102 West Seventy-fifth street, New York City; Raymond Healy, 26 South Oxford Street, Brooklyn, N. Y.; F. J. Youngblood, 1034 Broomfield Street, Hoboken, N. J.; Vernon E. Royle, 618 East Twenty-eighth Street, Paterson, N. J.; Thaddeus R. Bell, 197 Wooster Street, New York City; W. Jac Marland, 249 West 123d Street, New York City; W. H. Brown, 1880 Lexington Avenue, New York City; Richard Braithwaite, 237 Fourth Street, Jersey City, N. J.; William E. Toldt, 497 South Tenth Street, Newark, N. J.; M. F. McAlpin, 55 Duane Street, New York City.

A Woman in Independent Telephony.

It is stated that Mrs. Anne McElroy Brett is president of the Southern Independent Telephone & Telegraph Company, of El Paso, Texas, and president and general manager of the Brett Construction, Telephone & Telegraph Company. In 1893 her late husband organized the Detroit independent company to fight the Bell telephone monopoly. Governor Pingree was just coming into power in Michigan, and he became interested in Mr. Brett's fight, and gave it a vigorous backing, with the result that Detroit acquired an inde-

pendent telephone system. Mr. Brett was an invalid, and all of the work was directed from a sick room. Mrs. Brett was her husband's chief lieutenant, and following his death, two years ago, she invaded the telephone field, making her start at El Paso. She is now at the head of several companies, and is financing telephone companies at Alamo Gordo, Texas, and Deming, N. M., under the firm name given above. In appearance Mrs. Brett is more the young woman of leisure of fashionable society than the active, persistent and successful worker in a new electrical field.

Mrs. Brett expects to carry her line from El Paso to San Antonio, and from thence to Kansas City. Another line will run from Deming, N. M., to Silver City, thence to Denver, and from Denver to Kansas City. It was two years ago that Mrs. Brett set about securing an up-to-date telephone system for El Paso. It was an uphill fight for some time, but finally she secured the backing of Cleveland capitalists, and then she set about securing patrons, and says that she got contracts from 90 per cent of them for three years. Next she applied for a franchise, and fought the City Council for nearly a year before she could get the franchise. She now has three-year contracts for 1200 telephones in and about El Paso.

New Telephone Patents.

Telephone patents of the issue of Dec. 17 touch low-water mark in point of numbers, as there are two only. These two are wide apart as the poles, both in object and in complication, one being a fire-proof covering for overhead telephone cables and simplicity itself as to design and construction; the other a selective bell system, complicated as only a selective bell system can be.

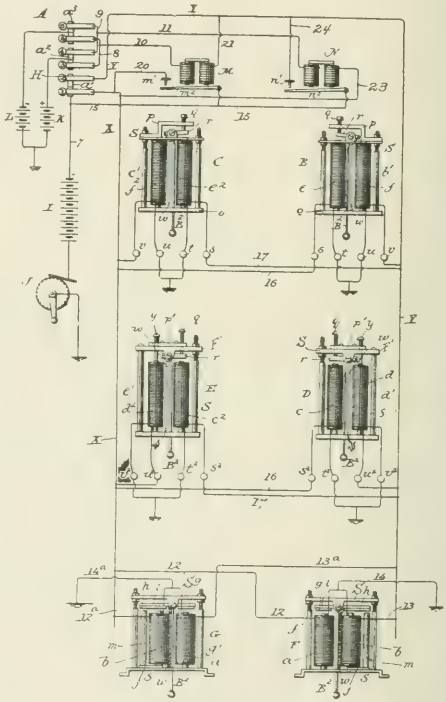
Mr. Frank D. Saylor, of St. Louis, patents a fire protector for telephone-cables, which consists of a split tube of asbestos formed over a strip of steel gauze, bent in the form of a tube, to give it mechanical strength and form. A number of these tubes of increasing diameter are telescoped together with appropriate guides and stops, and an asbestos covered rope is attached to the innermost tube by means of which the whole telescopic combination may be hauled over the cable when danger from fire occurs and hauled back and closed up when the fire is out. Mr. Saylor's idea is that when a fire breaks out in a building equipped with roof fixtures carrying telephone cables the firemen "or others" would spring these asbestos telescopes over the telephone cables, proceed to the next fixture or pole and haul on the asbestos covered rope until the cable was fully covered by the protective telescope. In suggesting that the firemen "or others" would do any such thing the inventor shows very little knowledge of the ways of firemen—and others. The firemen would be much more likely to use their little hatchets on the cables than to wrap them up in asbestos telescopes, and as for "others"—well, it strains the imagination a little to picture volunteers working to put jackets on telephone cables with a bad fire raging beneath them. One would think when an impractical device like this is deemed worthy of patenting that simplicity in invention could no further go.

There is nothing at all simple about the selective telephone system patented by Mr. John V. Stout, of Easton, Pa. This system relates to selective signals for party lines worked from an exchange. It is of the "strength and polarity" family, and is apparently limited to six bells, although this is not expressly stated. The general principle of the system is to make one coil of each ringer magnet the working coil to act on the armature for ringing purposes, and the other coil an opposing or assisting coil, as the case may be.

Referring to the accompanying diagram, it will be seen that the two line wires X and Y each go to ground at each station through one of the magnet coils. Line X carries coil f^2 at station C, e at station B, d^2 at station E, c at station D, b at station G and a at station F, e, c and a being ringing coils and f^2, d^2 and b opposing coils. Line Y carries f at station B, c^2 at station C, d at station D, c^2 at station E, b at station F and a at station G, e^2, c^2 and a being ringing coils, and f, d and b opposing coils. The call-bell magnets, it will be seen, are of different construction at the different stations, although those at C, B, D and E are practically similar, except for slight differences in detail in the arrangement of the soft iron polarizers p and p^1.

The magnets at G and F are different from the others in that they employ two armatures g and h attached to a strip of non-magnetic metal i (which is pivoted and carries the bell hammer B^2), these armatures are opposite the poles of the ringer magnet a and the club-footed magnet b, with bare cores m, respectively. In all cases the bell hammer armatures are held away from the magnets by springs w and magnets b, of stations F and G, serve to hold the armatures in their normally retracted positions when those magnets are energized. At the central office there is a keyboard having six keys. Tracing the connections it will be seen that key 1 puts battery I (having an interrupter J in circuit) to line X, key 2 puts battery I to line Y, key 3 puts positive current from battery K through magnet M to line Y, and causes M to close the contact at m^1, and so put battery I to line X. In the same key 4 puts K to line X through N, and causes N to close contact, putting battery I to line Y, and key 5 puts negative current through M to Y and causes M to connect X with I, lastly key 6 puts negative current through N to X and causes N to connect Y with I.

When key 1 is depressed the bell at station F is rung, and key 2 rings station G. These two ringers respond to either polarity of current, it being only necessary that the current shall be strong enough to overcome the tension of spring w. The other four ringers of the system are so adjusted by means of the retracting springs w



SELECTIVE TELEPHONE SYSTEM.

that they will not be affected by the current. Key 3 rings station B as follows: Positive current flows over Y through the magnets connected with it to ground, but is not strong enough to attract any of the armatures; current from I flowing through X, however, actuates magnet e the strength of e being augmented by f, which is energized by the constant current from K. The ringer at D will not operate because d here becomes an opposing instead of an assisting coil, and F will not ring because magnet b, energized by K, aids spring w in holding the armature against the attraction of a. Similarly key 5 rings station D, and keys 4 and 6 ring C and E, respectively.

The system has been worked out with a painstaking amount of ingenuity, and 19 claims are required to set out the various combinations for which protection is demanded. A selective system is naturally complicated, and this one is not more so in its wiring and auxiliary appliances than many of its prototypes. One is apt to doubt whether in practical working the spring adjustments on which dependence is placed to maintain some of the signals silent when others are being rung would always give the desired performance.

CURRENT NEWS AND NOTES.

THE ASIATIC ASSOCIATION, which includes 200 firms interested in trade in the Far East, has addressed President Roosevelt in favor of private ownership of the Pacific Cable. It also wants pledges from Russia that the door of Manchuria shall be kept open.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—Over 200 persons have already enrolled for membership in this proposed new society, and the first meeting for definite organization and reading of papers and discussion will probably be held in Philadelphia about Easter. An enthusiastic gathering of electro-chemists from all over the United States is assured.

NEW ORE SEPARATOR IN SWEDEN.—Consul Bergh reports from Gothenburg as follows: *The Morning Post,* of this city, says that Knut Ericson, an engineer, has invented an apparatus for the separation of ore by the magnetic method, and last September exhibited it before Swedish and foreign experts. The apparatus, which is very simple in construction, yet ingenious, attracted wide attention. A Swedish company is being organized to work the invention. It is believed that it will be of the greatest importance for mining.

DIPLOMACY BY TELEPHONE.—A dispatch from Marseilles to *The Times* reports the refusal of the Negus Menelek to grant mining concessions in his equatorial provinces to engineers of the Abyssinian Exploration Company. The engineers encamped outside the walls of Harar and telephoned their request. The Emperor replied by telephone that he would not grant fresh mining concessions till he knew the first results of the existing concessions. Such methods, if generally adopted, will result in considerable economy of official etiquette and court uniforms.

WESTERN INDEPENDENT TELEPHONY.—A telegram from Minneapolis of Dec. 19 says: It was learned here last night that the owners of the independent telephone lines in Wisconsin, Minnesota and Northern Michigan will unite to form a long-distance toll-line service in the Northwest, to compete with the Erie system. It is said that the Milwaukee Telephone & Telegraph Company, which is now seeking a franchise in Milwaukee, is a part of the proposed new company. It is also rumored, though denied, that the Twin City and the Rapid Service Companies of this city are to be included. Every independent line in Wisconsin and Northern Michigan is said to be interested, and there will be a meeting of the owners of the independent lines at Milwaukee in February, at which the matter will be discussed.

THE GROWTH OF WORDS.—Profesor Brander Matthews, of Columbia University, discussing in *Scribner's Magazine* the use, abuse, decadence and growth of English words, says: "'Telegram' was denounced as a mismade word and 'cablegram' was rejected with abhorrence by all defenders of purity. Yet the firm establishment of 'telegraph' and 'telephone' made certain the acceptance of 'telegram.' 'Cablegram' is still on probation, and may fail of admission because a part of the word seems better fitted for its purpose than the whole. Mr. Howells, always bold in using new words, accepts 'fake' as good enough for him, and prints it without the stigma of italics or quotation marks, just as he has adopted the colloquial 'electrics' for electric lights. And hereafter the rest of us may use either with a clear conscience, for Mr. Howells can always give a good account of himself when attacked. American contributions to the English language are not a few. Some are brand-new words, minted at the minute of sudden demand, and well or ill made as chance would have it. 'Phonograph' is one of these."

"SEEING BY TELEPHONE."—A disptach from Paris of Dec. 18 says: Dr. Sylvestre, the inventor who claims to have discovered how to see by telephone, has just described his remarkable discovery, which he declares was a matter of chance. He said: "There is no reason why as soon as telephonic cables are established between Paris and New York we should not see our friends there as easily as I see you. I have already seen the Marseilles Telephone Exchange from this room by means of my apparatus, and I have chatted by telephone with M. Mougeot, the French Postmaster General, watched his astonishment and described his appearance, his clothes, his office as we talked." The dispatch continues: "Dr. Sylvestre showed a small circular mirror, with a hole in the center, into which is screwed a tiny electric light of 1-10th candle-power. This is fixed to a telephone's microphonic plate by an india rubber band, a pencil-like instrument connecting the current with the apparatus. Two acids are allowed to mix, drop by drop, in a torpedo-like machine, about 3 inches long. This process throws what Dr. Sylvestre terms a phosphorescent flame on the looking glass connected with the poles, and pencil and a sheet of any white, semi-transparent tissue, placed before the glass, shows the rooms in which the other person is telephoning, no matter how many miles away that person may be."

ELECTRIC FURNACE.—A novel form of electric furnace, suited especially for large units, is described in a patent issued Dec. 17 to Charles Albert Keller, of Paris. The electrodes take the form of trucks mounted upon rails and each adjustable toward a central horizontal firebrick hearth which carries the main body of the charge. The electrode carriages are framed in iron and covered by a raised arch of firebrick, upon which, inclined slightly toward the hearth and with its lower edge level therewith, is the carbon or other surface which constitutes the working face of the electrode. The central horizontal hearth and the upwardly inclined lateral electrodes together form a broad shallow furnace bed, over which a layer of granular carbon is spread. This layer serves to close the circuit between the electrodes and by its resistance to develop a temperature sufficient for the reaction desired. Or if such excess of carbon would be injurious, other resistance material may be substituted, either the charge itself or one of its components being so employed. For instance, in the production of chrome-iron, the carburization of which is to be avoided, a bed of granular iron may be used to develop the necessary heat, the metal being alloyed as reduced. The furnace proper is enclosed by a firebrick vault to conserve its heat and exclude the air. The specifications show a careful elaboration of details and the construction seems thoroughly practical.

ELECTRICITY IN BERLIN.—Consul-General Mason, of Berlin, reports that the electricity works of Berlin now supply from its generators 353,253 incandescent and 14,274 arc lamps, besides 6426 electric motors of 21,448 aggregate horse-power ,and that of this 49,949 incandescent lights, 1878 arc lamps, and 1462 motors were newly installed within the circuit of that one company during the year which ended on the 1st of October. This increase of 21 per cent in the consumption of current, of course, does not take into account the numerous large new buildings, factories and other establishments which have independent lighting, and power plants under private ownership and control. The development of electrical tramway lines has been on a phenomenal scale. One year ago the aggregate electrical energy consumed for this purpose was 8000 hp; it is now 16,800 hp, having more than doubled in a single twelve-month. When the principal city lines were changed from horse to electric equipment, the municipality held out firmly against the use of overhead conductors in the central districts. The trolley was tabooed on all except suburban routes, so that cars intended for use on lines running from the central portions of Berlin to outlying districts were equipped for both methods of transmission—trolleys for suburban sections and heavy storage batteries to carry them over the downtown portion of their route. This made the cars heavy and costly, but they worked fairly well until a 6-inch snowfall exhausted the already overtaxed current supply, and filled the busy downtown streets with "dead" cars that had to be hauled out by horse-power. From that time the overhead wires crept farther and farther into the city, until they now substantially supply most of the lines throughout their entire length. This vastly improved service—especially the greatly accelerated speed on the suburban lines—has practically revolutionized the conditions of public transportation in Berlin, and has drawn a constantly increasing percentage of population to Halensee, Chârlottenburg, Friedenau, Wilmersdorf, and a dozen more populous and handsomely built towns which have sprung up in recent years within a radius of 7 or 8 miles from the cathedral of Berlin. Of the entire consumption of current, 21 per cent is used for lighting, 22 per cent for miscellaneous power purposes, while the remaining 57 per cent are charged to the tramway lines. The average price to consumers in Berlin is 4.5 cents per kw-hour, and the total current supplied by the company increased from 62,349,846 kw-hours in 1900 to 89,668,258 in the fiscal year 1901.

CHICAGO BUCKET SHOPS.—Several members of the Chicago Board of Trade have been expelled for collusion with bucket shop keepers in furnishing quotations, etc.

NEW YORK CENTRAL.—The Boston Herald says that the New York Central has sent out for estimates of the cost for electrically equipping the Newton circuit of the Boston & Albany. The company figures the cost at about $1,000,000.

AMERICAN MANUFACTURES.—The U. S. Census Office has about completed its manufacturing statistics. The value of the manufactured output for 1900 exceeded $13,000,000,000, an increase of $4,000,000,000 over 1890, a 30 per cent increase. The value of American manufactures in 1900 was almost 13 times that of 1850.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—The tenth annual convention of the Northwestern Electrical Association will be held at Milwaukee, Wis., on Jan. 15, 1902. Reports and papers on subjects of special interest to central station men will be read and discussed. Mr. Thomas R. Mercein is secretary of the Association.

STEAM RAILROAD TROLLEYS.—It is announced that on Christmas Day the Webster (Mass.) extension of the People's Tramway Company in the northeastern part of Connecticut will be opened. This will give a through trolley line, more than than 35 miles long, between Danielsonville, Conn., and Worcester, Mass., paralleling closely the Norwich and Worcester division of the New Haven steam railroad system, and it is well understood that the New Haven Railroad Company controls the parallel for the purpose of regulating competition and developing lateral trolley feeders for freight traffic.

AQUEDUCT THROUGH A MOUNTAIN.—The Vancouver Power Company, a corporation allied to the British Columbia Electric Railway Company, which owns all of the tramways in the province, will soon undertake a novel piece of hydraulic engineering work in connection with an electric transmission project. A water power electric generating station is located near the headwaters of the Coquitlam River, and to add to the supply of water furnished by a dam it is proposed to tap a lake at an altitude of 2500 ft. above the sea. Instead of laying a pipe line, the company will drive an inclined tunnel through a mountain of solid rock. The bore will be 3 by 8 ft., and 2½ miles in length. The cost of the tunnel is estimated at $350,000. The cities of Vancouver, B. C., and New Westminster will be supplied with current from this source.

WATER POWER DEVELOPMENT IN INDIANA.—Electricity generated by water power seems to be attracting attention in Northern Indiana, a portion of the State where coal is scarce and too expensive for profitable use. The conditions on the St. Joseph and the Tippecanoe rivers are particularly favorable for development in this direction. Citizens of South Bend are constructing a dam in the St. Joseph River for the development and transmission of electrical energy to a number of cities and towns for light and power purposes. Capitalists of Lafayette and Monticello have purchased a large tract of land on the Tippecanoe River, and propose to dam the swift stream at a bend in the river and cut a channel across at a point one-half mile wide getting a fall of 50 ft. It is proposed to transmit electric power to towns and cities in that section. There are other streams in Indiana equally available for water power.

TELEGRAPHY IN ARABIA.—Reports are published of the strenuous opposition offered by the wild tribesmen in Arabia to the construction of the telegraph line the Turkish authorities are carrying to Hodeida, on the Yemen littoral of the Red Sea. A gunboat was sent from that port to put a stop to the interference of the Arabs with the work of the engineers, but it had only a temporary effect, for, on its departure, the wires were again cut and the work otherwise impeded. The main object of the line is to have the Yemen officials under more direct control from Constantinople, but it is doubted whether the work will ever be successfully accomplished, since the tribes along the coast are not sufficient subdued to be persuaded to desist from their opposition, and the effective guarding of the line by troops would be so costly as to be out of the question.

ADIRONDACK TROLLEYS.—The Adirondack air is filled with rumors of trolley road building. Just now two roads are projected from Lake Champlain to Lake Placid and Saranac Lake, one via the Ausable Valley and the other via Keene Valley, as noted recently in these pages. The erection of electric power plants on the streams of that part of the Adirondacks makes these roads a greater possibility than ever. One company is the Keesville, Ausable Chasm, Lake Champlain Railway; its route being through Clintonville, Ausable Forks, Jay, Wilmington, Keene and Lake Placid. We have given details in regard to this. The second company is promoted by Paul Smith, the hotel man, and Wallace Murray, of Saranac Lake, and its line will be the first trolley road through the eastern Adirondacks. The route is to Saranac Lake via Keene Valley, and through the purchase of water power at Franklin Falls, Saranac Lake, and Halls Falls, they have sufficient power to operate an extensive electric line.

ALTERNATING-CURRENT METER.—A patent issued Dec. 17 to K. O. F. Schrottke, of Berlin, Germany, describes an alternating-current meter which has for its object the provision of an improved means for adjusting the phase difference between the shunt field and the voltage impressed upon the shunt circuit. As illustrated, the principle is applied to a motormeter with a ring field having four projecting poles 90 degs. apart. Designating the legs of a three-phase circuit by the numerals 1, 2 and 3, the leg 1 is in series with the windings on two opposite poles; the other two opposite poles each carry a separate shunt winding, one of which is connected across the legs 1 and 3, and the other across the legs 1 and 2. The two shunt coils are wound in opposite directions. The field due to the coil 1-3 is dampened, and that due to the coil 1-2 is strengthened in order to maintain the desired displacement of 90 degs. To obtain a resultant field perpendicular to either of the shunt voltages, the ratio of the ampere turns between the coils is changed until the displacement of the resultant field has reached its desired magnitude.

TREATMENT OF EXHAUSTED CYANIDE SOLUTIONS.—A method, in part electrolytic, for the regeneration of fouled cyanide solutions, is covered by a patent recently issued to William Orr, of Salt Lake City, Utah. The dilute cyanide solution employed for the extraction of gold from ores or tailings is extremely sensitive, its solvent power varying widely under different conditions of concentration and temperature, depending largely on the free access of oxygen, and decreasing to a marked degree under the influence of dissolved base metals. In use these solutions become quickly weakened from the presence of copper and zinc, the former derived often from the ores, and the latter from the precipitation vats, and both existing in the form of double cyanides which are without solvent action on gold. If zinc alone be present the fouled solutions yield readily to known methods of treatment, but in the presence of both copper and zinc the familiar chemical reactions fail, owing probably to the formation of complex ions not susceptible of direct precipitation by the usual reagents. Solutions of this character are electrolyzed, according to the new method, with anodes of zinc and cathodes of copper, whereby the copper separates out in metallic form and the zinc of the anode enters into solution as a cyanide, replacing the corresponding copper salt. After this preliminary treatment the solution is rendered alkaline by a mixture of sodium and calcium hydrates and the zinc thrown down as sulphide, care being taken to avoid excess of the precipitant. The solution, thus restored as regards its content of free cyanide, is returned to the ores.

LETTERS TO THE EDITORS.

Direction of Street Car Travel.

To the Editors of Electrical World and Engineer:

SIRS.—In ELECTRICAL WORLD AND ENGINEER for Sept. 21, I notice a report of the annual meeting of the New York Street Railway Association, in which there is a suggestion from Mr. Rogers that if the direction of traffic on the street were the same as in England, that is, the traffic (including cars) keeping to the left hand, many accidents,

especially those caused by ladies alighting from a car facing backwards, would be avoided.

I have had over five years' experience on a tramway operated under the conditions suggested by Mr. Rogers, and find that ladies still get off facing backwards. My explanation is that a woman never signals a car to stop until it is past the place where she wants to get off, and that when she gets off she makes a bee-line for the objective point, which is nearly always towards the rear of the car.

J. S. Badger.

Brisbane Tramways, Queensland, Australia.

A 10,000-Volt Shock.

To the Editors of Electrical World and Engineer:

Sirs.—We notice you have a paragraph in your issue of Nov. 23 referring to a 10,000-volt shock at Mascara, Algeria. The installation is a 20-mile three-phase transmission of power at 10,000 volts, which we put down at Mascara some years ago. The engineer, Mr. Viel, who received the shock is one of the men sent out by us to erect and look after the plant. The matter is, of course, the subject of an official inquiry at the moment, but there is no doubt the shock was given through a telephone wire, and was caused by a dissatisfied workman connecting the telephone wire with one of the line wires. From advices we have received, Mr. Viel was burned very badly on his left side, and was unconscious for 11 hours. He is now, however, progressing satisfactorily. If he does pull through, he will probably be the only person who can boast of having received a 10,000-volt shock and survived.

Liege, Belgium. Henri Pieper.

Combined Telegraph and Telephone Service.

To the Editors of Electrical World and Engineer:

Sirs.—The suggestive editorial comments on "The Telephone and Telegraph," published in your issue of Dec. 7, deserves the careful consideration of all who are interested in the development of long-distance communication, especially of those who are directly engaged in the telephone business. Long-distance lines are necessarily expensive, both in construction and maintenance, and when restricted to telephone business they are practically idle during more than half of every 24 hours. To make them remunerative the charges for communications must be high. The line can only carry messages at the speed of conversation, and an average of 60 words a minute during the hours of use is doubtless the full measure of its capacity.

The telephone is only useful for immediate and direct intercourse. It has been advantageously used in connection with the telegraph, but never as a substitute therefor. In Europe, and to a less extent in this country, messages are telephoned to telegraph offices for further transmission. But with us the combination is not much in favor. During the past summer the writer had occasion to send a 10-word message to a point in New York State where there was a telephone connection with a railway telegraph station. The charge for the telegram was 25 cents, and the telephone charge was 20 cents, making 45 cents to send 10 words 20 miles.

The telephone cannot encroach upon the telegraph, but there is no reason why the two should not be operated together on the same wires. The ideal combination would be high-speed, automatic machine telegraphy, carrying letter-telegrams of 100 words and upward at cheap rates, working on long-distance telephone lines. By this means long-distance telephone charges could be greatly reduced.

So long as it is necessary to make the telephone earn dividends on large capital investments in plants which are idle 16 hours every day, the high rates must be maintained. But if the costs are shared by the high-speed telegraph operated, for example, on the Delany system, the long-distance charges could be reduced 50 or perhaps 80 per cent. It is a safe prediction that either telephone companies will enter the telegraph field or else independent high-speed telegraph interests will establish new lines and enter the telephone field.

As regards the practicability of simultaneous telegraph and telephone operating, this has already been abundantly shown with the ordinary Morse key telegraphy. But this mode of operating does not offer any great inducement to long-distance telephone companies to enter into competition with existing telegraph companies. With high-speed automatic working the conditions are radically different. High-speed operation enables one telephone circuit to carry an enormous amount of telegraph business, whereby, without any interference with the regular telephone work, the plant will yield much larger returns than the telephone is capable of earning at its highest possible development.

It may be mentioned in this connection that the Delany system is in regular daily operation over a telephone line of the Pennsylvania Railroad, without interfering with the telephone business.

New York. Romyn Hitchcock.

Money Order Telephony.

To the Editors of Electrical World and Engineer:

Sirs.—With reference to your article, "A Telephone Money Order System," in your issue of Dec. 7, 1901, may I be permitted to add the following: In London, England, there is a system in vogue with the National Telephone Company by which money is charged various subscribers. This, at present, is used exclusively for the service of what are called trunk lines (these being post office lines, used for telephone communication for districts outside of London, extending to the provinces), and telegrams, for the use of either of which there is the extra charge referred to. Subscribers making use of these facilities have a sum of money on deposit with the telephone company.

At the end of the period, when the deposit is exhausted, the subscriber is rendered a statement, he not being allowed to overdraw to any great extent. This, while being exceedingly commodious to the subscriber, is easily kept track of by the company, although having to open an account for each subscriber paying in the deposit.

The writer would suggest that a system of such a nature could advantageously be adopted for a money order system. Subscribers making use of such a system could have a deposit account with the telephone company, and instruct them through their own instrument to pay to any particular person the required sum, giving them the time, the place and under what conditions. This, I think, could be worked successfully in conjunction with the post office.

Louis J. Abrahams.

Bruce Mines, Ontario, Can.

Properties of Collector Rings.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23 I note a very complete resume of the articles of M. Maurice Leblanc and of M. Bunet, relating to the properties of collector rings. As a subscriber to your journal, I beg to direct attention to the article of M. Maurice Latour in the issue of Nov. 23 of *L'Eclairage Electrique*. The researches of M. Latour antedated the above publications, and a French patent based upon them was applied for on Dec. 13, 1900, when application was also made for an American patent. The article referred to is a reply to M. Leblanc, and at the same time establishes M. Latour's priority over Mr. Heyland.

Paris, France. H. St. Martin.

[An abstract of the article above referred to appears in our issue of Dec. 14, page 996.—Eds.]

Pressure of Radiation.

To the Editors of Electrical World and Engineer:

Sirs.—The editorial note in your issue of Dec. 14, 1901, under the caption of "Pressure of Radiation," being a review of experiments made to determine the truth of the Maxwellian theory regarding the pressure exerted by radiant energy in the direction of its path, contains this clause, "At any considerable distance from the sun the attraction and repulsion become theoretically equal upon a spherical particle of matter about one-quarter of a micron in radius, or half a micron in diameter, that is to say, having a diameter about equl to the wave length of violet. *Segregated particles smaller than this would be pushed from the sun, while particles larger than this would be pulled towards it.*"

To the part italicized I wish to direct attention, as it appears to contain the gist of the reason why the tails of comets are directed

away from the sun. For, given a quantity of minute segregated particles surrounding a nucleus or nuclei, the sizes of the particles and nucleus being such that the sum of the gravitational attractions of the sun and nucleus upon the particles shall be less than the repulsive pressure of the sun's radiant energy upon the particles, we have a condition that will cause the surrounding particles to be directed from the sun, thus forming the tail.

This would also account for the condensed appearance of the tail near the head, for the particles would there be moving slowly, owing to the retarding effect of the gravitational attraction of the sun and nucleus or nuclei, while as the particles moved towards the outer end of the tail, they would separate more and more, their speed increasing until it attained the velocity of light, or they fell under the influence of some celestial body.

The loss of the tail of a comet would be accounted for under this theory by the disappearance of the minute particles surrounding the nucleus, the same having been dissipated by the action of the sun's radiant energy; hence a tailless comet would be one consisting only of a comparative large mass or masses, having no surrounding envelope of finely divided matter. If the above theory is true the tails of comets should progressively diminish.

BALTIMORE, MD. J. W. DARLEY, JR.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Electric Railway Motor Performance.—HANCHETT.—This subject is treated by a preliminary discussion of the ordinary curves used in displaying the properties of an electric railway motor under all conditions of load, and showing how the various curves may be checked on each other and how, when the curves of torque and speed are given, the remaining curves can be computed therefrom. He then takes up the problem of determining the heating of electric railway motors under practical load conditions, and proposes a new method which he believes to be more accurate than any heretofore suggested. This method is briefly as follows: The heating inertia capacity of the motor is experimentally determined and the quantity C, which represents the amount of heat in kw-hours required to bring the motor to a certain limiting temperature, is definitely known. The radiating rate R at this temperature in kw-hours, is also made determinate, and it is assumed that $C \div R$ represents a constant which, when multiplied by the heat in the motor at any given time, will give the rate of radiation at that time. This proposition is true, if the rate of radiation is proportional to the temperature, which is also assumed to be proportional to the amount of contained heat in the motor. This amount of heat is readily determined at any given time by integrating a loss curve with reference to time and dividing by the elapsed time, subject if necessary to certain corrections. If the contained heat in the motor is known, multiplying by the constant will give the rate of radiation, and if the motor is to ascend a grade where it will be overloaded, that is to say, where the heat given to the motor is greater than the maximum rate of radiation, the difference between the contained heat and the total heat capacity represents a reserve which must not be exceeded. Therefore, dividing this reserve heat capacity by an average rate of radiation, which is mathematically determined, by the given data, will give the time that the motor will operate under this overload before reaching limited temperature. He suggests empirical modifications of the formulæ and methods of testing whereby this system of measurement can be developed and refined.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Theory of Commutation.—PICHELMAYER.—Girault, Fischer-Hinnen and Arnold have given the mathematical condition for sparkless commutation in commutating machines. He shows that this condition can be expressed simply as follows. The mean e. m. f. of self-induction of the short-circuited armature coil must be smaller than the volts lost at a brush. He then gives a correction of a method of Parshall and Hobart for calculating the reactance voltage.—*Elek. Zeit.*, Nov. 21.

Rotary Converters.—MCALLISTER.—An article on polyphase rotary converters. The author states that the operation of a rotary converter is in general much more satisfactory than that of a corresponding direct-current generator, due to several causes: (1) Absence of field distortion; the rotary is both a generator and a motor. As a generator the armature current tends to distort the field in a direction opposite to the distortion as a motor. The effects of the armature reactions, therefore, neutralize each other, and since there is no shifting of the field, the point of commutation does not vary with the load, and sparkless commutation results. (2) Lessened friction loss. (3) Greater output from same armature. Since the load current at portions of each revolution feeds directly from the alternating-current side without traversing the whole winding, as must be the case with a generator, the effective armature resistance is less than it is for the same armature used in a generator.—*Am. Elec.*, Dec.

REFERENCES.

Three-Phase Induction Motor.—WEISSHAAR.—A mathematical article in which he develops some analytical equations for the three-phase induction motor, from the well-known diagram. He also gives some numerical examples to show the practicability of the analytical method.—*Elek. Zeit.*, Nov. 14.

Some Brush Arc-Light Dynamo Troubles.—HANLON.—Considering the numer of years since its introduction, the author is surprised that no machine has been designed to satisfactorily take the place of the old Brush open-coil series arc-light dynamo. For hard wear and tear and severe usage, he claims that this old machine, designed in the early days of electric lighting, has not been surpassed or equaled. He enumerates a number of troubles which he met with in his experience with the machine, and gives their causes and remedies. —*Am. Elec.*, Dec.

One of the Old-Timers.—WEEKS.—A short article illustrating one of the relics of the early days of electrical engineering, still doing service as a motor in a bicycle repair shop in Niagara Falls, N. Y. The relic is one of the earliest types of Brush arc-light machines, and has required no repairs since it has been built, other than the rewinding of an armature bobbin.—*Am. Elec.*, Dec.

Theory of Induction Motors.—MELLER.—A rotary magnetic field, similar to that produced by the primaries of a polyphase induction motor, can be obtained by rotating a coil carrying a constant direct current. From this he explains the ordinary formulas for starting torque, lag, etc., of induction motors, also their use as frequency changers.—*Ass. Ing. El. Liege*, July 6; briefly abstracted in *Science Abstracts*, Nov.

Operation of Alternators in Parallel.—DARROW.—He states that when his company recently wished to install some alternators and engines, the manufacturers of each suggested specifications for the other which were not harmonious. He is in favor of the adoption of a common ground upon which the manufacturers of engines and generators can meet, as he believes that there should be no difficulty in reaching such a position.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

LIGHTS AND LIGHTING.

Crawford-Voelker Incandescent Lamp.—MAGUIRE.—An illustrated article on a new incandescent lamp. The inventor of the Crawford-Voelker lamp claims to have discovered a method of effecting chemical union between several rare metals or earths and carbon, thereby being enabled to produce "for the first time a true carbide filament." The filaments made under the new process possess a higher specific resistance than carbon filaments, seem to disintegrate much more slowly, and are practically uniform in their resistance. It is stated that 500-volt lamps made by the new process do not seem to possess the same delicacy as the ordinary commercitl type of 200-volt lamps. A feature of the new lamp bulb is that it is bifurcated at the end, the purpose being to insulate the two ends of the filament. Preece has shown long ago that as the voltage applied to

incandescent lamps increases, a current flows through the exhausted space between the heels of the filament without passing through the filament at all, which simply wastes energy. Numerous tests with the new lamp are said to have shown that the life of the filament is greatly enhanced by this division of the globe. For light voltages it is claimed to be essential. In the new commercial lamp the carbide of titanium is used, but the carbides of other rare earths also give satisfactory results. Abstracts are given of a report of Holden who has made a 1000-hour test of the new lamp. He tested 50 lamps; 11 broke in the first 500 hours. Of these the average life would be about 350 hours. During the second 500 hours 15 lamps broke. Their average life was 762 hours. Twenty-four lamps did not break while burning for 1000 hours. At the beginning of the test the lamps had an efficiency of 2.535 watts per candle. At the end of 500 hours it was 2.845, and after 1000 hours 3.35 watts per candle.—Lond. *Elec. Rev.*, Dec. 6.

Power.

Refuse Destructors.—Goodrich.—A very long and well illustrated article on "Town refuse in Great Britain, its fuel value for steam raising." He claims that to-day British refuse destructors represent the world's best practice in this field of engineering, and that America and Continental Europe are far behind. He describes the following British destructors: Fryer, with Boulnois, Wood & Brodie's combination; Warner, Baker, Meldrum, Horsfall, Heenan, Mason, Beaman & Deas. In a table (in which some of the column headings are carelessly stated) he gives the comparative results from six distinct types of destructors in 12 Lancashire towns. The ihp (hour?) produced per ton of refuse on a basis of 20 lbs. of steam per ihp (hour?) varies between 60 and 218. The "evaporation per pound of refuse" for most of them is between about 1.5 and 2. He claims that while there is wide difference in the results, this difference is due to the type of destructor in use, and not by reason of any serious difference between the qualities of the refuse.—*Cassier's Mag.*, Dec.

REFERENCES.

The Use of Zinc in Boilers.—Douglass.—A discussion of the placing of zinc in boilers in order to prevent the destruction of the plates and tubes from the action of feed-water containing elements of a corrosive nature. The author states that as a preventive to the formation of scale, zinc is of no particular value.—*Am. Elec.*, Dec.

Brake Magnets for Electric Cranes.—Ehnert.—A brief illustrated article on the calculation of the brake electromagnet for electric cranes.—*Elek. Anz.*, Dec. 5.

Traction.

Electric Traction Service Without Track.—Schiemann.—An illustrated article on an installation of a regular traction service without track, the current being supplied from a pair of overhead wires. This he recommends especially where there is no great traffic, or as a preliminary installation for a future regular tramway. While in the Lombard-Gerin system shown at the Paris Exposition, and for connection between the city and railroad depot of Eberswalde, a small, peculiar electrically driven carriage runs on the two overhead wires, and is always a little ahead of the car below, he describes an installation near Dresden, Germany, in which the car has two trolley poles, which take off the current from the overhead wires by means of a sliding contact device, which can be turned around a vertical and horizontal axle. The arrangement is so made that the car can turn out; but the degree of turning out is much more limited than with the Lombard-Gerin system. When two cars, running in opposite directions, meet one another, the one takes off its trolley poles from the overhead wires, and the other passes by. The system is said to work quite satisfactory. From the results of three months of service, it appears that on the line the specific consumption of current is only twice that of a tramway with rails. This larger cost of current is in this case only about a tenth of the amount of interest, amortisation, and repair of the cost of construction of a track-mile. But this is correct only when the traffic is small. For frequent traffic a tramway with rails will always be cheaper.—*Elek. Zeit.*, Nov. 21.

Milford, Holliston & Framingham Street Railway.—This company has more than doubled its mileage during the present year, and expects to have its enlarged system in operation in a few weeks. A year ago a new management took control and has thoroughly reconstructed the road, besides making the extensive additions. With the town of Milford as the center, the system radiates on all sides but to the southeast. Two parks, one owned and operated by the company, are located on the road sufficiently near opposite extremities so as not to interfere with each other's business. The power station of the entire system is in Milford. It is being greatly enlarged by the addition of a 600-kw Westinghouse railway generator. The present equipment of the plant consists of two generators of 225 kw and 325 kw capacity, respectively, direct coupled to simple engines made by the Slater Engine Company. The entire electric lighting for Milford and the nearest adjoining town, is supplied by two 125-kw alternators made by the Stanley Electric Manufacturing Co., which are installed in the railway company's power station, and supply current at 66 cycles per second. This department is entirely distinct from the railway work, switchboards being separated by considerable space and a separate company controlling the distribution and sale of current. There will be three sub-stations. Two are storage battery stations, having a capacity of 240 amperes, situated at convenient distribution centers. The third is a rotary converter sub-station, which is situated on a separate branch and used in connection with a rotary conventer in the main power station, receiving current from the regular railway circuits. These two rotaries are of 150 kw capacity each. The transmission line between the two rotaries is 10,000-volt, three-phase circuit, for which aluminum wire is used. Five snowplows are owned by the company, and two more have been contracted for. One of these plows has two rotary fans placed near the rails. It was in use last winter and gave excellent results. Air brakes are used on all the large cars. A complete telephone system has been installed, the road being a single track line with turnouts at long intervals. The road is built in the most up-to-date manner, double overhead trolley wire being used to obviate the necessity of switches at turnouts, and the track being laid in accordance to steam railroad practice where the company's own right of way is used. This occurs for a large part of the new construction.—*St. R'y Jour.*, Dec. 7.

Shallow Underground Tramway Schemes.—Extracts of a report by Baker and Rider on the construction and working of the Boston subway and on the rapid transit subway now under construction in New York, with the proposal to introduce shallow underground tramways in London. They think that two important objects would thus be gained; a method of linking up existing tramways by taking surface cars underground through congested and prohibited areas, and a provision for pipes, cables, wires, etc., which would obviate the continual breaking up of the streets. They believe that shallow subways, as in Boston and New York, are in many respects preferable to deep level railways. The absence of elevators and the ready access from the street to the stations, and vice versa, by means of short stairways, render them particularly useful to those who wish only to ride short distances. The ideal form of transit is thought to be the one proposed in New York, viz., a subway, easy of access from the street, catering for express and local traffic.—Lond. *Elec.*, Dec. 6.

Operation of the Union Traction Company's Lines in Indiana.—A description of a high-speed interurban line operating 153 miles of track. The cars are dispatched by telephone and connection is made with the telephone wires at each turn out. The connection is made by the motorman without leaving the car. In addition to the telephone connections at each turnout there is a telephone connection box every half mile. The maximum speeds are as high as 60 miles per hour. The trolley wheels used are 6 inches in diameter, and at full speed the current required is 150 amperes, although during acceleration the motors often take 300 to 350 amperes. Some of the cars are equipped with two and some with four motors. For removing the trucks, the company uses a pneumatic hoist which raises the car body and allows the trucks to be run out from under the car. The cars are cleaned by compressed air, by means of the nozzles. A table of operating cost is given. Power is distributed at 15,000 volts by means of the three-phase system. A portable sub-station is an important feature of the equipment. This is contained in a closed car, which carries a 250-kw rotary converter and three transformers. It can be run to any sub-station on the line and connected with the apparatus there. The article is profusely illustrated.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

REFERENCES.

Sacramento.—A description of the traction system. The population of this city is 29,000, and 21 cars are run on ordinary schedule. The company sells 22 tickets for a dollar, and the tickets are made

of aluminum, about the size of a nickel. Cheap water power is used. —*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Loop Terminals for Elevated Railways.—An argument in favor of a terminal in which the trains discharge and receive passengers from separate platforms instead of from the same platform. Several instances are cited to prove the case.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

British Electric Schemes.—An editorial on the 1902 parliamentary session, giving a summary of the private bills which will be brought before the British Parliament next session. These bills relate to an extremely large number of new electric traction schemes. All the "tube" railway projects for London will also come up for consideration. If all these projects were realized, there would be, together with the existing lines, nearly 180 miles of deep level railway in London. A bill, which is hoped to be the forerunner of many, to convert main railway lines from steam to electric driving, is one promoted by the London, Tilbury & Southend Railway. An underground railway is proposed to tunnel under the Tyne and connect Tynemouth with South Shields. A large number of private bills relate to electric lighting and power supply. Two municipalities are buying out the companies which are now operating in their towns. Several municipalities ask for permission to supply electric power "in bulk," outside their own areas.—Lond. *Elec.*, Dec. 6.

Isolated Plant.—An illustrated article on the reconstruction of the isolated plant of a large department store in Chicago. The old plant contained an engine connected to a countershaft by a rope drive; two 50-kw generators were belted from the countershaft. The countershaft and old generators have been taken out and there have been installed a direct connected 100-kw generator, and another generator of equal capacity to be operated by means of the old engine and rope drive. The principal load on the plant is for lighting, the building being wired for a straight 110-volt, two-wire service. There are 160 enclosed arc lamps of 5 amperes and 1200 cp, and 600 incandescent lamps of 16 cp.—*West. Elec.*, Dec. 7.

Electric Installation of a Laboratory.—A description of the electric installation of the chemical laboratory of the university of Bonn, Germany. High-tension, three-phase currents are obtained from the public supply main and transformed to 110 volts, for supplying the lamps and a 10-hp, three-phase motor, which drives a direct-current dynamo. To obtain the different voltages required for electro-chemical experiments, two storage batteries are provided, one of 60 cells and 158 ampere-hours capacity, the other of 14 cells and 24 ampere-hours. At any table in the laboratory pressures of 4, 8, 12 or 20 volts are available, and by means of rheostats other voltages may be obtained. Stirring apparatus are operated by small 8-volt machines. A diagram shows the arrangement of the switchboard and the total wiring.—*Elek. Zeit.*, Nov. 14.

REFERENCES.

Regulations.—A reprint of the proposed revised regulations for electric installations, for voltages below 600. The subject is also discussed editorially.—*Elek. Zeit.*, Nov. 21.

Combined Traction and Lighting Switchboard.—An illustrated description of a standard type of board built by Ferranti for a combined 460-volt lighting and 400-volt traction system. The storage battery regulating switch is under the regulating table in front of the board. There are five generator panels and seven traction panels. The equipment of each panel is described.—*St. R'y Jour.*, Int. Ed., Dec.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Most Economical Cross-Section of Electric Conductors.—ROSSANDER and FORSBERG.—A mathematical article. They remark that W. Thomson's (Kelvin's) formula for calculating the most favorable cross-section of the conductor of an electric circuit is based upon assumptions which do not apply at all when the electric energy is generated by water power. They develop a new formula for this case, which is more complicated than Thomson's, as it contains two more constants.—*Teknisk Tidskrift;* translated into German in *Elek. Anz.*, Dec. 1.

ELECTRO-PHYSICS AND MAGNETISM.

Electron Theory.—OLIVER LODGE.—A brief editorial note on "modern views of electricity and matter." He reviews electrical phenomena from the electron point of view, and expresses the opinion that the electron hypothesis of the constitution of matter would be found to be capable of explaining apparently non-electrical properties such as rigidity. Atoms which at one time were regarded as hard spheres, and subsequently as vortex rings, of ether, are now to be thought of as congeries of electrons—each a "sort of solar system in miniature." Thus the fundamental element in matter, might, after all, prove to be electricity. There is also a brief note on a recent address by Lodge, on self-induction. He expressed the startling view that self-induction is a truly mechanical inertia; in fact, the only inertia that exists, the properties of matter having to be explained in terms of electricity.—Lond. *Elec.*, Dec. 6.

Action of Radium Rays Upon Bacteria.—ASCHKINASS and CASPARI.—A paper on the therapeutic value of the action of Becquerel rays in certain diseases. They used the method of Buchner for demonstrating the bactericidal action of light. A layer of agar-agar containing germs of micrococcus prodigiosus was poured into a flat glass dish and allowed to set. The dish had black letters painted or stuck on its cover and light was admitted from above. After a couple of days the portion of the nutritive medium below the letters was colored deep red by colonies of the micrococcus, while the exposed portions were quite clear. On exposing a similar culture to a radium preparation contained in an aluminum capsule no effect was produced. But an exposure to the rays from the bare preparation killed the germs very effectively in about three hours. They made sure that the effect was nither due to phosphorescence nor to ionized air, nor to bromide vapor. This shows that the effective rays are those which are more easily absorbed, and the physical distinction between the two classes of radium rays is thus emphasized by a marked physiological difference.—*Ann. der Physik.*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemical Industry in Germany.—J. B. C. KERSHAW.—The fourth of his series of articles on the electro-chemical and electro-metallurgical industry, dealing with the progress in Germany. There are nine electrolytic copper refineries in Germany, but their output is not large, and the scarcity of raw copper suitable for refining by the electrolytic process checks all hopes of any expansion of the industry. At Schladern, the Elmore process for making tubes and sheets is worked with better financial results than in England, and the refinery is said to have 1000 hp available for its operations. At Papenberg, the Hoepfner process for extracting copper from its ores is worked in conjunction with a nickel process, cuprous chloride being used as the leaching agent. This installation is comparatively recent, and it is too early yet to say that the process has been demonstrated to be a success. The Siemens & Halske copper process did not yield satisfactory results on practical trial, and the Marchese copper extraction process, when tried at Stolberg, also proved a costly failure. In the two factories at Neuhausen and Rheinfelden, owned by the Neuhausen Company, there are 9000 hp available for the manufacture of aluminum, but the whole of this is not devoted to the production of aluminum. Reliable data are not available, but the company is financially one of the most successful electro-metallurgical companies in Europe, the dividend paid on its capital of $3,077,000 usually ranging from 10 to 13 per cent. The German alkali plants have directed their energy to supply all the requirements of the home market for potash salts, the bleaching powder being regarded as a bye-product. Several plants use the "Electron" process which is unpatented and a secret; it is believed to be a diaphragm process. The Castner cell is used in one plant where 1500 hp are available. The eight German electrolytic alkali works have over 14,000 hp available for the manufacture of caustic alkalies and bleaching powder. Gold and silver bullion refineries are in operation at Hamburg, Frankfort and Pforgheim. The process used resembles in principle that for refining crude copper. The gold or silver bullion is used as an anode in a suitable electrolyte, with thin plates of pure metal as cathode. On the passage of the current the silver or gold is deposited at the cathode, while the impurities either remain in solution or collect as the anode "sludge." Since gold bullion often contains palladium and platinum as impurities, and these metals can be separated by comparatively easy methods from the "sludge," the electrolytic bul-

lion refining process offers many advantages. The value of the output of the Hamburg and Frankfort refineries in 1900 was $12,500,000. The hypochlorite cells most widely used in Germany are those of Kellner, Vogelsang and Oettel. They are chiefly used in the textile factories of Saxony. Over 1500 hp are now utilized for this purpose. Nickel is refined by an electrolytic process at Siegen, and the same metal is extracted from the Caledonian ore by the Hoepfner process at Papenberg. It is, however, too early yet to consider that the success of this process has been demonstrated. In 1900 the Papenberg works were stated to be producing one and a half tons of nickel per day. The larger German color works are known to use electrolytic methods for reduction and oxydation purposes in the manufacture of dyes and other organic products, but no details of these methods are allowed to be made public.—*Elec. Rev.*, Dec. 14.

Secondary Reactions in Electrolysis.—J. W. Richards.—A Franklin Institute paper. He defines primary electrolysis as the action of the current whereby it directs the ions towards the electrodes and liberates them as ions at the electrodes; secondary reactions are such reactions of the ions upon themselves, or the electrodes, or the electrolyte, whereby substances other than the ions come into existence at the electrodes. The work done during electrolysis is of two kinds: First, the work done in overcoming the ohmic resistance of the bath; second, the work done which is rendered latent as chemical energy. The latter energy includes not only the chemical energy expended in the primary electrolysis, but also the energy expended in the secondary reaction. The total chemical work of the current is represented by that required to transform the original ingredients into the compounds of substances which come into existence by the electrolysis, whether of primary or secondary origin. He discusses the calculation of the voltage required for an electro-chemical reaction, from the thermo-chemical data. He classifies the secondary reactions into the following four types: The ions polymerize into more complex forms; the ions decompose or dissociate into simpler forms; the ions react upon the electrodes; the ions react upon the electrolyte. The action at the cathode is a reducing action, at the anode an oxidizing action. Instead of oxidizing in this general sense he recommends calling it "perducing," the reverse of "reducing." A large number of examples are given, when the product at the electrodes is either a gas, or a liquid, or a solid soluble or not in the electrolyte. For all these cases the equations are given and the voltage is calculated from the thermo-chemical data. Among the processes discussed are Salom's lead reduction, by using lead sulphide as cathode in an acid solution; the Castner cell for producing caustic soda, and many others.—*Jour. Frank. Inst.*, Sept.

Losses of Energy in Storage Batteries.—Hopkinson.—The conclusion of his article. While diffusion must be an important factor in the dissipation of energy it need not necessarily be the only cause. He thinks it is possible that there is secondary chemical action in the plates themselves which takes time to perform. When there is gas evolution, it, of course, causes a loss of energy. It has often been remarked that the same number of ampere-hours can be gotten into a battery with a less expenditure of energy and in a less time if the charging be done at a constant potential than if it be done at a constant current. He found that when a Tudor cell was discharged for two hours at a current of 2.4 amperes, and the current then reversed to charge, gas began to be given off in considerable quantities after half an hour, and there was a considerable rise in the potential. In such a case not only is the energy due to the evolution of gas lost, but the electro-chemical value of the current is lost also. By keeping the potential down, the evolution of gas may be stopped to a great extent, and both the waste of energy and of current may be prevented, though in the latter parts of the charge the current must necessarily be small.—Lond. *Elec.*, Dec. 6.

Manufacture of Carbon Electrodes.—Strauss.—A description of the process used for manufacturing and testing carbon electrodes at the factory of the Société des Carbures Metalliques, which owns several calcium carbide plants. The raw materials are retort carbon, petroleum coke and coal tar. The carbon is first crushed into a powder. It is then mixed in steam-jacketed apparatus with the necessary proportion of tar, and ground under edge runners. As it leaves the grinding machines the mixture forms a thin, flat cake, hard, but flexible, and is then ready to be moulded into shape. There are two methods commonly adopted for forming the electrodes: By simple pressure, or by extrusion, i. e., forcing the material through a drawplate. The latter method requires more costly apparatus, but gives a more uniform product and is used at that plant. The electric properties of carbon electrodes vary greatly, according to the nature of the raw materials used, and are also affected by the manufacturing process.—Lond. *Elec. Rev.*, Dec. 6.

Units, Measurements and Instruments.

Testing the Magnetic Qualities of Materials in Bulk.—Drysdale.—An illustrated paper read before the Brit. Inst. of Elec. Eng. on a new and very simple permeameter for testing the magnetic qualities of materials in bulk. He has adopted the plan in commercial testing of making both the specimen and the greater part of the return path from the bulk of the material tested. A drill of a special form is used which cuts a circular hole in the specimen, conical at the top, leaving a pin in the center of it. In the usual form of instrument this hole is 3/8 inch in diameter and 5/8 inch deep, and the diameter of the pin is 0.1 inch, but these dimensions could be considerably reduced if necessary. The testing arrangement consists simply of a soft iron plug, carrying a bobbin, on which are wound two circuits, a magnetizing coil and a search coil. The plug is split and is turned slightly conical on its outside surface, while the drill cuts the cone of the same angle as that of the plug. It will be seen from the adjoining figure that on drilling the hole and inserting the plug, a perfect min-

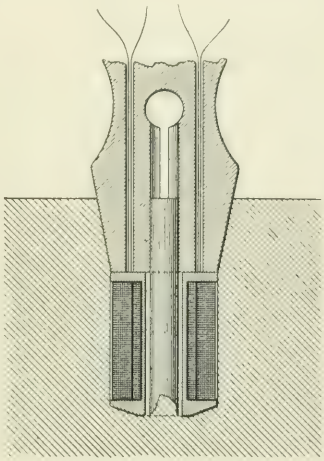


FIG. 1.—SECTION THROUGH PLUG AND SPECIMEN.

iature permeameter is produced, having an exceedingly good magnetic circuit, and in which either the permeability, retentivity, or hysteresis can be determined by ordinary methods. The adjoining diagram shows the connections which are mostly employed. The magnetizing coil *M C* of the plug is supplied with current from a battery *B*, through a regulating resistance *R* and ammeter G_1 and a reversing switch *R S*. Connection is also made from the search coil *C C* to a ballistic galvanometer G_2. On making, breaking, and reversing the

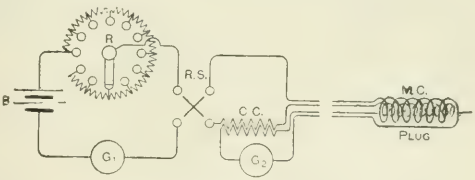


FIG. 2.—CONNECTIONS FOR BALLISTIC TEST.

circuit, deflections are obtained on the galvanometer G_2, which are proportional to the magnetism of the specimen. In order to make the instruments direct reading it is easy to provide a scale for the galvanometer G_1 so that it reads the value of *H*. In the same way a scale is provided for G_2 reading the values of *B* directly. The permeability is then obtained, if necessary, by dividing *B* by *H*; but it is generally sufficient to compare the values of *B* obtained with the curve of some satisfactory specimen. In ordinary commercial testing of castings, etc., it would probably be sufficient to know the value

of the permeability for one value of the magnetizing force. In this case the arrangement may be further simplified by withdrawing the resistance R and galvanometer G_1 and simply arranging the cells to give one definite current. The divisions on the galvanometer G_2 may then be marked directly with values of the permeability. He also describes a zero-reading method and a direct deflecting method, but he prefers the simple ballistic test, as the connections are more simple. Commercial forms of the apparatus are described and details of construction and calibration are given. On examination the accuracy has been found to be most satisfactory, so much so as to be quite equal to that of other commercial methods.—Lond. *Elec.*, Dec. 6. The discussion which followed is abstracted in Lond. *Elec. Rev.*, Dec. 6.

Hysteresis Measurements.—Finzi.—A description of a method of measurement, based on the assumption that, after magnetic saturation, the hysteresis of soft iron is proportional to its coercive force. The specimen may be of any dimensions provided it can pass into the magnetizing solenoid. It is magnetized till practically saturated, and the current diminished to zero and then reversed. The field required to demagnetize the iron is measured on an ammeter, the demagnetization being ascertained by a magnetoscope. For soft iron the hysteresis coefficient in Steinmetz's formula is equal to the coercive force multiplied by 0.00135.—*Elettricita*, June 8; abstracted in *Science Abstracts*, Nov.

REFERENCE.

Measuring the Insulating Resistance.—Strecker.—An illustrated paper, read before the Electro-Technical Society of Berlin. He describes in detail the methods used by the government telegraph office for determining the insulation resistance of the telegraph cables connecting the larger cities of Germany. There is nothing essentially new in the method, but certain simplifications have been introduced, more especially a slide rule for this particular purpose, which enable one to complete calculations of the tests in one-tenth the time required before.—*Elek Zeit.*, Nov. 14.

Telegraphy, Telephony and Signals.

Electro-Capillary Relay.—A description of a relay, devised by Orling and Armstrong, which is said to be sensitive to 0.003 volt. It is based on the same principle as the capillary electrometer. The relay consists of an inverted U-tube containing mercury. One end of this tube is immersed in a mercury reservoir, and the other end, which is drawn to a fine point, reducing the bore to something in the order of 0.004 inch, dips into a bath of dilute acid. Just beneath this point is one end of a lever whose middle rests on a knife edge, the other end of the lever moving between the two contacts of the local circuit. The height of the mercury in the reservoir is such that its pressure is just balanced by the capillary force at the point of the tube. The current is led in at the top of the bend of the U-tube, and out at the bath of dilute acid. As soon as a small current passes, the capillary force is diminished, and the mercury begins to drop from the tube, ceasing again as soon as the current ceases. The mercury falling on the end of the lever tips it up and closes the local circuit.—Lond. *Elec.*, Dec. 6; with illustration in Lond. *Eng'ing*, Dec. 6.

REFERENCES.

Hotel Telephone Exchanges in Chicago.—An illustrated article on the establishment in Chicago of branch exchanges in hotels, affording interior communication and also giving every guest the advantage of talking from his own room to any instrument in the city system or the long-distance lines. Five Chicago hotels are thus equipped. Two large ones are served from one exchange, which is said to supply the largest hotel-telephone system in the United States, and is described in detail. The central battery, automatic signaling system is used.—*West. Elec.*, Dec. 14.

Berlin Telephone Exchange.—Kroesing.—A very long and well illustrated description in detail of the telephone system installed by Siemens & Halske in an exchange in Berlin.—*Elek. Zeit.*, Oct. 31, Nov. 7, 14.

Telephone Exchange Notes.—Henry.—A short article containing a number of practical and useful suggestions on telephone exchange equipment.—*Am. Elec.*, Dec.

Miscellaneous.

REFERENCES.

Rowland.—The full address held by Mendenhall, at the Memorial Meeting at the Johns Hopkins University on the life and work of Henry Augustus Rowland.—*Science*, Dec. 6.

German Manufacturing Plant.—A short illustrated description of the works of Lahmeyer & Co. at Frankfort.—*St. R'y Jour.*, Int. Ed., Dec.

New Books.

Lessons in Practical Electricity. Principles, Experiments and Arithmetical Problems. An Elementary Text-Book. By C. Walton Swoope. New York: D. Van Nostrand Company. 462 pages, 385 illustrations. Price, $2.

This work is based upon a similar one prepared and printed by the author several years ago for use in the Spring Garden Institute, Philadelphia, in connection with the author's evening classes in practical electricity. As a text-book for such work, and as an elementary treatise written from the practical standpoint, this book serves an admirable purpose.

The first seven chapters treat of the fundamental principles of electricity and magnetism, following which are chapters on all the various practical applications of these sciences. The information conveyed is made as practical in character as the subjects will admit. Following the development of each subject is one or more numerical problems, and whenever practicable instructions are given for the performance of experiments illustrating the text, and employing apparatus easily made by the student. Much practical data are scattered throughout the book. In the section on resistance, for example, is given a useful table of the resistances of commercial apparatus, including ammeters and voltmeters, primary batteries, telegraphic and telephonic apparatus, dynamos and motors, transformerrs and incandescent lamps. At the end of each chapter is a series of questions by means of which the student can test his understanding of what he has read. Thirty-two tables, principally of practical application, are given in an appendix. A pocket in the back cover contains two folded plates, one of which contains a diagram of connections of a direct-curent switchboard, and the other a car wiring diagram for a K-10 controller with two motors.

This book can be recommended with confidence to those beginning the self-study of electricity, and particularly to those who wish to confine their knowledge of the science to its more practical aspects. It should also serve as an excellent text-book in teaching evening classes.

Schaltungsarten und Betriebsvorschriften. By Alfred Kistner. Berlin: Julius Springer. 210 pages, 81 illustrations.. Price, 4 marks.

This clear and concise little volume on storage battery switchboards gives the various schemes of interconnection of the line, battery and machine that have been found commercially successful. As the book is intended chiefly for the use of isolated plant engineers and switchboard attendants, pains have been taken to present the subject in a readily comprehensible and not too technical manner.

The plan of the book is good, there being first a very short section on dynamos, pointing out which types are suitable for battery charging and why, and a rather more extended mention of the various switches, automatics and other controlling devices found on battery boards with statements as to their functions. Then comes a section pointing out that it is the e. m. f. variation of accumulators at different stages of change that necessitates much of the switchboard complication and showing how to figure the number of end cells needed, etc. After this follows the main subject matter; that is, an explanation of the various standard ways of connecting up battery plants. Four general types of installation are named as follows: Plants with shunt dynamos and simple single end cell switches; plants with shunt dynamos and double end cells switches; plants where boosters are used, and plants in which the battery is divided into two groups which are coupled in parallel in charging, and in series when discharging.

Of course, under each heading alternative groupings are given, the whole mounting up to seventeen different plans, each suited to meet some special set of conditions. A valuable feature is the clear full page diagram accompanying each description. In addition to this there are directions for operating installations of each of the several kinds which, while necessitating considerable repetition, nevertheless should enhance very materially the value of the work as a reference book to those for whose use it is intended.

No attempt has been made to bring in the elaborate and heavy apparatus needed where storage batteries are in use in large central

stations, nor are three or five-wire plants mentioned. There is further a gratifying absence of padding with descriptions of dynamos and batteries, and the care of each, which matters while strictly speaking are foreign to the scope of the volume are still closely enough allied to it to present temptation.

BOOKS RECEIVED.

KALENDER FUR ELEKTROCHEMIKER. Sowie Technische Chemiker und Physiker fur das jahr 1902. VI. jahrgang. Mit einer Beilage. Von Dr. A. Neuberger. Berlin: M. Krayn. 555 pages, 21 illustrations. Beilage, 448 pages. Price, 4 marks.

GRUNDRISS DER ELEKTROTECHNIK. Von Heinrich Kratzert. II. thiel, 2 buch und 3 buch. 2 auflage. Leipzig und Wien: Franz Deuticke. 436 and 275 pages. Price, 10 marks and 6 marks.

ELECTRIC GAS LIGHTING. By H. S. Norrie. New York: Spon & Chamberlain. 101 pages, 57 illustrations. Price, cloth, 50 cents.

ENGINEERING EDUCATION.—Proceedings of the Society for the Promotion of Engineering Education. Buffalo Meeting, 1901. Vol. IX. New York: Engineering News Publishing Company. 348 pages, 4 illustrations. Price, $2.50.

VELOCITY DIAGRAMS. Their Construction and Their Uses. By Charles W. MacCord, A. M., Sc. D. New York: John Wiley & Sons. 116 pages, 83 illustrations. Price, cloth, $1.50.

Tests of Mechanical Stokers at the General Electric Company's Works at Schenectady.

BY WILLIAM R. RONEY.

THERE appeared in the Nov. 7 issue of the *Engineering News* an article, which consisted of extracts from the report of a series of tests made by Professor J. E. Denton and Mr. Geo. H. Barrus, representing the American Stoker Company, and Messrs. Deane & Main, Boston, representing the General Electric Company. Owing to the manner in which these extracts were presented by the *Engineering News*, and the absence of reference to several important facts connected with the tests, it seems to the writer that the article in question does not present the case in a manner equally fair to all parties concerned.

As stated in the report, these tests were conducted for the purpose of determinng whether the American Stoker Company had fulfilled certain guarantees in their contract with the General Electric Company. On account of a clause in the contract, in which the American Stoker Company guaranteed to "generate a *net* horse-power of steam as economically as the Roney stoker," the engineers decided to test one of the Babcock & Wilcox boilers equipped with the Roney stoker, which had been installed in 1898, and which had been in operation continuously, day and night, for over two and half years.

The position was taken by the engineers, that as the tests were to be conducted for the purpose of determining whether the American Stoker Company had fulfilled its guarantees, the manufacturers of the Roney stoker had no interest or part in the matter, their stokers having been accepted and paid for several years before. Under this ruling the Roney stoker was brought into a competitive test, in which the makers were not permitted to direct its operation, and were not represented, except by an erecting superintendent who was allowed to witness the final test, but not to give directions. One of the results of this ruling is shown in that part of the report regarding "Labor required for operating the stokers," where the report states that "in the Roney stokers, according to the practice of the fireman during the test there was a continual attention and exertion required, etc." This method of handling the stoker was contrary to the "instructions for operation," which are furnished with the Roney stoker, and was the result of inexperience, the fireman having never fired on a test before. If the manufacturers had been permitted to direct the operation of the stoker, this unnecessary labor would have been avoided.

Under the paragraph, "Comparative Economy of the American Stoker and Roney Stoker," various costs of operation are summed up in the following table. In this table it seems rather illogical from an engineering standpoint to credit the American Stoker repair account with the excess over 5 per cent, which the makers, under their contract, assumed for a period of two years. The question of financial liability will not be apt to have much effect on the actual deterioration of the stoker.

As the report assumes that this table demonstrates that "the cost of steam is less with the American stoker than with the Roney Stoker," it is but fair to call attention to some facts not brought out in the report which bear on the other side of the question.

The principal item in the table is "Cost of Coal" per horse-power

Costs per hp per Year.	American Stokers. Repairs according to 3 mos. record on log book.	Repairs guaranteed in contract.	Roney Stokers.
Cost of coal	$34.95	$34.95	$35.76
Cost of repairs	0.77	0.12	0.48
Wages of fireman and helpers	1.44	1.44	1.44
Interest and depreciation	0.38	0.38	0.38
	$37.54	$36.89	$38.06

per year. This is obtained by dividing the amount of water required per horse-power for 300 days of 24 hours each by the net evaporation from and at 212 degs. F. per pound of coal. This method of determining the efficiency of the stoker by means of the boiler performance is manifestly an improper one. The condition of the boiler or the arrangement of the heating surface may be such that its inability to properly absorb heat will neutralize the most perfect combustion obtainable in the furnace. If in these tests the boiler evaporation was to be assumed as the standard of stoker efficiency, the boilers should have been of the same type and the heating surface and settings in the same condition. The Babcock & Wilcox boiler and Roney stoker had been in use over two and a half years, and had never had the fire sides of the tubes cleaned, except by blowing from the outside, and the setting was more or less cracked, while the Stirling boiler with American stoker was new and recently put in service. A contract test was made some six months after this Babcock & Wilcox boiler and Roney stoker were put in service, at which an evaporation of 12.66 from and at 212 degs. per pound of combustible was obtained, exceeding the results obtained by either stoker in the series of tests under consideration. Substituting this evaporation for that obtained on June 18, 1901, when the boiler was old and dirty, would make the cost of coal required per horse-power per hour $34.08 instead of $35.76, as given in the above table. If the table be corrected to make the "Cost of Coal" correspond with what it was when the boiler was new and clean the "Cost per horse-power per year" of operating the Roney Stoker would be $36.40 per horse-power instead of $38.06, as given in the table and less than either of the amounts given as "cost of operating" the American stoker.

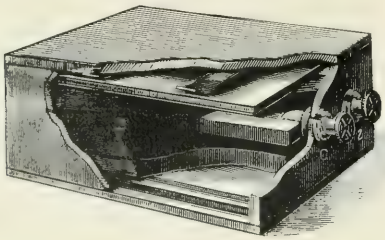
The "Cost of Repairs," namely, 48 cents per horse-power per year, is excessive on account of the fact that the draft of the Babcock & Wilcox boiler was only .15 to .16 of an inch in the furnace, due to insufficient chimney. These boilers and stokers are operated with natural draft and the poor draft caused high temperature in the ash-pit and excessive repairs. The records of many large plants show that the cost of grate bar repairs for the Roney stoker with proper draft conditions should not exceed 12 cents per horse-power per year.

A stoker does not evaporate water. Its function is to burn coal, and the measure of its efficiency is the ability to produce good combustion, as shown by the analysis of the flue gases and not the amount of water evaporated per pound of coal by the boiler to which it is attached. The record of the analysis of flue gases from the Roney stoker shows an average of $\frac{CO_2}{14.2}$, $\frac{O}{4.67}$, $\frac{CO}{0.20}$. This is as good combustion as has ever been obtained, and the fact that the evaporation from and at 212 degs. F. per pound of coal by the Babcock & Wilcox boiler and Roney stoker was 11.169, instead of 11.7, as obtained when the same boiler was new and clean, simply shows that the difference is due to the fact that the boiler was not in condition to absorb the heat generated by the stoker. The heat balance given in the report shows that the Stirling boiler absorbed 77.1 per cent, and the Babcock & Wilcox boiler 72 per cent of the heat of combustion. Or, in other words, judged by the ability of the boilers to absorb heat, the Roney stoker was handicapped by a difference in boiler efficiency of 7 per cent. This is more than double the amount given in the table quoted above as the difference between the two stokers in "Cost of steam per horse-power per year," and completely reverses the statement in the report that "in point of relative economy the guarantee of the American Stoker Company is fulfilled." It is most important in comparing these tests, to remember that the boiler to which the Roney stoker was attached was old and

dirty, and that the combustion was of the best. In comparing the economy of the two stokers the operation of the boilers should have been eliminated and the efficiency of the stokers determined by their ability to produce good combustion. To be consistent, the experts should have considered the results of the tests from this standpoint. Had they done so their conclusions would obviously have been different.

Pile-Block Dry Battery.

The Imperial Electric Supplies, Limited, of London, is putting on the market a novel form of dry battery known as the pile-block dry battery, which was devised and patented by M. P. Germain, of Paris. It has been largely used in France by the Post Office authorities for telegraph purposes, and by the railway companies for their telegraphs and telephones. It is also much used for electric bells, and a special type has been largely adopted for ignition purposes in automobiles. The accompanying illustration shows clearly the construction of the battery, which is hermetically sealed in an oak case. The e. m. f. of



DRY BATTERY.

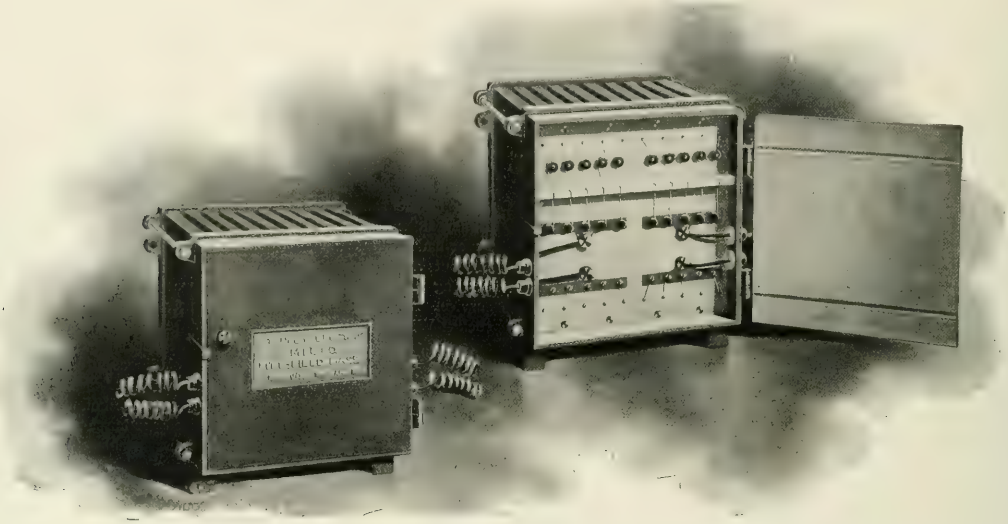
the battery is 1.6 volts, and its internal resistance is not only extremely low but remains low even when the battery is nearly exhausted.

Motor Condensers.

As it is well known, a condenser of proper capacity connected in multiple with the field coil of an alternating-current motor will supply the lagging component or magnetizing current—in other words, will neutralize the inductance of the field. Alternating-current motors so connected take current in proportion to their load substantially as direct-current motors do. The wattless currents, instead of flowing back to the generator and burdening the whole system, simply surge in the local circuit through the condensers.

Condensers were used for this purpose as early as ten years or more ago; in fact, coincident with the introduction of the Stanley-Kelly type of induction motor. The Stanley Electric Manufacturing Company has continuously manufactured such condensers, and recently having greatly enlarged its facilities in this line. The accompanying illustration shows two of the standard types. The standard sizes are made in sections contained in a tin box 12 inches by 10 inches by ¾ inch. For motor work these sections or slabs operate on 550 volts at common frequency. They are made in three sizes, approximately 3, 2.4 and 1.8 microfarads each, the same size tin box being used to contain either.

Special sections can be made to order of different capacity, or so sub-divided that by grouping different sub-divisions or sections a wide range of capacity can be secured, condensers being furnished within very close limits to any required capacity. Specially prepared paper and tinfoil are used, assembled in layers and treated in paraffine under a vacuum at the proper temperature to remove all moisture and gases. This treatment insures a perfect sealing of the paper and tinfoil, leaving no space for vibration of the parts or for a discharge to pass through the dialectic.



CONDENSERS ASSEMBLED.

For motor work the sections of S. K. C. condensers are assembled in a cast iron frame or case. Two standard sizes of the latter are provided, one to contain up to six sections, the other for as many as ten sections. An enclosed terminal and fuse box is located at one end of these cases, and it is intended that each section be separately fused. By combining groups of these cases the condenser capacity for various sizes of motors is obtained.

Switchboard Apparatus.

One of the largest types of switchboards made by the Kellogg Switchboard & Supply Company is shown herewith. The entire front, sides and back of the cabinet are of quartered oak, neatly paneled and beautifully polished, which presents a very striking appearance.

The front and rear panels are readily removable, being held in place by flush ring catches of highly polished brass. This construction makes access to all apparatus a very simple matter. The key shelf is three-ply and hinged. The plug shelf is covered with heavy belt leather to prevent wear of the plugs. The foot-rail is of brass and highly polished, which adds much to the general attractiveness of the board.

In designing this board it was the purpose of the company to produce one that would, by means of its superior construction and latest types of devices, overcome a number of objectionable features found in most boards, and at the same time make it very rapid in operation. It has a capacity of 300 magneto lines, and is equipped with the Kellogg combined mechanically self-restoring drop and jack, and is provided with lamp transfers.

In each end position is shown, just beneath the drops, the lamp

transfers, five in number, with a capacity of ten in each position. These are operated by 10 cells of Fuller battery. The object of these lamp transfers is to make rapid connections between subscribers whose lines terminate in a position not within easy reaching distance of the operator who receives the call. As an illustration, a subscriber asks the operator at the right for a number in the position on her extreme left. She immediately plugs into the transfer lamp, as shown in this cut, which lights her lamp, and the corresponding lamp in the position where the connection is desired. This being a signal for the second operator, she immediately plugs into the jack corresponding to this lamp, as shown, which being done extinguishes both lamps, and completes the circuit between the two operators, thus enabling the first operator to give the second one the subscriber's number, who makes the desired connection.

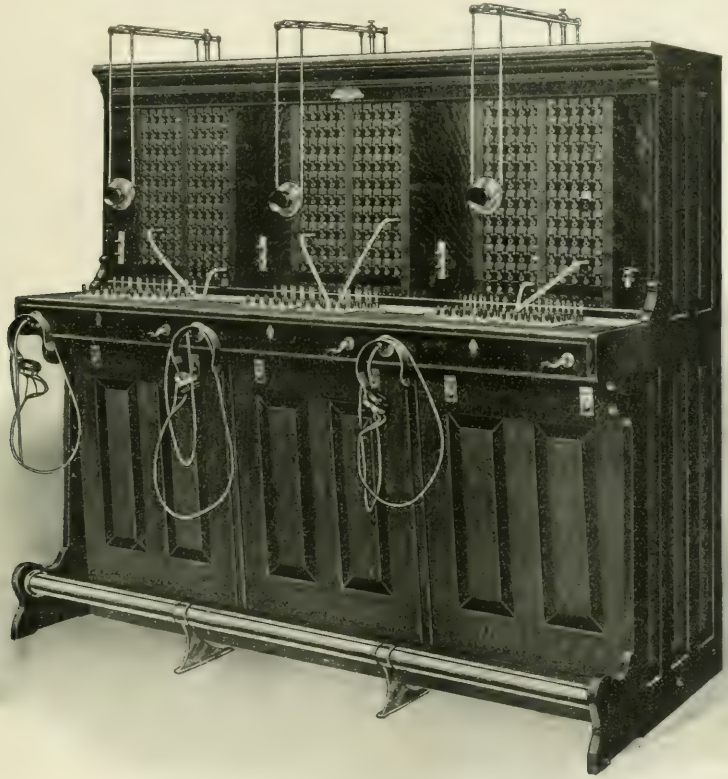
After the conversation has ended, the subscriber rings off, operating clearing out drops in the position, and then the operator pulls out both plugs. This operation illuminates the lamps in both positions, thus telling the first operator that the conversation has ended and connection should be taken down, which being done, both lamps are extinguished.

Each position is separated by a quartered oak panel. A key is mounted on the two middle and left-hand end panels, which are so arranged that only one generator, either hand or power, can be connected in at any one time. The fourth switch, as shown on the extreme right, controls the night bell alarm, the object of which is to ring a bell whenever a drop falls, thus calling the attention of the operator.

The drops are of the tubular type, which gives the maximum electrical and mechanical efficiency. The jack and drop are rigidly connected together by a metallic mounting strip, which makes their adjustment permanent. Any single drop and jack, or any part of one, can be readily removed from the board for repairs without the use of the soldering iron. The drop is cut out during conversation, presenting an absolutely free talking circuit. The jacks and drops are mounted five per strip, and fastened to a structural steel frame, with machine screw *s*. The front and back is of polished hard rubber reinforced by heavy brass, thus giving a neat appearance, combined with good insulation, and entire freedom from warping. The clearing-out drops are of the tubular type, high wound, and bridged across the cord circuit. All the drops and jacks are mounted in a structural steel framework. The combined ringing and listening keys are very simple and well constructed. The springs are of German silver, with 99 per cent pure platinum contacts.

Each key is so arranged that the operator can ring out on either answering or connecting cord. The plugs and cords are the same as used on large multiple boards, and are warranted to give satisfaction. The plugs are reinforced by a steel pointed tip. The board is wired on the full metallic plan, and is consequently readily adapted to common return or grounded circuits. The operator's transmitter is the well-known Kellogg type, adapted for long-distance work, suspended from a graceful nickel-plated arm, which has two adjustments, one for height and one for distance from the board. The head telephone is provided with a 6-ft. green silk cord, terminating in a plug, which may be inserted in the cut-in jack in the face of the keyboard, as shown in the cut. This cut-in jack is so arranged that when the operator's plug is withdrawn, the circuit of the operator's battery is automatically opened, as is also the operator's talking circuit. This prevents the wasting of the operator's battery, when the board is not in use. The operator's hand generator is of the four-magnet type, and mounted in the rear of the board where it is readily accessible.

The cabling throughout the switchboard is done with silk and cotton insulated wire. All joints are soldered to their respective terminals without the use of any acid. All the line drops and jacks may be cabled down to a connecting rack, at the bottom of the board and within the closing rear panels, or may be brought out direct in any length of cable, as desired.



Telephone Switchboard.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 6 per cent for 60 days' loans. The decreased apprehensions of financial stringency caused a firmer feeling in stocks. The cut in copper prices and the reduction of Amalgamated Copper dividend brought some relief to the stock market. Anthracite coal shares, trunk lines and southern securities showed strength. Apart from Amalgamated Copper the industrial list was exceedingly dull, with a few exceptions. The traction list continued the upward movement in pirces, all of the leading stocks closing with substantial gains. Brooklyn Rapid Transit closed at 64¾, a net gain of 2⅛ points; Metropolitan Street Railway closed at 163⅜, a net gain of 3⅞, and Manhattan at 134, a net gain of 1½. General Electric, which has been steadily advancing for the past several weeks, broke the record last week and closed with a net loss of 1 point, the closing price being 281. Westinghouse Elcertic suffered a net loss of 9⅞ points, closing at 158, ex-div. Western Union closed at 91⅝, ex-div., a net gain of 1⅞ points. American District Telegraph is quoted at 36, a net loss of 1 point from the last previous quotation, and American Telephone & Telegraph closed at 162. American Telegraph & Cable closed with a net loss of 3¾ points, at 95. In Boston General Electric showed an advance of 10 points for the week, with American Telephone & Telegraph 2½ points higher. Following are the closing quotations of Monday, Dec. 23:

NEW YORK.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
American Tel. & Cable..	97	—	General Electric.....	281	281
American Dist. Tel.....	36	36¼	General Carriage	1½	1¼
Brooklyn Rapid Transit..	62½	64⅞	Hudson River Tel.....	104	104
Ches. & Pot. Telephone..	66	66	Metropolitan Street Ry..	161	162¼
Commercial Cable.....	181	170	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	19	19	N. Y. Elec. Veh. Tran...	12¾	12
Electric Boat pfd.....	40	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1⅞	1¾	Tel. & Tel. Co. of Am....	—	—
Electric Vehicle.....	2½	2¼	Western Union Tel.....	91¼	91
Electric Vehicle pfd.....	4	4	West. E. & M. Co.....	117	162½

BOSTON.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Am. Tel. & Tel.....	161	161½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	134	—
Edison Elec. Illum.....	235	250	Westinghouse Elec.....	—	80
Erie Telephone.....	19	17	Westinghouse Elec. pfd..	—	—
General Electric pfd ...	--	—			

PHILADELPHIA.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
American Railways.....	43	43½	Phila. Traction.....	97¾	97⅞
Electric Storage Battery.	60	61	Philadelphia Electric....	4¾	4⅝
Elec. Storage Batt'y pfd.	60	61	Pa. Electric Vehicle.....	½	¾
Elec. Co. of America....	6	6	Pa. Elec. Veh. pfd.....	2	2

CHICAGO.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Central Union Telephone	40	—	National Carbon pfd....	85½	83½
Chicago Edison.....	—	160	Northwest Elev. com....	*35	37
Chicago City Ry.....	187	185	Union Traction.....	10½	10½
Chicago Telep. Co.....	240	223	Union Traction pfd.....	47	47
National Carbon.....	16¾	16¾			

*Asked.

DIVIDENDS.—The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent on both the common and preferred stocks, payable Jan. 2 to stockholders of record Dec. 24. Westinghouse Electric & Manufacturing directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2, to stockholders of record Dec. 21, 1901. The directors of the American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ per cent. The Washburn Wire Company has declared a regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 1. New York Metropolitan Street Railway directors have declared the regular quarterly dividend of 1¾ per cent, payable Jan. 15.

WESTERN UNION ADVANCE.—The advance in Western Union has been on the Washington report of a plan for the purchase of the Western Union and the Postal Telegraph companies by the issue of a 2 per cent Government bond. Such a plan has been under consideration for some months, it is said. The underlying principle is that a 2 per cent Government bond could be sold at par. The properties purchased would pay 5 per cent or more in dividends. The difference between the yield by the companies and the interest on the Government bond, acting as a sinking fund, would, in a comparatively short time, provide for the payment of the principle of the bonds, leaving the Government the owner of the property without any continuing cost. In view of the drop in cable securities in England, it is rather surprising that the Western Union, owning cable properties, has not declined.

A WESTINGHOUSE TRACTION COMPANY.—It is announced that the Westinghouse interests in London have formed a new company with a capital of $5,500,000, to be known as the Traction & Power Securities Company, Limited. A prime object of the new company is to receive payment in debenture securities and pay cash to the producing interest. Urgency for the formation of the company arose through a contract of the British Westinghouse Company, which is also a large shareholder, with the Mersey Railway Company for the equipment of the line.

MIAMI & ERIE CANAL.—The Miami & Erie Canal Transportation Company has filed a mortgage for $2,000,000. The Cincinnati Trust Company is trustee. The bonds bear 5 per cent and are payable in 20 years. The mortgage covers all the property owned by the company between this city and Dayton. The company is equipping the canal banks with tracks and will haul boats by electric power.

NEW YORK TRANSPORTATION.—Stockholders of New York Electric Vehicle Transportation Company have received notice that a special meeting of the stockholders will be held in Jersey City on Jan. 9, 1902, to vote on decreasing the capital stock from $25,000,000 to $5,000,000 and changing the name of the company to New York Transportation Company, as recommended by the board of directors.

NEW BRUNSWICK & TRENTON RAILWAY.—A mortgage for $1,000,000 has been filed with the County Clerk by the New Brunswick & Trenton Railway Company, recently incorporated to construct a third-rail electric railway from Milltown to Trenton. The mortgage is given to secure an issue of $1,000,000 is bonds, and is given to the Finance Company of Pennsylvania.

UTICA & MOHAWK VALLEY.—N. W. Harris & Co., of New York City, offer to investors $1,400,000 Utica & Mohawk Valley Railway Company 40-year 4½ per cent gold bonds. These bonds are secured by a mortgage on the entire street railway system operating under perpetual franchise in Utica and adjacent cities, including branches now in process of construction.

AMERICAN LIGHT & TRACTION.—The Emerson-McMillin interests of New York have secured control of the Lincoln Gas & Electric Light Company. The concern will be reorganized at once with a capital of $1,500,000.

ANSONIA BRASS & COPPER COMPANY has increased its capital from $1,500,000 to $2,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade was the most prominent feature in the business situation, being stimulated by the influences of very cold weather throughout the country, and a more pronounced holiday demand, while jobbers in many lines report a good re-order business growing out of the above conditions. Wholesale trade, as a rule, has been seasonably quiet, among the exceptions to this being iron and steel. According to *Bradstreet's*, the holiday influences have not been entirely favorable to active business, as is proved by the general quieting down of demand and the easing of values in the leading speculative markets. The feeling in these markets, however, is one of deferred rather than postponed activity, the turn of the year being expected to bring marked developments in all lines. The spectacular feature of the week in prices has been the continued marking down of copper and the sympathetic drop in tin and lead. Bank clearings and railroad earnings continue to maintain their high average, and there is no visible backward tendency in the general volume of business now as compared with a year ago. Slow but steady accretions in the price of pig iron are proof of the heavy buying going on in the cruder forms, which vies with the active call for bars, sheets, plates, rails and structural material among unfinished products. The returns of railroad earnings show that 50 roads earned 8 per cent more in the first week of December this year than the same month last year, while for the second week 42 roads show a gain of $400,000 over the middle week of De-

cember last year. In sharp contrast to the strength in iron and steel is the weakness of copper, a result of the failure of combinations to artificially maintain prices. The metal is four cents lower than it was two weeks ago, and yet the actual demands seem slow to materialize. During the week two declines of 1⅜ cents were made. The United Metals Selling Company announced a decline of 1⅜c., quoting Lake at 15⅜c. to 15⅝c.; electrolytic, 15c. to 15¼c., and casting, 15c. A later official cut brought the price down to 14c. for Lake, 13⅞c. for electrolytic, and 13c. for casting. The business failures for the week, as reported by *Bradstreet's*, numbered 262, as against 233 the week previous, and 262 the same week last year.

EDISON PORTLAND CEMENT COMPANY, at Stewartsville, N. J., on the Pennsylvania border, about two miles from Easton, has been making great headway with its work, and Superintendent Darling expects to be running full blast early in the spring. Last week Mr. Edison, accompanied by some of the directors and large stockholders and by Messrs. Mallory and Upton, visited the property, and all were much gratified at the progress found. Mr. Edison, it may be mentioned, is working on an extensive ledge of natural cement rock, which gives practically an exact Portland assay, and the deposit is so great that the plant now equipped for 10,000 barrels a day can be run on it for at least a century. The deposit begins about a mile from the vast works, and part of it has already been stripped, two large steam shovels being already at work on the face about 80 ft. down. The Allis engines for the works are in position, supplemented by an Armington & Sims, and most of the machinery is ready to run. A good deal of it is due as usual to Mr. Edison's invention and initiative—all looking to economy of labor and effort. About 100 electric motors, from 100 down to 5 hp, will drive the mechanism, in addition to direct engine drives, and the motors are chiefly General Electric, with some Crocker-Wheeler. Mr. Edison finds the motors admirably adapted for such work, and has himself devised several ingenious automatic features for their control and cut off. The prospects for a profitable industry are extremely good, and present inquiries alone would keep the plant running all the time, while when it starts it will be one more proof of Mr. Edison's versatility, courage and perserverance.

THE HAINES & NOYES COMPANY, which makes a specialty of telephone apparatus for private telephone plants, has recently closed up four large contracts with Stone & Webster, 93 Federal Street, Boston, Mass., for equipping the following electric railways: Ponce Electric Railway & Light Company, Ponce, Porto, Rico; Tampa Electric Railway Company, Tampa, Fla.; Houghton County Street Railway Company, Houghton, Mich.; Blue Hill Street Railway Company, Milton, Mass. The telephone apparatus for the Ponce Railway & Light Company and the Tampa Electric Railway Company consisted of a number of water-proof iron box telephones, which contained a bridging generator, a hand microphone with extra long cord, two "Hydra" double batteries and long lever hook with German silver springs and platinum contacts. These iron box telephones have the name of the electric railway company printed on them, and they are very small and compact. A number of desk telephones were also furnished with this equipment. The equipment for the Houghton County Street Railway Company consisted of a number of portable car telephones containing a bridging generator, two "Hydra" double batteries and a hand microphone mounted in a small but heavy oak box with dove-tail corners. When the lid is opened the battery is cut in. These little telephones have nickel plated hinges and nickeled handle for carrying, and they may be connected anywhere on the telephone line. The Blue Hill Street Railway Company's equipment consisted of Haines & Noyes standard wall sets.

TELEPHONY IN EGYPT.—The Telephone Company of Egypt, Limited, operating a large telephone system in Egypt, has experienced great difficulty in securing a suitable pole. The climate of the country is so hot and dry that good timber to use for a pole line for the transmission of an electric current, does not grow and timber imported from other countries dry-rots and becomes useless in a very short time. A certain pole imported from Sweden proved to be the most valuable so far, but its greatest life was not over four years. The company began negotiations, therefore, with cedar pole firms in the United States, with the result that arrangements have just been completed with W. C. Sterling & Son, of Monroe, Michigan, wholesale producers of cedar poles, ties and posts for the shipment of 1500 poles of the white cedar variety, Michigan grown, to Alexandria and Cairo, Egypt. Correspondence opened between the two firms last June, but owing to the great distance and slow transportation of mail matter, arrangements were not completed until last week, and the shipment of the material will begin at once. Sterling & Son have earned an enviable reputation as reliable dealers and have, it is understood, made the only previous shipment of material in their line to a foreign country. Two years ago they made a large shipment to Beunos Ayres, South America, and naturally feel elated at receiving a second foreign order. They are now negotiating for the shipment of a large order for poles to Spain and Portugal.

ENLARGING BULLOCK FACTORY.—The Bullock Electric Manufacturing Company will soon erect one of the largest machine shops in the country. Plans have been prepared and contracts will be let in the near future for an addition to the plant which will double its present capacity. The new machine shop will be built with a view to building electrical units of the largest size. The machine shop will be 62 ft. under the roof trusses, the main span will be 75 ft. between the crane tracks with two more spans of 45 ft. each between the crane tracks. The building, when entirely finished, will be 1200 ft. long, and will cost $150,000. The decision to push the building to completion at this time is in part due to a contract closed recently with the Cincinnati Gas & Electric Company for electrical equipment, to the amount of $250,000, to be delivered in nine months. The contracts call for two 3200-kw generators to be direct connected to two Allis engines with a nominal rating of 3750 hp, and a maximum capacity of 5500 hp. One of the generators will be of the direct-current type, 75 r. p. m., 300 volts, and will supply current to the three-wire system of the company, while the other unit will be of the alternating-current, revolving field type. The total weight of this generator will be 660,000 lbs. The Cincinnati Gas & Electric Company will erect a new building that will be a duplicate of the one now in operation.

H. W. JOHNS-MANVILLE COMPANY.—The H. W. Johns Manufacturing Company, of New York, and the Manville Covering Company, of Milwaukee, each company having been closely identified as handling the goods manufactured by the other, have consolidated their interests. This consolidation is to take effect Jan. 1. The new company, whose capital stock will be $3,000,000, will be known as the H. W. Johns-Manville Company. The officers of the new company will be: Mr. T. F. Manville, president; Mr. C. B. Manville, vice-president; Mr. George W. Gladwin, vice-president; Mr. F. R. Boocock, treasurer, and Mr. H. E. Manville, secretary. Mr. James G. Cannon will be chairman of the board of directors. Mr. C. R. Manville will be manager of the Western department, and he, with Mr. C. B. Manville, will remain in Milwaukee. Mr. T. F. Manville and Mr. H. E. Manville will remove to New York. The new company is rapidly completing a plant at Milwaukee for the manufacture of carbonate of magnesia and mineral wool. When this plant is completed, the company will be prepared to furnish a most complete line of all grades of steam pipe and boiler coverings and asbestos goods of all descriptions.

ELECTRIC VEHICLE COMPANY.—Great interest has been aroused in electrical and automobile circles in this city by the action of the Electric Vehicle Company in closing down its Elizabethport factory and concentrating practically all its manufacturing work at Hartford. Colonel G. H. Day, when seen in this city last Thursday, accompanied by Superintendent Budlong, stated that all the necessary plans had been carried out, and that great benefits were expected from the change, especially in the economies due to producing automobiles all from one plant. It is now stated that in connection with these changes, Messrs. A. L. Riker, H. M. Byllesby and A. H. Whiting have resigned from the Electric Vehicle Company. The prominence of these gentlemen in the company and in electrical work naturally invests this news with considerable importance, and their moves and plans are awaited with much interest. Mr. Byllesby is a late comer into the automobile field; from other electrical branches, but Messrs. Riker and Whiting have long been prominent in it, and the former has made a deep mark on the art.

PROMINENT BUYER HERE FROM SPAIN.—J. F. Villalta, the principal of the house of J. F. Villalta, Barcelona, Spain, which is the only concern handling American machinery exclusively in that part of the world, has arrived in the United States with a view to placing some substantial contracts, including electrical machinery, supplies, machine tools, etc. He may be found downtown at the offices of the foreign freight contracting and forwarding firm of Alfred H. Post & Co., Produce Exchange. Mr. Villalta, who, according to present arrangements, expects to be in America for about a week or ten days, is at the Hotel America, Irving Place and Fifteenth Street.

AMERICAN BICYCLE COMPANY interests have incorporated two companies in New Jersey, one the American Bicycle Manufacturing Company, with $8,000,000 capital, the other the International Motor Car Company, with $2,000,000 capital. The new bicycle company will take over the bicycle department of the big company, and the new motor company will make and operate automobiles. The capital stocks of the new companies will be held by the American Bicycle Company.

GAS DRIVEN GENERATORS.—The Lackawanna Iron & Steel Company, of Buffalo, N. Y., are putting in a new power plant, which comprises three 500-kw Sprague split pole generators, to furnish current for motors, lights, etc. The Sprague Electric Company has received a handsome contract. The generators will be driven by three German gas engines.

AMERICAN EQUIPMENT FOR FIRST TOKIO ELECTRIC TRACTION SYSTEM.—The Tokio Densha Tetsudo Kabushika Kwaisha, which Japanese concern will operate the first street railway in Tokio, placed last week indirectly a contract with the General Electric Company for the generators, engines, boilers, pumps, condensers, heaters, etc., for its projected power house equipment, also for the trucks and motor equipment for the cars. The value of the contract is stated to be about $750,000. As the Tokio company, in view of the monetary stringency at present existing in Japan, was desirous of securing an extended credit for its purchases in this country, financial arrangements have been made through the Japanese house of Mitsui & Co., 445-7 Broome Street, whereby that firm guarantees the payments for the machinery, etc., ordered from the General Electric Company. The power house plant will include three 1200-kw direct-connected G. E. generators and six rotaries of 400 kw each; three cross-compound horizontal engines of 1800 hp capacity each, to be manufactured by McIntosh, Seymour & Co., and eight 350-hp boilers to be built by the Babcock & Wilcox Company. The pumps comprising three main condensing outfits, one for the exciter engine, two feed pumps and three small equipments to be utilized for drainage and oil purposes are to be manufactured by the Blake branch of the International Pump Company, 120 Liberty Street. There will be four heaters of Wainwright make. The Morgan Engineering Company, Alliance, Ohio, will build a 20-ton overhead electric crane. The contract for piping, valves, etc.—valued at about $25,000—is not included in the General Electric contract, it having been awarded to McMann & Taylor, of 104-6 John Street. The trucks will be manufactured by the Peckham Manufacturing Company, of Kingston, N. Y., 250 having been ordered. They will be fitted with double-motor equipments of G. E. 54 type. The car bodies, owing to the cheapness of wood in Japan, will be manufactured there. The rails will be purchased in England. The company will commence operations by utilizing 22 miles of track through the principal streets in Tokio. It is anticipated that everything will be ready for business early in 1903. Mr. Enyo, chief engineer of the Tokio enterprise, has sailed for home this week via Vancouver. Orders for machine tools, etc., have yet to be awarded.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 18: Antwerp—9 pkgs. material, $720; 9 pkgs. machinery, $2,609. Alexandria—3 pkgs. material, $60. Argentine Republic—48 pkgs. material, $770; 13 pkgs. machinery, $1,623. Brussels—4 pkgs. material, $882. Brazil—25 pkgs. material, $1,380; 611 pkgs. material, $8,466. British East Indies—9 pkgs. machinery, $2,350. Bordeaux—1 pkg. machinery, $711. Barcelona—17 pkgs. copper wire, $3,100. British West Indies—28 pkgs. material, $991; 1 pkg. machinery, $21; 1 pkg. motors, $47. British Australia—247 packages material, $17,000; 299 pkgs. machinery, $47,238. Central America—14 pkgs. material, $283; 1 pkg. material, $420. China—2 pkgs. material, $50. Cuba—49 pkgs. machinery, $3,152; 331 pkgs. material, $3,467; 76 pkgs. wire, $1,152. Dublin—1 pkg. wire, $91. Hong Kong—35 pkgs. material, $2,550. Havre—31 pkgs. material, $771; 5 pkgs. machinery, $245. Japan—38 pkgs. material, $8,535. Leicester—6 pkgs. machinery, $200. Liverpool—13 pkgs. machinery, $814; 68 pkgs. material, $3,284. London—188 pkgs. machinery, $8,219; 160 pkgs. material, $5,774; 100 pkgs. wire, $1,200; 2 pkgs. wire, $140. Marseilles—20 pkgs. material, $100. Manchester—10 pkgs. machinery, $1,600. Moscow—12 pkgs. material, $1,085. Mexico—70 pkgs. material, $4,232; 27 pkgs. wire, $125; 14 pkgs. wire, $636; 150 pkgs. wire, $2,277. Nova Scotia—9 pkgs. material, $160. Newfoundland—13 pkgs. material, $132. Newcastle—15 pkgs. machinery, $1,722. Peru—16 pkgs. material, $429; 82 pkgs. copper wire, $1,968. Philippines—101 pkgs. material, $3,248; 89 pkgs. machinery, $12,653. Rotterdam—3 pkgs. goods, $130. Santo Domingo—3 pkgs. material, $25. Southampton—8 pkgs. material, $127. Siam—34 pkgs. material, $1,700. Stockholm—7 pkgs. machinery, $900. Taunton—7 pkgs. machinery, $3,000. Uruguay—8 pkgs. material, $351; 2 pkgs. machinery, $1,000. Venezuela—1 pkg. machinery, $20; 80 pkgs. material, $345; 2 pkgs. wire, $20. Yarmouth—12 pkgs. wire, $891.

COMBINATION IN MISSOURI.—C. E. Hart, of Joplin, who is said to represent the Westinghouse Electric & Manufacturing Company, submitted a proposition to the City Council Dec. 3 to purchase the municipal electric lighting plant. Mr. Hart made a similar proposition to the Council of Carthage, Mo. He offers to pay the cost of a special election if the Council will signify its consent. The deal has been progressing quietly for the past two weeks, and it was learned that the transaction may assume large proportions by consolidating the lighting companies of Southwest Missouri and Southeast Kansas. Such a combination would include the Southwest Missouri Electric Railway Company, which runs from Carthage, Mo., to Galena, Kan., the municipal and corporate plant at Carthage, the municipal plant at Joplin, the corporate plant at Galena, Kan., and possibly the Southwest Missouri Electric Light Company, which supplies Joplin, Webb City and Carterville, Mo., with private electric light and power.

WATER POWER DEVELOPMENT IN MONTANA.—Former Governor S. T. Hauser, of Montana, has perfected plans for a second dam above the present Canyon Ferry plant on the Missouri River, to furnish power and light to the mines and smelters in Butte, Mont. All the necessary land joining the dam site has been secured by the company, and in the spring work will be started and the dam proper built, when the water of the Missouri is at low ebb. The construction of a second dam on the river will entail an outlay of something like $1,000,000. From Stubbs Ferry to Canyon Ferry, a distance of 6 miles, a new pole line will be built. From Canyon Ferry to Butte and to Helena the power will be transmitted over a new aluminum line. The plant will have a capacity of 20,000 hp, and will be one of the largest power plants in the Northwest. A large amount of power will be used in Butte. In this connection it might be said that there is every probability of several large power plants being constructed next year in different parts of Montana.

EQUIPMENT ORDERS PENDING FOR MATTEAWAN (N. Y.) PLANT.—W. M. Sheehan & Co., electrical engineers and contractors of 136 Liberty Street, New York City, which concern is building and equipping the new plant of the Citizens' Street Railway Company, Matteawan, N. Y., will shortly give out contracts for a 400-hp Corliss engine and a 225-kw belted generator, shafting, and so forth. The induced draft system will be employed in the plant. The boiler order calling for two boilers of 200 hp each has already been contracted for with Thayer & Co., Incorporated, of 39-41 Cortlandt Street. These boilers will be built by the Aultman & Taylor Company, of Mansfield, Ohio. The new plant is expected to be in operation by May next.

EDISON CENTRAL STATION BOILERS.—All the boilers in the Edison Electric Illuminating Company's plant at Paterson, N. J., have been equipped with the "Potter" mesh separator (dry pipe) and superheater. The owners state the steam at the boiler outlet has been improved 50 per cent, as shown by calorimeter tests for dryness, and that the parties have no trouble with water in their steam engines. Messrs. James Beggs & Co., 9 Dey Street, New York, are meeting with much success with the "Potter mesh," which was described before the American Society of Mechanical Engineers a couple of weeks ago by Mr. Fred Scheffler, the well-known steam and electrical expert, and was duly noted at that time in these pages.

EQUIPMENT FOR LORILLARD'S PLANT.—The P. Lorillard Company's tobacco plant at Jersey Street, which is about to be operated by electricity, will be equipped with 45 two-phase alternating-current motors, varying from 2 to 30 hp, built by the Westinghouse Electric & Manufacturing Company. The wiring for these motors as well as for 1300 incandescent lamps will be executed by W. M. Sheehan & Co., of 136 Liberty Street, with John A. Roebling's Sons Company's wire.

CINCINNATI CONTRACTS.—The Bullock Electric Manufacturing Company, of Cincinnati, has, as stated above, the contract for two 3200-kw generators to be installed in the new plant of the Cincinnati Gas & Electric Company, contracts for the erection of which will be let at once. The Allis-Chalmers Company has secured the contracts for two 3750-hp engines. Contracts call for the delivery of the machinery within nine months.

THE ACME SWITCH COMPANY, of Hartford, Conn., whose address has recently been changed to 438 Asylum Street, is moving from its old shop to one much larger, and is installing machinery to enable it to do all of its own work. It hopes in this way to catch up with accumulated orders. On Dec. 3 the company increased its capital stock from $12,500 to $25,000.

THE HALL SIGNAL COMPANY has recently fully paid off out of its earnings a $200,000 issue of bonds, dated 1894, due 1904. This represents the entire bonded debt of the company. The company now has on hand a handsome surplus, and besides doing a large business in this country the company is putting its signal system on railroads in Belgium, France and England.

NEW STILWELL-BIERCE & SMITH-VAILE SHOPS.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, whose New York offices are in the Washington Life Building, 141 Broadway, has just appropriated $150,000 for the purpose of erecting new foundry and machine shops.

General News.

THE TELEPHONE.

GADSDEN, ALA.—Alabama & Georgia Long Distance Telephone Company has increased its capital stock from $10,000 to $30,000.

SCOTTSBORO, ALA.—The citizens of Paint Rock Valley are building a co-operative telephone line up the valley from Paint Rock station.

COURTLAND, ALA.—The long distance telephone system is now being put up here. The local telephone exchange will also be put in as soon as the poles can be placed.

SAN FRANCISCO, CALIF.—It is reported that the Alaska Telephone Company has let contracts for the early construction of a telephone line from Nome to Council City, Alaska, a distance of 100 miles. It is the intention of ex-Mayor Harry White, of Seattle, Wash., who is the promoter of the enterprise, to build an extension of 200 miles from Nome to Teller and Kougurock. Telegraph lines, also, are included in the company's plans.

JACKSONVILLE, FLA.—The Peninsular Telephone Company has a charter for a system in this city, and has arranged to commence work at once.

DUBLIN, GA.—J. O. Persons, of Greenville, S. C., will organize a stock company for the construction of an independent telephone system at Dublin.

EDELSTEIN, ILL.—Van Antwerp and Baily are building a telephone line south from Edelstein.

MATTOON, ILL.—The Farmers' Mutual Telephone Company, capital stock $10,000, has been incorporated by J. F. Miller, J. F. Brewster and A. G. Hildreth.

WEST FREEPORT, ILL.—The West Freeport Village Board granted a twenty-year franchise to Bills & Wortham for the construction of a telephone system.

PITTSFIELD, ILL.—The stockholders of the Pike County Telephone Company will consider a proposition to increase the capital stock from $20,000 to not to exceed $40,000.

ROCKFORD, ILL.—A charter was filed for the Rockford Home Telephone Company, with a capital stock of $200,000. Incorporators: George F. Miner, George F. Wilson and F. M. Puffer.

ALTON, ILL.—It is rumored that the Kinloch long distance telephone people of St. Louis are contemplating the erection of an electric lighting plant in Alton, and that they will go into competition with the present Alton Railway, Gas & Electric Company. The officers of the Kinloch Company refuse to talk of the project, but several of the members of the Council state that they have been talked to about the matter officially.

SOUTH WHITLEY, IND.—The South Whitley Telephone Company filed application for a franchise in Huntington, Ind.

SHELBYVILLE, IND.—John A. Tindell, of this city, is negotiating for the purchase of the plant of the Mutual Telephone Company.

EVANSVILLE, IND.—The Eureka Telephone Company requests the right to operate in this city. Charles Laval is its representative.

JEFFERSONVILLE, IND.—The Independent Long Distance Telephone & Telegraph Company has been granted a franchise by the Scott County Commissioners.

PORTLAND, IND.—The Redkey Telephone Company has asked a franchise of the County Commissioners of Jay County. An extension of its lines is under contemplation.

INDIANAPOLIS, IND.—The Independent Long-Distance Telephone & Telegraph Company, of Delaware, capital $200,000, has complied with the foreign incorporation law. Its Indiana investments are placed at $25,000, and C. D. Knoefel, of New Albany, is named as State agent.

INDIANAPOLIS, IND.—The Mooreland Rural Telephone Company, of Mooreland, with a capital of $1,500, and the Halleck Telephone Company, of Rensselaer, capital $10,000, have been incorporated. The former's board of directors is headed by W. E. Moore, and the latter's by Charles Halleck. The Mooreland Company will operate a village exchange with farmer-line connections, and the Halleck Company will operate an extensive system in Jasper and fifteen contiguous counties. The plan is to buy up and consolidate the smaller plants into one system.

BRAZIL, IND.—The New Long Distance Telephone Company, which has been planning to parallel the Central Union from Terre Haute to Indianapolis, has reached this city with the poles, and the company asserts that the wires will be strung and the exchanges will be in operation between this city and Terre Haute within ten days. This company will co-operate with the newly organized Brazil Telephone Company, which was recently granted a local franchise by the City Council. Until now the Central Union has enjoyed an undisputed monopoly of the telephone business here. The new company proposes to erect a rural exchange, to touch all the important towns in the county.

ROCHESTER, IND.—The growth of the independent telephone industry is fairly sweeping this section of the State. Logansport, Peru and South Bend are being equipped with the finest of new independent plants, and a franchise has just been granted to a Fort Wayne syndicate to put in an independent system at Hammond. When these plants are completed they will afford independent telephone service to every town in the northern part of the State. Even little towns of a few hundred inhabitants are putting in exchanges, and the farmers in surrounding territory are being connected with town and toll line service on party lines. At Silver Lake and Bann automatic switchboards are being put in. Between the larger exchanges full metallic copper toll lines are being constructed.

MARCUS, IA.—A franchise has been granted to two citizens to construct and operate a telephone system in this town.

ATLANTIC, IA.—The residents of the country between Massena and Cumberland are preparing to build a telephone line.

CALIFORNIA, IA.—A rural telephone line is being installed in the farmers' homes between Missouri Valley and California Junction.

MORNING SUN, IA.—The Morning Sun Telephone Company has filed articles of incorporation with a capital stock of $10,000. Fred. Courts is president.

ANAMOSA, IA.—Jones County Telephone Company, capital stock $50,000, has been incorporated. President, L. H. Camp; vice-president, L. Middleton; secretary, C. H. Brown; treasurer, H. F. Camp.

COIN, IA.—The Coin & Northboro Telephone Company, capital stock $7,000, has been incorporated by W. T. Uttvitts, John H. Rew, E. E. Bryant, Lewis Harris, John Haisch, J. R. Harris, J. K. Herron, J. F. Whitmore and Ed. F. Rose.

GOWRIE, IA.—A telephone exchange will be installed here. The franchise was granted to Robert L. Parker. Several rural lines are being planned, and the indications are that Gowrie will soon be the center of an extensive telephone system.

FRANKFORT, KY.—The Burning Springs and East Bernstadt Telephone & Telegraph Company, of Laurel County, has been incorporated, with a capital stock of $2,000. R. M. Jackson is the chief stockholder.

VANCEBURG, KY.—Mayor-elect A. J. Stein has purchased the Odd Fellow telephone that runs between Tolesboro and Maysville, and will soon begin the erection of a line connecting Vanceburg with Tolesboro, thereby giving connection with Maysville.

BALTIMORE, MD.—The plan for the lighting and drainage of Baltimore, which has many novel features and great possibilities, is to construct a canal between Baltimore and the Susquehanna River which will convey a sufficient amount of water to flush the harbor and produce the sanitary conditions needed for over 1,000,000 population. The water would be brought in at an elevation of about 125 feet. With it the city would light the streets and operate the water department pumps, and it would have enough left to supply all the inhabitants of Baltimore at a much lower rate than the cost of steam, which will produce a revenue of from $1,000,000 to $2,000,000 annually. The canal would be about thirty-five miles long, and if it could be excavated through dirt would cost about $4,500,000.

OMENA, MICH.—The farmers at Northport and Omena have organized local independent telephone companies.

ALBION, MICH.—A new telephone franchise for the People's Telephone Company has been asked of the City Council.

DETROIT, MICH.—The Michigan Telephone Company will increase its rates on Jan. 1. It claims to have about 12,000 subscribers in Detroit. Among subscribers there seems to be much opposition to the increase.

McCOMB CITY, MISS.—The Pike County Telephone Company has been purchased by J. J. White, Dr. O. B. Quin, T. W. James and W. R. Caston. Dr. O. B. Quin was elected president, W. R. Caston vice-president and T. W. James secretary and treasurer. The lines will be extended and the service will be generally improved. The company now has exchanges in Summit, McComb City, Magnolia and Osyka.

HELENA, MONT.—The Yellowstone Park Telephone & Telegraph Company has increased its capital and changed its place of business from Bozeman to Livingston.

BAY, MO.—The Gasconade Central Telephone Company, capital stock $1,200, has been incorporated by E. T. Williams, W. F. Langenberg, Peter Danuser and others.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company will expend $1,000,000 between Jan. 1 and May 1 next year, in improving its system in this city and Kansas.

SEDALIA, MO.—The Telephone Association of Central Missouri, composed of independent lines, was organized here recently, and the following officers were elected: G. W. Schweer, of Windsor, president; Dr. Force, of Jefferson City, first vice-president; Fred. A. Churchill, Sr., St. Louis, second vice-president; J. Golloday, Holden, secretary. The following towns are members of the association: Fayette, Glasgow, Columbia, Boonville, Bunceton, California, Jefferson City, Windsor, Clinton, Calhoun, Warrensburg, Holden, Harrisonville, Caldwell County and Sedalia. This city was made the permanent headquarters of the association.

EAGLE, NEB.—The Eagle Telephone Company has been organized. A. C. Adams is president, Frank Clements vice-president and S. A. Morrison secretary.

LONG PINE, NEB.—A company has been organized by the business men of Long Pine to build a telephone line from this place to the "A. D." cattle ranch via Selden, Spragg and Butler. M. D. James, of Spragg, is president.

BETHANY, N. Y.—It is said that farmers are arranging to build a telephone line from Batavia to Bethany.

NEWBURGH, N. Y.—The Hudson River Telephone Company has installed an exchange in Walden with thirty-five subscribers.

BINGHAMTON, N. Y.—The independent telephone system in Binghamton now has 775 subscribers. It will soon be connected with a Broome County long distance line.

ALBANY, N. Y.—The Utica Home Telephone Company has been incorporated; capital, $200,000. Directors: C. H. Poole, H. F. Miller, and E. B. Odell, of Utica.

CLYDE, N. Y.—The Lyons Telephone Company and the Wayne Telephone & Telegraph Company, including all rights, privileges, and franchises, trunk lines and local exchanges, owned and controlled by H. P. and S. E. Bishop, of Clyde, have been pruchased by the Eastern Electrical Construction Company, of Philadelphia, Pa.

COLUMBIA, OHIO.—A new telephone line is to be erected in Columbia.

[illegible], OHIO.—[illegible] Haas contemplates building a telephone line to Steubenville.

BELLEVUE, OHIO.—The Bellevue Telephone Company has completed a line from Bellevue to Colby Station, giving connection from Bellevue to Clyde.

SHELBY, OHIO.—The business of the People's Telephone Company has been growing rapidly of late, and service is now given to nearly 500 subscribers.

NORTH LIMA, OHIO.—The farmers and business men of Beaver Township will hold a meeting to form a stock company, to put up an independent telephone line.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company has practically completed its system and about two-thirds of its 1000 subscribers have been connected up. This is one of the new properties controlled by the Federal Telephone Company of Cleveland.

CHICAGO JUNCTION, OHIO.—The growth of the Huron County Telephone Company's exchange here has been remarkable. At present there are 320 telephones in operation and it is expected that before the new management's first year is up there will be 400 telephones connected.

CLEVELAND, OHIO.—There is considerable speculation among Cleveland financiers as to the cause of the drop in the price of Federal Telephone securities. A month ago the stock was quoted at in the neighborhood of 28, but since then it has been steadily falling, with a sudden drop of several points a couple of weeks ago. On Dec. 14 the stock was offered at 15, with no takers, but since then there has been a slight improvement. At the same time the new business being secured by the Federal properties is of the most promising character. Exchanges at Cleveland, Columbus, Dayton, Mansfield, Bowling Green, Massillon, Findlay, Zanesville, Lima, Canton, Shelby, Dunkirk, Youngstown, Alliance, Fostoria, Portsmouth, Lancaster and Galion show a gain in new business for November of $40,946. Total number of telephones added to these properties was 1837. Average cost of securing the business was $1.76. As compared with the month of October, the gain in contracts was nearly 500. The gain in total revenue over $11,000 and the gain in average revenue per contract was about $4. A number of the plants have reached the limit of switchboard capacity and will require new equipment. The United States Telephone Company (long distance) shows a net gain in revenue during November of over $2,500 and carried over $3,600 to dividends.

GUTHRIE, OKLA.—The Texas Telephone Company has filed notice of its intention to do business in Oklahoma and of the appointment of W. J. Donald, of Lawton as its territorial agent. The company has a capital stock of $3,000.

WOODWARD, OKLA.—The Home Enterprise Telephone Company, of Woodward, has been incorporated, with $10,000 capital stock. Directors: C. R. Alexander, E. S. Wiggins, Geo. H. Brophy and J. H. Hopkins, E. B. Roll, B. W. Key and F. D. Healey, L. B. Collins and Chas. Swendall, all of Woodward.

OTTAWA, ONT.—At the January elections the question of the establishment of a municipal telephone system will be voted upon. The agreement between the Bell Telephone Company and the city expires early in April, 1903, and it is considered in the interests of the citizens that a telephone system, under municipal ownership and operation, should be inaugurated. The proposition will undoubtedly carry by a large majority.

SCOTLAND, S. D.—The Western Electric Telephone Company has decided to extend its line direct from Tabor to Yankton.

HURON, S. D.—A new telephone line is being constructed to connect Huron, La Delle, Lake Byron, Sheffield and other towns in that part of the State.

JACKSON, TENN.—C. L. Meyers, of Chicago, has completed arrangements for the construction of the Jackson Home Telephone Company.

CHATTANOOGA, TENN.—The City Telephone Company has been granted a charter for the purpose of constructing a new telephone plant system in this city. Capital stock, $50,000.

GRAHAM, TEX.—The Northwest Texas Telephone Company, capital stock $5,000, has been incorporated by R. J. Graham, W. L. Donnell, J. H. Ball and others.

NACOGDOCHES, TEX.—The Central Texas Telephone Company, of Nacogdoches, capital stock $10,000, has been incorporated by E. C. Branch, W. S. Beeson and W. S. Patton.

BRENHAM, TEX.—At a meeting of the stockholders of the Brenham and Brazos Valley Telephone Company, the following officers were elected: J. T. Hairston, president; W. M. Aven, vice-president; O. A. Seward, secretary.

SALT LAKE CITY, UTAH.—Citizens of Daisy and Rice, Wash., are building a telephone line between those points, connecting with each farm house.

SALT LAKE CITY, UTAH.—The Pacific Telephone Company, of Spokane, Wash., will enlarge its present quarters to twice the size. The new addition will allow the accommodation of about 10,000 new subscribers. When the company entered its building two years ago it had less than 3000 telephones in use. The increase in the past two years has been remarkable, and the company's local representatives say that there is every indication that it will continue. Four new switchboards have been ordered from New York. The work of construction will commence at once.

EVERETT, WASH.—The Sunset Telephone & Telegraph Company will erect a two-story brick building for headquarters in this city.

MADISON, WIS.—The Great Western Telephone & Telegraph Company, of Milwaukee, capital stock $500,000, has been incorporated by C. G. Foster, E. R. Stillman and C. W. Milbrath.

JANESVILLE, WIS.—There are nearly 50 cities in this State that have exchanges of over 100 telephones, and scores of smaller places with a less number. Following is a list of the exchanges of 100 subscribers or more: Madison, 1350; Appleton, 1200; Superior, 812; La Crosse, 860; Racine, 800; Janesville, 785; Sheboygan, 700; Richland Center, 650; Fond du Lac, 500; Wausau, 480; Beloit, 475; Baraboo, 400; Portage, 355; Monroe, 340; Viroqua, 320; Grand Rapids, 305; Rhinelander, 300; Elkhorn-Delavan, 300; Merrill, 295; Hancock, 210; Brodhead, 200; Mauston, 200; Evansville, 300; Reedsburg, 200; Clinton, 197; St. Croix Falls, 195; Sparta, 190; Edgerton, 180; Pardeeville, 175; Fort Atkinson, 174; Marshfield, 170; Neillsville, 165; Tomah, 140; Platteville, 136; Mineral Point, 134; Prairie du Chien, 130; Lancaster, 125; Barron, 125; East Troy, 120; New Richmond, 120; Ripon, 120; Sauk City, 102; Plymouth, 100; Milton, 100.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Douglas Electric Company has completed a new electric lighting system, which will supply lights and power in Roseburg, Ore. The generating machinery is located in the new pumping station of the Roseburg Water Company and operated by hydraulic power.

SAN FRANCISCO, CALIF.—The Washington Water & Power Company, which controls the water power of the falls of the Spokane River, has begun a survey for a pole line for its projected electric power transmission to the Cœur d'Alene silver and lead mines in Idaho. The length of this line from Spokane, Washington, to Northern Idaho is about 100 miles.

SAN FRANCISCO, CALIF.—Bakersfield, Calif., now has a city ordinance regulating the granting of franchises and providing for the placing of all electric light and telephone wires underground. Within three years all poles and wires used for transmitting electricity are required to be removed from the public streets and placed in underground conduits. No franchises will hereafter be granted to companies for overhead wiring.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, Calif., recently held its annual meeting and elected P. B. Cornwall, president; W. R. Summerhayes, vice-president and general manager; James Fisher, secretary, and Alvinza Hayward and T. R. Henshelwood as additional directors. The annual report showed that the company's gross earnings for light service during the preceding year were $120,922.65. Officials of the company own coal mines, which enables them to compete with oil burning plants.

SAN FRANCISCO, CALIF.—The California Gas & Electric Corporation has been incorporated, with San Francisco as the principal place of business, and a capital stock of $30,000,000, of which $450,000 is paid up. The directors are: A. E. Childs, R. R. Colgate, Eugene de Sabla, Jr., R. M. Hotaling, L. P. Lowe, John Martin and William M. Pierson. R. R. Colgate will be president of the company and John Martin and E. de Sabla, Jr., vice-presidents. The new company is backed by some of the capitalists who have successfully financed and carried out the plans of the Bay Counties Power Company, which operates the longest electric transmission in the world, and the California Central Gas & Electric Company.

SAVANNAH, GA.—It is announced that the Edison Electric Illuminating Company has acquired the street railway interests in this city. The Edison Company is owned principally in Boston and Savannah. George Parsons, of New York, was president and majority owner of the street railway company. It is understood that he got more than $1,000,000 for his interest. The Edison Company now operates a lighting plant here and has the city contract. The two companies are capitalized at about $3,500,000. They will be consolidated and new securities issued. George J. Baldwin, president of the Edison Company, will be president of the new corporation.

RIDGEFARM, ILL.—The Ridgefarm Electric Light, Heat & Power Company has increased its capital stock from $5,000 to $10,000.

LINCOLN, ILL.—The Lincoln Heat, Light & Water Company, Lincoln, capital, $50,000, has been incorporated by W. A. Thomas, James W. Collins and David H. Harts.

WINAMAE, IND.—The City Council has decided to compel electric light consumers to use meters. The flat rates have been too low to pay expenses of improvements and meet interest on bonds of the municipal plant. The new rate is ½ cent per lamp-hour to business houses and ¾ cents an hour to residences.

ST. PAUL, MINN.—The Black River Falls Company, of Minnesota, filed articles of incorporation. The headquarters of the company will be at Duluth, and the object is to manufacture electric power for lighting and manufacturing in St. Louis County. The capital is $50,000.

LIVINGSTON, MONT.—At a meeting of the City Council a franchise was granted to A. O. Newton for the construction and maintenance of a new electric light plant in this city.

OMAHA, NEB.—The Overland Limited trains of the Union Pacific & Northwestern will be lighted by electricity after Jan. 1. Sixty Pullmans which make up these trains are now being equipped with electric lights, and the engines pulling the trains will have dynamos.

ALBANY, N. Y.—The Syracuse Lighting Company filed a certificate of an increase of its capital stock from $2,500,000 to $4,000,000.

YONKERS, N. Y.—The gas-contract muddle in this city, involving about $1,000,000, has brought on a spirited contest since the election of ex-Alderman Walsh as Mayor. Nearly two years ago the Board of Aldermen voted to give a contract to the Westchester Lighting Company, calling for the establishment of 1600 Welsbach lights at $30 a lamp. There was a protest on the part of some of the citizens, and Mayor Sutherland refused to sign the contract. The Westchester Company began to put up lamps, holding that the contract was valid without the Mayor's signature. The contract for electric lighting expired soon after the other contract came up for discussion, and the Aldermen refused to vote on the question of a new electric lighting contract until the gas question should be settled. The gas people put up Welsbach lamps where arc lamps had been, but the electric light people hold that they never received any instructions to discontinue their service. The Mayor now refuses to pay any bills of the Westchester Company unless it charges at the rate of $9 a lamp, the old price paid for common gas lights.

LA RUE, OHIO.—The Village Council has appointed a committee to investigate the cost of a municipal lighting plant.

NORTH AMHERST, OHIO.—The Village Council is having plans prepared for the erection of a municipal lighting plant.

LIMA, OHIO.—The Cincinnati, Hamilton & Dayton Railway has equipped a new wrecking train with an electric lighting outfit.

COLUMBUS, OHIO.—President Theobald of the Columbus Edison Electric Light Company, states that the options secured on the properties of the two Columbus lighting plants have expired and the deal is off.

SALINEVILLE, OHIO.—The Salineville Council has granted a 25-year franchise to John Goeppinger of Youngstown, who has offered to furnish arc lights at $48 per year. The town has the privilege of buying the plant at the end of ten years.

COSHOCTON, OHIO.—The Merchants' Electric Light & Power Company has complied with the law and made returns to the Secretary of State as a foreign corporation. It is incorporated under the laws of New Jersey with $125,000 capital stock. The suit brought by the State Attorney General to collect fees and penalty will be withdrawn.

OTTAWA, ONT.—The town of Fort William, Ont., is asking power from the Legislature in order to develop 1000 electric horse-power from the waters of the Kaministiquia River.

OTTAWA, ONT.—The promoters of the scheme to develop the water power at Lac du Bonnett, Manitoba, are considering the project of building an electric railway from the city of Winnipeg to that place, at a cost of about $1,000,000.

OTTAWA, ONT.—It is announced that Mr. E. Spencer Jennison, the Chicago engineer, has completed financial arrangements for developing power in the neighborhood of Port Arthur and Fort William, Ont. The scheme is a large one, and involves the diversion of water from the Kaminisquia River, to a series of reservoirs, affording a fall of 300 feet, from which 40,000 electrical horse-power is expected. To carry out the project will require about $1,000,000.

HARRISBURG, PA.—The Mount Joy Electric Light, Heat & Power Company, of Mount Joy, capital $15,000, has been incorporated.

ALTOONA, PA.—The Edison Electric Illuminating Company, of Altoona, which supplies this city with electric light, and the control of which has been the subject of litigation between it and the Electric Company of America, has finally passed into the control of the latter. A. Loudon Snowden, H. T. Hartman, Joseph B. McCall, and Frank B. Ball, all of Philadelphia, have been elected directors of the Altoona Company, together with John Lloyd and T. B. Patton, of Altoona.

SIOUX FALLS, S. D.—R. M. Parsons, an Estelline capitalist, has decided to establish an electric light system in Estelline.

HOUSTON, TEX.—The property of the Citizens' Electric Light & Power Company of Houston, was disposed of at public sale on Dec. 3, to George C. Hollister for $240,000.

HOUSTON, TEX.—The Houston Light & Power Company has filed its charter at Austin. It has a capital stock of $750,000. The incorporators are Howard C. Lewis, E. L. Carr, E. R. Coffin, H. M. Francis and Edward Clark, all of Schenectady, N. Y., and Blake Dupree and W. H. Chapman, of Houston.

SALT LAKE CITY, UTAH.—The Union Electric Light & Power Company has filed articles of incorporation. The company is capitalized at $50,000, and will furnish light and power for Cache and Hyrum counties. The company will erect plants at Hyrum and Wellsville and succeed to the old Hyrum plant.

GRAFTON, W. VA.—The Grafton Gas, Electric Light & Power Company will make a number of improvements to its lighting plant.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Bessemer Electrical Company has sold out to the Birmingham Railway Light & Power Company, the consideration being $24,000.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has commenced the conversion of its 25-mile steam loop between Bessemer and Birmingham into an electric railway laid with 80-lb. rails, and has staked off the site and ordered the erection of a $100,000 car barn at Birmingham besides purchasing the Bessemer Electric plant, on which $200,000 will be expended. The renovated and enlarged plant will supply current for the loop and other car lines.

SAN FRANCISCO, CALIF.—The latest report as to the plans of California Gas & Electric Corporation, which has been organized to take over and amplify the business carried on by the Bay Counties Power Company, of San Francisco, and its allies, is that it is about to absorb the North Pacific Coast Railroad and convert it into an electric road. It is said that the entire railroad from Sausalito, its terminal on San Francisco Bay, to San Rafael and San Quentin, from the junction to Mill Valley and from San Auselino northward 80 miles to Cazadero, will be changed over to an electric railway. An extension from San Rafael to Petaluma is among the improvements projected. The lines will be operated by current from the North Yuba transmission plant.

SAN FRANCISCO, CALIF.—The San Francisco & Piedmont Railway Company has been incorporated. The subscribers to its capital stock of $2,500,000 are F. M. Smith, F. C. Havens, W. H. Martin, E. A. Heron and W. F. Kelly. The Oakland Transit Company and the Oakland & San Jose Railway Company, with more than 100 miles of electric railway will act as feeders to the new line, which will be 17 miles in length, including the ferry trip across San Francisco Bay, and will terminate near Leona Heights, east of Oakland. The new company will give a somewhat improved service as soon as its pier and ferryboats are completed, but in order to reduce the time by one-half, plans have been prepared for laying a steel subway beneath the waters of the bay, where it is comparatively shallow. It will consist of a steel tube two miles in length extending from the end of the Oakland pier to near the shore line of Goat Island, which is occupied by the United States Government. Here it is proposed to establish a ferry landing and reduce the steamer's time to 5 minutes instead of 20. If the Government will permit, the ferries to land directly at the island the tube will be shortened ½ mile.

TAMPA, FLA.—Mr. John P. Martin, of Xenia, Ohio, is interested in a scheme to build electric railways from Tampa throughout Hillsboro County. The Martin syndicate also proposes to construct a complete system of street car lines in Tampa, and also a modern electric lighting plant. Two local companies have secured injunctions estopping the city from contracting with Mr. Martin for furnishing lights.

SAVANNAH, GA.—It has been authoritatively announced that the Edison Electric Illuminating Company has secured the street railway interests of Savannah. It is understood that Texas oil will be used as fuel by the newly consolidated company.

RICHMOND, IND.—The Richmond Street & Interurban Company will build a line from Melton, this county, to Connersville.

KNIGHTSTOWN, IND.—O. D. Ogburn and others, of New Castle, have secured from the County Commissioners a franchise for an electric railway along the National road in this county.

COVINGTON, IND.—The City Council has granted to the Fountain and Warren Traction Company a franchise. The line will extend from Danville, Ill., and will form a part of the great system that is expected to connect Danville with Lafayette, Logansport, Wabash and Fort Wayne, commonly called the tow-path line.

LOUISVILLE, KY.—Steps are being taken to construct an electric railway from Louisville to West Point, a distance of 20 miles. It is thought that a bond issue of $150,000 will be made.

DURANGO, MEXICO.—The Government of the State of Durango, Mexico, has granted a concession to Maximiliano Damm, of the city of Durango, for the construction and operation of a tramway line from Chinacates station, on the Mexican International Railroad, to the mining camp of Promontorio. The length of the proposed line is about 25 kilometers. It is probable that it will be electrically operated.

DETROIT, MICH.—The Detroit & Michigan Air Line and the Middle States Railway Company have been incorporated by the attorneys for the Everett-Moore syndicate.

DETROIT, MICH.—The Rapid Railway System (Detroit & Port Huron Shore Line) has been successful in condemnation proceedings to secure right of way for the new short cut from New Baltimore to Marine City. The new cut will shorten the distance from Detroit to Port Huron about ten miles.

ANACONDA, MONT.—The City Council has passed an ordinance requiring all railways to maintain arc lights at the intersections of streets with the railway lines.

OMAHA, NEB.—The Omaha Street Railway Company has decided to extend the line to Florence, Neb.

LEAKSVILLE, N. C.—There is a proposition to build an electric railway from Leaksville and Spray to Ridgway, Va., and possibly to Reidsville, N. C.

DURHAM, N. C.—The Durham Light & Power Company has given a mortgage to the Consolidated Railway & Light Company, of Maryland, to secure a $100,000 loan. The work on the plant will be pushed.

ELIZABETH CITY, N. C.—The Elizabeth City Railway & Power Company has been chartered, with a paid-up capital of $20,000, to construct an electric railway in the town and adjacent country. J. A. Wallace, of Berkley, Va.; C. M. Ferebee and others are the incorporators.

BRIDGEPORT, OHIO.—The Wheeling Traction Company will spend $500,000 in completing its line to Steubenville.

MASSILLON, OHIO.—Charles Currie has been elected general manager and treasurer of the Canton-Massillon Railway.

EATON, OHIO.—The Hamilton, Eaton, Richmond & Muncie Traction Company has been granted a 25-year franchise through Eaton.

CLEVELAND, OHIO.—The Middle States Railway Company, incorporated recently, has increased its capital stock from $1,000 to $50,000.

MADISONVILLE, OHIO.—The Madisonville Council has granted a franchise through town to the Cincinnati & Columbus Traction Company.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway has been authorized to increase its capital stock from $400,000 to $1,500,000.

TOLEDO, OHIO.—The Toledo & Indiana Railway has completed arrangements with the Toledo Railways & Light Company for entrance to the center of the city.

LIMA, OHIO.—The City Council has been asked to grant a franchise on North Jackson Street to the Lima Electric Light & Power Company, which operates the city lines.

CANTON, OHIO.—The Stark County Electric Railway has secured all the required private right of way between Canton and Alliance. Construction work is progressing rapidly.

MECHANICSBURG, OHIO.—The Columbus, London & Springfield Railway has obtained a franchise for a branch to Somerford, and the line is to be extended to Mechanicsburg.

LIMA, OHIO.—The Allen County Commissioners have granted franchises through the county to the Toledo & Lima Railway and the Lima, Delphos, Van Wert & Fort Wayne Traction Company.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has filed a mortgage to the Knickerbocker Trust Company, trustee, to secure an issue of $1,500,000 of 5 per cent 20-year bonds.

AKRON, OHIO.—Daniel Gindelsperger and Frederick Green, of Cleveland, have applied for a franchise through Summit County for a road which they propose to build from Cleveland to Akron and Barberton.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Southwestern Railway, will commence construction work next spring on a line from Springfield to Yellow Springs, Clifton, Cedarville and Jamestown.

CLEVELAND, OHIO.—It is reported that the Cleveland, Terminal & Valley Railway, which is a part of the Baltimore & Ohio system, is to be equipped with electricity for the operation of suburban cars out of Cleveland.

WELLINGTON, OHIO.—The Cleveland, Elyria & Western Railway has asked the Wellington Council for a franchise to the south corporation line to furnish entrance for the proposed Cleveland, Ashland & Mansfield Railway.

CANTON, OHIO.—On the application of the Canton, Lodi & Medina Electric Railway Company, the Canton Council has established a route through town and will call for bids. W. W. Irwin, J. J. Whitacre and others of Canton are promoters.

CLEVELAND, OHIO.—Stockholders of the Cleveland Electric Railway will meet Jan. 15 to take action on a proposition to increase the capital stock of the company $1,000,000. The present capital stock is $13,000,000, with outstanding bonds amounting to $4,350,000.

MARIETTA, OHIO.—The Parkersburg & Marietta Interurban Railway has acquired three-fourths of the stock of the Marietta Electric Company, thereby securing control of the lines of the two cities. The stock was bought on a basis of $400,000 for the entire plant.

CLEVELAND, OHIO.—A dispatch from Richmond, Va., states that the Cleveland Construction Company of Cleveland has bought up the property of the Richmond Passenger & Power Company, including 85 miles of city and suburban lines. A leading official of the Cleveland Construction Company states there is no truth in the report.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has organized as follows: E. M. Hopkins, Detroit, president; W. W. Steele, Detroit, vice-president; H. S. Forgy, New Carlisle, treasurer; C. L. Hubbard, Dayton, secretary; B. H. Rannells, Dayton, general manager. The main line will run from Dayton to Kenton, 75 miles.

BARBERTON, OHIO.—The Northern Ohio Traction Company has submitted a new proposition for illuminating Barberton. It offered to furnish street lamps at 3½ cents per hour each or 3 cents per hour each for 50 lamps on a five-year contract. Commercial lighting for 12 and 13 cents. The company is unwilling to take a three-year contract.

TIFFIN, OHIO.—The Tiffin & Southern Railway Company has incorporated at Charlestown, W. Va., with $500,000 capital stock to build a road from Tiffin to Kenton, and to maintain telephone, lighting and power plants. Incorporators: Michael Riely, Pittsburg; Allen Smalley, Upper Sandusky; D. C. Donovan, W. F. Malone and M. A. Smalley, Toledo.

CANTON, OHIO.—H. C. Fogle, one of the directors of the Canton-Massillon Railway, gives the first official verification of the report that the line has been sold to the Northern Ohio Traction Company. The stock of the road has been transferred to J. B. McCall, of Philadelphia Electric Company, Philadelphia, which represented the Everett-Moore syndicate.

JEFFERSON, OHIO.—It is claimed by residents of Jefferson that there is an excellent opening for an electric road to run through Ashtabula and Geauga counties to Cleveland. The counties include the towns of Jefferson, Andover, New Lyme, Windsor and East Orwell, with rich farming districts surrounding the towns. At present these towns are almost isolated from Cleveland because of the poor railway connection.

OTTAWA, ONT.—Electric railways between Brockville and Ottawa, 60 miles, and Cornwall and Toronto, 266 miles, are projected by the Ontario Electric Company, which will seek incorporation at the next session of the Legislature. A. L. Smith and Geo. E. Smith, of Boston, Mass., are interested.

OTTAWA, ONT.—Negotiations are now under way for the acquisition, by the Niagara, St. Catharines & Toronto Railway, of the Port Dalhousie, St. Catharines & Thorold Electric Railway. The possession of this line will give the Niagara & St. Catharines road control of all the electric railways in the Niagara Peninsula, with the exception of the Niagara Falls Park & River Railway.

AUSTIN, TEX.—There is a good prospect that the negotiations which have been pending for some time past for the sale of the two street railway systems of Monterey, Mexico, to an American syndicate will soon be consummated.

THE AUTOMOBILE.

THE NEWARK AUTO-COACH COMPANY, of Newark, Ohio, is putting on the streets large passenger vehicles capable of carrying a dozen persons.

AUTOMOBILE SHOW.—The automobile dealers of Indianapolis, Ind., have decided to give an automobile show the third week in February. Frank Stanley has been elected chairman and C. G. Fisher secretary.

THE SALEM AUTOMOBILE COMPANY, of Salem, Oregon, will establish a public automobile service early next year. The City Council recently granted a franchise to Frank N. Derby, who is at the head of the company. An annual tax of $12 is imposed on each vehicle.

A COMMERCIAL NECESSITY.—Mr. Henri Fournier, the well known French automobilist, says in the January *Success*: "Automobiling is a royal sport, as any one knows who has ridden in the chauffeur's seat of a forty-horse-power machine on a well-kept country road. But I do not plead for the automobile as a pleasure machine. I am not a faddist. The automobile is a commercial necessity. Its place is with the electric street car, the locomotive, and the traction engine.

EXHIBITION AT COPENHAGEN.—An exhibition of automobiles will be held in Copenhagen from April 11 to April 27, 1902, under the auspices of the Danish Automobile Club and the Society for the Promotion of Industrial Arts. It will be held in the building of the last mentioned society, and is designed mainly for automobiles, but some space will be given to motor cycles and articles relating to the driving of automobiles. The exhibition is intended to attract visitors from all the Scandinavian countries. No rent whatever is to be paid by the exhibitor. The showrooms, cases, and tables belonging to the society are put at the disposal of exhibitors without charge. The committee will insure a duty free import of all articles which are again exported at the close of the exhibition.

NEW INDUSTRIAL COMPANIES.

THE SHAW ELECTRICAL COMPANY, Camden, N. J., has been incorporated to manufacture electrical devices; capital, $50,000. Incorporators: J. Elliott Shaw, Wm. Gibson, George H. B. Martin.

THE NORTH CAROLINA CONSTRUCTION COMPANY has been chartered at Greensboro, N. C., to build and operate street railways, electric light plants, etc. R. Williamston and others are the incorporators. The capital is $1,000.

UNION ELECTRICAL SUPPLY COMPANY.—In noting recently the incorporation of the Union Electrical Supply Company, of 74 Cortlandt Street, New York City, the name of Mr. E. M. Zabriskie as one of the directors was omitted. He is also vice-president and treasurer.

THE RENAULT INSULATOR & ELECTRICAL MANUFACTURING COMPANY has been commissioned, its principal place of business being in Aiken County, S. C. It will manufacture insulators of porcelain, mica, clay, etc. The company will operate on valuable clay deposits.

THE MILLER STORAGE BATTERY & ELECTRIC COMPANY has been organized at Bellefontaine, Ohio, with $20,000 capital stock for the purpose of manufacturing and selling storage batteries, automobiles and electrical appliances. Those interested are A. J. Miller, J. H. Wilson, N. V. Elliott, John M. Gregory, W. W. Fisher, W. R. Niven, W. C. Huston, Geo. J. Miller and R. F. Tremain. George J. Miller, of Kenton, will be in charge of the mechanical end of the business. A factory will be established at once.

LEGAL.

POOL ROOM TELEGRAPHY LEGAL.—The Kentucky Court of Appeals has ruled that a telegraph company, as a common carrier, cannot be indicted for or restrained from furnishing information concerning races to pool-rooms. The decision was rendered in the case of the commonwealth against the Western Union Telegraph Company at Louisville.

BRUSH STORAGE BATTERY PATENT AGAIN SUSTAINED.—Judge Coxe, of the United States District Court of the Northern District of New York, has handed down a decision against American Bicycle Company interests which adds another to the long list sustaining the fundamental Brush storage battery patent of March 2, 1886. The controversy was limited to the proposition whether the electrode of the defendants in suit is of the kind described in an Italian Brush patent which has expired. The court adhered to a preceding decision that the electrodes of the Italian and 1886 patents "are different things, and one does not interfere with another." Quoting from a previous decision, the invention of the 1886 Brush patent is described as follows: "There is (1) the supporting plate; (2) the active material mechanically applied thereto; (3) the active material held to the plate by pressure, or by sheet of porous non-conducting material. It is the combination of these elements in the formation of the secondary battery which is covered by the patent in suit. By this means Brush produced the first commercial storage battery ever made." In rejoinder to the claim of the defence that their plates, after leaving the molds, are put through a long preliminary forming process which distinguishes them from the Brush electrodes, the court held that the so-called forming process is not a forming process as that term has been understood in the art and interpreted by the courts. That the active material has all been mechanically applied to the plates before being placed in the battery fluid, and there is, therefore, nothing to form, the process being simply a prolonged charging process.

OBITUARY.

GEO. H. CARLETON.—The funeral of Geo. H. Carleton, late City Electrician, of Oakland, Calif., took place on Dec. 8, the interment being at Mountain View Cemetery under Masonic auspices. Mr. Carleton was one of the most popular citizens of Oakland, and the police and fire departments and local military organizations participated in the funeral ceremonies, and made appropriate floral offerings.

PERSONAL.

MR. FRANCIS S. THAYER, superintendent of the gas and electric plants at Warren, R. I., has been appointed general manager of the Westerly, R. I., Gas & Electric Light Company.

MR. GEORGE WESTINGHOUSE has returned from England this week with very satisfactory reports as to the Westinghouse electrical outlook abroad and in time to receive the patent decision against the New York Air Brake Company as a Christmas box.

PRESIDENT S. INSULL, of the Chicago Edison Company, dismisses with scorn the rumor that the Chicago People's Gas Company has bought the property. It is an old report, anyhow.

PROF. R. B. OWENS, of the electrical engineering department of McGill University, Montreal, is on a Christmas vacation in this country. He has been very busy of late installing a new 300-kw-hour chloride battery, with other auxiliary apparatus.

MR. PHILIP J. DARLINGTON, superintendent of the Watsessing factory of the Sprague Electric Company, was married at Saturday, Dec. 21, to Miss Rebecca Mattson, of Philadelphia. Mr. and Mrs. Darlington will make their home in Glen Ridge, N. J.

MR. CHAS. BRANDEIS, of the electrical engineering department of the Lachine Rapids & Hydraulic Company, of Montreal, has been a visitor in New

York during Christmas week, for a vacation and to study the recent central station development in this vicinity.

GENERAL JOHN I. SABIN.—It is reported that General J. I. Sabin, president of the Chicago and Central Union Telephone companies, will be president of the Erie Company, and that it will be managed from Chicago. The territory is in proximity to the Chicago and Central Union properties.

PROF. F. B. CROCKER, of the electrical engineering department at Columbia University, New York City, is spending his Christmas vacation in Cuba, with the intention of shaking off in that genial climate a severe cold that has seriously inconvenienced him during the past busy Fall. He will be gone about a fortnight.

MR. JAMES RASCOVAR is now the sole surviving partner of the well known financial advertising agency of Albert Frank & Company, of which the titular senior died last August. It is stated that not long ago the firm cabled to London a 10,000-word announcement, which appeared in the London newspapers next morning. Other heavy cabling of the same kind is often done.

MR. C. D. RICHMONDT, formerly connected with the Richmondt Electric Wire Conduit Company, Waukegan, Ill., having sold out his interest, is establishing a large plant in Canada for the manufacture of conduit and electrical specialties, having taken three large buildings on Jarvis Street, Toronto, Canada. The factory which he established in Waukegan is now doing a prosperous business.

MR. HENRY FLOY, the well known electrical and mechanical engineer, has recovered from a recent protracted illness due to typhoid fever and pleurisy. He has just secured the appointment of consulting engineer to the Atlanta Electric Power Company, which is about to erect a large dam across the Chattahoochee River near Atlanta and develop electric power for transmission and use in the city.

DR. S. S. WHEELER, while attending the Lotos Club dinner last Saturday night to Judge O'Brien—re-elected for 14 years—received a long-distance telephone message that there was a fire at his big Ampere factory. Between the soup and the fish, however, he ascertained that it was limited to an outlying brass foundry, and calmly rejoined his friends at the banquet table. Congratulations were in order.

CAPT. GEORGE O. SQUIER, of the United States Signal Corps, has recently made an investigation of the sources of gutta percha supply in the Philippines, and has made a report to General Greely. He says that there are large quantities of so-called gutta-percha in the southern islands of the Philippines. The present market for the archipelago is Singapore, and not Manila. The Singapore dealers are interested that no knowledge of the subject shall be obtained, as they are looking for the purchase of whatever product can be obtained from the Philippines. None of the natives appreciate the present value of gutta-percha as a commercial product. Captain Squier recommends that immediate steps be taken to prevent the destroying of the gutta-percha trees by the natives in gathering the products, and, if a chemical analysis warrants, that a special expedition be sent out at an early date, under the general supervision of the forestry division of the Philippines, to determine the location, extent, quantity, etc., of this product.

THE FULLER FUND.—Some few months ago an effort was made to relieve the necessities of the wife and daughter of the late J. B. Fuller, the well known electrical inventor and dynamo designer, who died many years ago too young to realize any benefit from his work. We are glad to be able to record the following contributions received up to the present time: Edward Weston, $25; Thos. A. Edison, $10; Elihu Thomson, $25; James M. Kelly, $10; C. F. Brush, $25; Geo. W. Westinghouse, $100; R. H. Beach, $25; Sir Hiram L. Maxim, $10; W. Bryant, $15; C. O. Perkins, $10; Edwin Leigh, $10; F. A. C. Perrine, $25; Edw. F. Seixas, $5; H. L. Candel, $10; Bert E. Salisbury, $10; C. A. Coffin, $50; W. M. Habirshaw, $10; J. Brodie Smith, $10; Crouse-Hinds Electric Company, $10; Arthur Williams, $10; Allan C. Bakewell, $10; William F. Bossert, $10; W. M. Stanley, $25; Jos. Wetzler, $10; F. B. Crocker, $10; Cary T. Hutchinson, $10; Schuyler Skaats Wheeler, $10; L. Stieringer, $5; C. P. Steinmetz, $10; M. J. Insull, $10; C. W. Haskins, $5; Carl Hering, $5; J. F. Kelly, $5; G. H. Condict, $10.

Trade Notes.

DIRECT-CURRENT GENERATORS of the splitpole type, as manufactured by the Sprague Electric Company, New York, are the subject of Bulletin No. 102 of the Sprague Company.

THE OSBORN FLEXIBLE CONDUIT COMPANY has so many orders on hand that the factory is running day and night to keep up with the business. Mr. Corrigan is very much pleased with the outlook.

THE BURT MANFACTURING COMPANY, of Akron, Ohio, manufacturer of the Cross oil filter and the Burt exhaust head, has recently received its twenty-first order from the American Steel Wire Company, of Cleveland, Ohio.

CHANGE OF ADDRESS.—The offices of Wm. A. Rosenbaum, patent attorney, which have been located in the Times Building, New York City, for the past eleven years, will be removed on Jan. 1, 1902, to the Nassau-Beekman Building on Nassau Street.

MESSRS. BALLANTYNE & EVANS have taken into partnership M. H. S. Burroughs. The firm has offices at No. 20 Nassau Street, New York City, for the general practice of architecture, civil, electrical and mechanical engineering. The present firm name will be retained.

CABLE SUPPORT.—The Standard Underground Cable Company, Pittsburg, Pa., is manufacturing the Nordyke extensible cable support which affords a simple method of arranging the cables neatly around the sides of manholes. Full information regarding this device is given in a leaflet published by the company.

HIGH TENSION APPARATUS, as manufactured by the General Incandescent Arc Light Company, New York, is illustrated and described in Bulletin No. 53, recently issued. Various forms of high tension oil switches are illustrated, as well as the General Incandescent automatic overload-release oil circuit breaker.

THE HANDSOMEST CALENDAR of the season (in ten colors) six beautiful heads (on six sheets, 10x12 inches), reproductions of paintings by Moran, issued by General Passenger Department, Chicago, Milwaukee & St. Paul Railway, will be sent on receipt of twenty-five cents. Address F. A. Miller, General Passenger Agent, Chicago.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has prepared a question blank which, if properly filled out, will give it the exact situation in a plant. With this data it is enabled to ship incandescent lamps tested to fit the conditions as they are. These question blanks are meeting with favor and are certainly a step in the direction of good practice.

MR. JOHN T. McROY, of the McRoy Clay Works, Brazil, Ind., is issuing to his friends and customers a neat and handsome 2-foot steel rule put up in a neat metal-bound leather case, and intended to be carried in the pocket. The souvenirs of this kind issued from time to time by Mr. McRoy are always useful, and as lasting as the well-known conduits that bear his name.

PRICES ON TELEPHONES and telephone supplies can be quickly secured from the Central Electric Company of Chicago by means of its telephone price list, a copy of which will be sent to any one upon application. This company also wishes to call attention to the D. & W. telephone protector which embodies a lightning arrester, line fuses, and sneak coils. A descriptive bulletin will be sent to any one interested in this material.

ELECTROSE MANUFACTURING COMPANY, 127 North Tenth Street, Brooklyn Borough, New York, reports a steady increase in the foreign sales of its well known product, "Electrose," a substitute for hard rubber for all electrical purposes, such as telephone mouthpieces, receivers, transmitters, etc. It is only lately that the foreign buyers have been taking up this article, and the Electrose Company reports duplicate and increased orders wherever the material is used.

THE MILWAUKEE COMMUTATOR COMPANY, Milwaukee, Wis., although not an old company, has by its honest dealing and promptness in filling orders built up a business that taxes its utmost capacity. Its commutator segments are made from pure lake copper, cold drawn, true to gauge and angle, thus producing a bar of great density and hardness, calculated to stand the greatest amount of service with minimum wear. The company also makes copper and brass castings for the electrical trade.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that it is having an unusually large demand for its new K. P. fuseless rosette. It states that in this rosette it has one of the strongest, most practical and durable rosettes that has ever been made. It is especially adapted for 250-volt work, and is made so that the strain of the cord does not come on any connection. It is, therefore, impossible to break the connections by pulling or handling the cord. It is made in one solid piece, of glazed porcelain, and is easy to connect.

NINE HUNDRED DOLLARS FOR NECKTIES.—Last year a wealthy steel manufacturer spent $900 for neckties to give away for Christmas presents. His money would have been put to more productive use if he had bought a number of engineering scholarships in the American School of Correspondence. A scholarship in such an institution is a Christmas present worth having—and giving. A special Christmas offer is made to all new students in the full engineering course who enroll themselves during December. A hand-book of the school will be sent free to any one addressing The American School of Correspondence, Boston, Mass.

GAS ENGINES.—The Marinette Iron Works Manufacturing Company, Marinette, Wis., has recently put upon the market the Walrath gas engine. In the company's catalogue this engine is said to have very few working parts, which not only reduces the cost of repairs on account of breakage and wear, but also increases the efficiency of the engine. The engine is of the vertical crank-case type, and is built with one, two and three cylinders, and operates on the four-cycle principle. It is well adapted for both stationary and portable work, and owing to its close regulation is especially adapted for electric lighting. The catalogue contains illustrations of engines direct connected to dynamos. The largest machine shown is of 125 horse-power, and has three cylinders.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY has issued a forty-four page catalogue for 1902 bound up in leather. This catalogue is very fully illustrated, showing different shapes and sizes of miniature and decorative lamps. One page is devoted to surgical and dental lamps, another to special lamps for dry batteries, one of the interesting illustrations being that of a "disinfectant" lamp. Then, there are shown battery lamps with wire terminals and other lamps with bases. One page is devoted to switchboard lamps for telephone work, while another is given up to festoon lamps, requiring neither sockets nor receptacles. There are also larger lamps shown as well as candelabra lamps with both multiple and series lamps. The last few pages of the catalogue are devoted to the new electric advertising sign which has recently been brought out by this progressive company. The manager of the company is Mr. H. J. Jaeger, to whose untiring energy much of the success of the company is due.

THE JANUARY "SUCCESS" contains a number of up-to-date, timely subjects indicating the world's achievement. One of the most noticeable is the opening article, a graphic and hopeful prophecy by the famous explorer, Evelyn B. Baldwin, whose subject, "Why I am Certain of Reaching the North Pole," is instructive and entertaining. Mr. Baldwin writes that he feels certain of being successful in reaching the long sought-for spot next summer, and outlines a voyage that shows his dauntless courage and that of the forty-one young explorers who are with him. "It Transforms Forests into Newspapers," by Frank Hix Fayant, is an important paper on the newest of American industries, that of using wood pulp for making paper. In "The World's Richest School and its Purpose," Beauford A. Mason has told just what the Carnegie Institute in Pittsburg proposes to do as an institution of technical learning. Henri Fournier, the noted automobilist, whose record-breaking feats have given him world-wide fame, contributes an article on the possibilities of the automobile. A series of articles, entitled, "Business and the Larger Life," by Edwin Markham, the author of "The Man with the Hoe," "Lincoln and Other Poems," etc., begins with this number.

ELECTRIC COAL HANDLING.—C. W. Hunt Company, of New York City, issues a brochure devoted to coal handling in New York harbor by an electric

hoisting plant, which puts through some 25,000 tons annually. It is equipped with "Hunt" electric hoist and automatic railway. The coal is hoisted by means of the hoist, from the canal boats in ½-ton tubs, on a mast and gaff, to the automatic railway car, by which it is distributed in the yard. The car runs on an elevated self-acting railway and requires no steam, horse, or manual power for its operation. With the previous equipment the coal was hoisted by horse-power and trimmed into the stock pile. The old equipment cost $1,750, the new one $2,800. The cost of handling to the stock pile, interest and depreciation included, was, with the old plant, 17¼ cents per ton; with the new plant the cost is 7¼ cents. This difference of 10½ cents per ton on 25,000 tons per year makes an actual saving of $2,625. Thus every 13 months the whole cost of the plant is saved in the reduction of the pay roll. The unloading capacity with the old plant was 120 tons per day; with the new machinery the capacity is 200 tons per day, an increase of 80 tons. The power is purchased by meter at 5 cents per horse-power hour, and costs less than 7 mills for each ton of coal hoisted and delivered to the car.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DECEMBER 17, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

688,813. COMPOSITION OF MATTER AS A NON-CONDUCTOR OF ELECTRICITY; J. M. Ancira, New York, N. Y. App. filed July 26, 1901. The composition consists of cotton, lime and milk.

688,817. BRUSH HOLDER; W. E. Baker, New York, N. Y. App. filed Aug. 25, 1899. The brush holder is encased to confine the spring and other parts which might work loose in service, so as to prevent injury to the commutator or windings of the machine.

688,828. SPEED REGULATING DEVICE FOR OVERHEAD ELECTRIC CARRIERS; A. S. Clift, East Orange, N. J. App. filed April 19, 1901. A solenoid acting normally to hold the brake off, is in series with the motor; a shunt is arranged around the solenoid which is controlled by a gravity switch so that when the car tilts in going down grade it thereby automatically sets the brake.

688,855. EARTH CONDUCTOR FOR LIGHTNING CONDUCTORS; P. Immich, Charlottenburg, Germany. App. filed Oct. 7, 1901. An earth conductor for lightning conductors, comprising several metal bodies conductively connected with each other and with the earth-wire, said bodies being graduated both with regard to their electrical resistance and to the depth to which they are embedded in the earth or subsoil-water and forming an earth element.

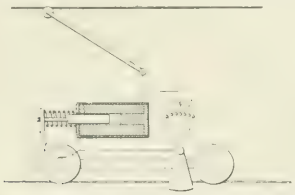
688,857. METHOD OF REGULATING WEIGHT OF METAL BLANKS; Warren Johnson, New Orleans, La. App. filed Jan. 25, 1901. Light weight and heavy weight gold blanks are separately put into an electrolytic bath through which current is passed, whereby metal is taken from one set of blanks and transferred to the other set.

688,869. MECHANISM FOR RAISING CONTACT SHOES ON THIRD RAIL SYSTEMS; S. H. Libby, Schenectady, N. Y. App. filed Aug. 24, 1897. When the car reaches a point where it is desirable to raise the shoe out of contact with the third rail, a lever attached to the car engages with a fixed cam on the roadbed and causes the shoe to be lifted, after which it is lowered at the proper time in a similar manner.

688,891. SEMAPHORE OPERATING DEVICE; J. Shoecraft, Eskridge, Kan. App. filed May 31, 1901. Details.

688,915. INDUCTION COIL; D. H. Wilson, Chicago, Ill. App. filed March 28, 1901. An induction coil having a laminated core made up of a series of short narrow strips, and completely surrounded by, and sealed up in, a non-conducting box.

688,919. ELECTROSTATIC INSTRUMENT; G. L. Addenbrooke, Westminster, London, England. App. filed June 10, 1901. Improvements in electrostatic instruments whereby the error known as contact difference is eliminated or reduced, consisting of a mica needle coated with metal foil and suspended by a wire electrically connected to the metal foil, and combined



688,828.—Speed Regulating Device for Overhead Electric Carriers.

with quadrant or sector plates having surfaces of the same metal as the metal foil.

688,922. ELECTRIC RAILWAY; R. Bingham, West Haddonfield, N. J. App. filed Aug. 22, 1901. Details.

688,935. APPARATUS FOR EXAMINING CAVITIES IN THE HUMAN BODY; S. B. Crane, Perry, Ia. App. filed March 13, 1899. Apparatus for conveniently attaching an electric lamp to a speculum.

688,964. QUADRUPLE RELAY CROSSING SIGNAL; B. N. Parrish, Jackson, Mich. App. filed Aug. 1, 1900. Details.

688,970. FIRE PROTECTOR FOR TELEPHONE CABLES; F. D. Saylor, St. Louis, Mo. App. filed May 13, 1901. (See Current News and Notes.)

688,982. AUTOMATIC ELECTRIC SWITCH; A. H. Adams, London, England. App. filed April 22, 1901. Details.

688,995. ELECTRIC HEATER; E. E. Gold, New York, N. Y. App. filed Aug. 19, 1898. Consists of an open work support designed to give good ventilation.

689,064. ICE CUTTING MACHINE; T. H. Butler and O. Hammond, Baltimore, Md. App. filed Feb. 23, 1901. An electrically operated machine for harvesting ice.

689,128. AUTOMATIC ELECTROMAGNETIC TIME SWITCH; J. Sachs, Hartford, Conn. App. filed Sept. 27, 1900. A time switch which avoids the necessity of manual winding by using a motor to actuate the switch, the circuit of the motor being controlled by a clock which is incidentally wound by the motor when the switch is operated.

689,130. ALTERNATING CURRENT METER; K. O. F. Schrottke, Berlin, Germany. App. filed Sept. 2, 1899. (See Current News and Notes.)

689,133. ELECTRIC LOCK; H. Seewald, Possneck, Germany. App. filed April 24, 1901. Details.

689,138. COVER FOR INTERIOR ELECTRIC CONDUIT BOXES; J. H. Stahley, New York, N. Y. App. filed Sept. 20, 1901. The primary feature of this invention is a sleeve fitting within the cover-opening and having two capacities for adjustment, one in line with its axis and the other angularly thereto, in order that the outer edge of the sleeve may be advanced or depressed after the box is placed in position to bring it in proper alignment with the face of the wall.

689,139. INTERIOR ELECTRIC CONDUIT BOX; J. H. Stahley, New York, N. Y. App. filed Oct. 30, 1901. A modification of the preceding.

689,141. SELECTIVE TELEPHONE SYSTEM; J. V. Stout, Easton, Pa. App. filed Aug. 3, 1901. (See page 1070.)

689,171. INSULATOR; J. F. Duffy and H. B. Bershey, Scranton, Pa. App. filed June 12, 1901. A double glass insulator adapted to supplant the pipe-arm insulator in use at the present time.

689,198. MAKE AND BREAK DEVICE; J. V. A. Kimmey, New Haven, Conn. App. filed March 30, 1901. Details.

689,199. ELECTRODE; T. B. Kinraide, Boston, Mass. App. filed May 2, 1901. An electrode having a discharge-point and means for electrically screening said point for limiting the tendency thereof to discharge.

689,218. ELECTRICAL INSULATOR; Albert F. Parks, Brooklyn, N. Y. App. filed April 8, 1901. A metallic socket rigidly secured to a cross-arm carries a wooden pin to which the insulator is secured; the wooden pin has reversed screw threads at its two ends; a sleeve of insulating material surrounds the metallic socket and extends within the flange of the insulator.

689,227. TROLLEY CATCHER; C. B. Robertson, Ottumwa, Ia. App. filed March 5, 1901. Details.

689,253. METHOD OF LOCATING FAULTS IN ELECTRICAL CIRCUITS; T. W. Varley, New York, N. Y. App. filed March 30, 1901. (See Current News and Notes.)

689,254. APPARATUS FOR LOCATING FAULTS IN ELECTRICAL CIRCUITS; T. W. Varley, New York, N. Y. App. filed March 30, 1901. (See Current News and Notes.)

689,278. ELECTRIC CONDUIT TERMINAL; W. F. Bossert, Utica, N. Y. App. filed June 4, 1901. A beaded bushing.

689,171.—Insulator.

689,286. MANUFACTURE OF SOLUBLE PHOSPHATES; Guillaume De Chalmot, Leaksville, N. C. App. filed Dec. 21, 1895. Renewed Nov. 23, 1901. Natural phosphates are mixed with silica and heated in an electric furnace; the phosphoric acid driven off is then recovered. The patent is almost identical with one issued to the same inventor in 1897.

689,321. TROLLEY; T. McWilliams, Kings Park, N. Y. App. filed March 6, 1901. A pilot wheel is used in front of the main wheel, to cause the latter to follow curvatures in the trolley wire.

689,335. JUNCTION BOX FOR ELECTRICAL CONDUITS; R. M. Thomas, New York, N. Y. App. filed June 20, 1901. Details.

689,353. PROTECTIVE MECHANISM FOR SYSTEMS OF ELECTRICAL DISTRIBUTION; R. V. Cheatham, Louisville, Ky. App. filed May 23, 1901. The invention consists of means thrown into operation by a breakage of one of the conductors of the system for grounding the other conductor, and thereby throwing into operation a circuit breaker and automatically cutting off the flow of current to the system.

689,356. ELECTRIC ARC LAMP; C. Eschwei, New York, N. Y. App. filed March 27, 1901. Details.

BINDING SECT. JUN 12 1980

TK
1
E47
v.38

Engin.

Electrical world

ENGIN STORAGE
PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY